TOWN OF CANTON

NORTH CAROLINA

Invitation for Bid

Canton Police Station Renovation

Bid Due Date: April 21, 2026

Time: 2:00 PM

Receipt Location: Town of Canton
85 Summer Street
Canton, NC 28716

Mandatory Pre-Bid/Site Visit Meeting: Will be held on March 24th, at 1:00 PM. Location: 138 Academy St., Canton, NC 28716. We will meet at the Town Hall Building and walk to the Police Station after.

Prepared by:

Creech & Associates
Michael Supino, AIA
1000 W. Morehead Street
Suite 120
Charlotte, NC 28208
(704) 376-6000

TABLE OF CONTENTS

DIVISION 0 - GENERAL REQUIREMENTS

SECTION

000000	Cover Sheet
001113	Advertisement for Bid
002100	Instructions to Bidders
004113	Bid Form
004313	Bid Security
004519	Non-Collusion Affidavit
004536	E-Verify Affidavit
005200	Agreement Form
006100	Bond Forms
007200	General Conditions

DIVISION 1 - GENERAL REQUIREMENTS

SECTION

011000	Summary of Work
012020	Progress Meetings
012600	Modification Procedures
012900	Applications for Payment
013100	Coordination
013200	Construction Progress Documentation
013300	Submittals
014000	Quality Requirements
014100	Testing and Inspection
015000	Construction Facilities and Temporary Controls
015700	Traffic Regulation
016000	Product Requirements
016000a	Substitution Request
016000b	Substitution Request
017300	Execution Requirements
017329	Cutting and Patching
017700	Closeout Procedures
017823	Operating and Maintenance Data
017839	Project Record Documents

DIVISION 2 - EXISTING CONDITIONS

SECTION

024118 Selective Demolition and Alteration Work

DIVISION 3 – CONCRETE

SECTION

031000 Concrete Forming and Accessories
031100a Concrete Formwork - Civil
032000 Concrete Reinforcing
032000a Concrete Reinforcing- Civil
033000 Cast In Place Concrete
033000a Cast In Place Concrete - Civil
039000 Penetrating Concrete Sealer

DIVISION 4 – MASONRY

SECTION

042000 Unit Masonry
047200 Cast Stone
049000 Masonry Restoration and Cleaning

DIVISION 5 - METALS

SECTION

051200 Structural Steel Framing
053100 Steel Decking
055000 Miscellaneous Metals
055100 Steel Pan Stairs

DIVISION 6 - WOOD, PLASTICS AND COMPOSITES

SECTION

061600 Gypsum Sheathing
062000 Carpentry
064023 Architectural Woodwork

DIVISION 7 - THERMAL AND MOISTURE PROTECTION

SECTION

071900 Water Repellent Coating

072100	Thermal Insulation
072700	Vapor Permeable Air Barrier Liquid Membrane
075423	Thermoplastic-Polyolefin (TPO) Roofing
076200	Sheet Metal Flashing
077100	Roof Specialties and Accessories
078100	Spray Fire Resistive Materials
078413	Firestops and Smokeseals
079200	Joint Sealers

DIVISION 8 - OPENINGS

SECTION

081113	Steel Doors and Frames
081416	Wood Doors
083113	Access Doors
084113	Aluminum Entrances and Storefronts
085213	Aluminum Clad Windows
085623	Bullet Resistant Transaction Windows
087100	Door Hardware
088000	Glass and Glazing

DIVISION 9 - FINISHES

SECTION

092900	Gypsum Drywall
093000	Ceramic Tile
095113	Acoustic Panel Ceiling
096500	Resilient Tile Flooring
096513	Resilient Base and Accessories
097624	Epoxy Composition Flooring
096813	Carpet Tile
098413	Acoustic Wall Panels
099000	Painting and Finishing

DIVISION 10 - SPECIALTIES

SECTION

101100	Visual Display Surfaces
101400	Signage
102600	Wall and Cornerguards
102800	Toilet Accessories

104416 Fire Extinguishers and Cabinets

DIVISION 11 – EQUIPMENT – NOT USED

DIVISION 12 – FURNISHINGS

SECTION

123661 Solid Surface Countertops

DIVISION 13 - SPECIAL CONSTRUCTION – NOT USED

DIVISION 14 - CONVEYING EQUIPMENT – NOT USED

DIVISION 21 – FIRE PROTECTION – SEE MEP DRAWINGS

210050 Common Work Results For Fire Protection
210080 Record Documents
210100 Penetration Fire Stopping
210548 Vibration And Seismic Controls For Fire Protection Piping & Equipment
211000 Water-Based Fire Suppression System
211100 Dry Chemical Or Clean Agent Fire Suppression System

DIVISION 22 – PLUMBING

220050 Common Work Results for Fire Protection
220800 Record Documents
220010 Penetration Firestopping
220516 Expansion Fittings And Loops For Plumbing Piping
220519 Meters And Gages For Plumbing Piping
220523 General-Duty Valves For Plumbing Piping
220529 Hangers And Supports For Plumbing Piping And Equipment
220533 Heat Tracing For Plumbing Piping
220548 Vibration And Seismic Controls For Plumbing Piping And Equipment
220553 Identification For Plumbing Piping And Equipment
220700 Plumbing Insulation
221116 Domestic Water Piping
221119 Domestic Water Piping Specialties
221316 Sanitary Waste And Vent Piping
221319 Sanitary Waste Piping Specialties
221413 Facility Storm Drainage Piping

221423 Storm Drainage Piping Specialties
223300 Electric Domestic Water Heaters
224000 Plumbing Fixtures
224700 Water Coolers

DIVISION 23 - HEATING, VENTILATING AND AIR CONDITIONING
230000 General Requirements For HVAC Work
230010 Submittal Procedures
230020 References
230030 Product Requirements
230040 Execution
230050 Cutting And Patching
230060 Closeout Procedures
230070 Operation And Maintenance Data
230080 Project Record Documents
230090 Demonstration And Training
230100 Penetration Firestopping
230500 Common Work Results For HVAC
230513 Common Motor Requirements For HVAC Equipment
230516 Expansion Fittings And Loops For HVAC Piping
230519 Meters And Gages For HVAC Piping
230529 Hangers And Supports For HVAC Piping And Equipment
230548 Vibration And Seismic Controls For HVAC
230553 Identification For HVAC Piping And Equipment
230593 Testing, Adjusting, And Balancing For HVAC
230700 HVAC Insulation
230800 Commissioning Of HVAC
230900 Instrumentation And Control For HVAC
230993 Sequence Of Operations For HVAC Controls
231123 Facility Natural-Gas Piping
232300 Refrigerant Piping
233113 Metal Ducts
233116 Nonmetal Ducts
233300 Air Duct Accessories
233416 Centrifugal HVAC Fans
233423 HVAC Power Ventilators
233713 Diffusers, Registers, And Grilles
235523 Gas-Fired Radiant Heaters
236300 Ductless Mini-Split System A/C Units Wall Mounted Units
237533 HVAC Fans
238126 Split-System Air-Conditioners

DIVISION 26 – ELECTRICAL

260050	Common Work Results For Electrical
260100	Penetration Firestopping
260519	Low-Voltage Electrical Power Conductors And Cables
260526	Grounding And Bonding For Electrical Systems
260529	Hangers And Supports For Electrical Systems
260533	Raceway And Boxes For Electrical Systems
260548	Vibration And Seismic Controls For Electrical Systems
260553	Identification For Electrical Systems
260923	Lighting Control Devices
262416	Panelboards
262726	Wiring Devices
262816	Enclosed Switches And Circuit Breakers
263213	Engine Generators
263600	Transfer Switches
264313	Transient-Voltage Suppression For Low-Voltage Electrical Power Circuits
265100	Interior Lighting

DIVISION 27 – COMMUNICATIONS

SECTION

270500	Common Work Results For Communications
271100	Communications Equipment Room Fittings

DIVISION 28– ELECTRONIC SECURITY AND SAFETY

SECTION

283111	Digital, Addressable Fire-Alarm System
284800	Emergency Response Systems

DIVISION 31 – EARTHWORK

SECTION

31 05 05	Demolition
31 05 19	Engineering Fabrics
31 10 05	Waste Material Disposal
31 11 00	Clearing And Grubbing
31 22 00	Grading
31 23 13	Subgrade
31 25 00	Erosion And Sediment Control
31 25 13	Temporary Silt Fence
31 32 00	Site Stabilization

DIVISION 32 – EXTERIOR IMPROVEMENT

SECTION

32 01 00	Restoration Of Surfaces
32 01 17	Asphalt Pavement Repairs
32 05 23	Miscellaneous Concrete Construction
32 11 23	Aggregate Base Course
32 12 16	Asphalt Paving
32 16 13	Concrete Curb And Gutter
32 16 23	Concrete Walks
32 17 23	Pavement Markings
32 91 13	Soil Preparation
32 93 00	Plants

DIVISION 33 – UTILITIES – NOT USED

CANTON, NORTH CAROLINA

ADVERTISEMENT FOR BID
Police Station Renovation Bid

Sealed Bids for the Police Station Renovation will be **received by the Town of Canton *until* 2:00 PM local time on April 21,2026,** at the Town Offices, 85 Summer Street, Canton, NC 28716. The public bid opening will be conducted in the boardroom of the Town of Canton address listed above at the specified date and time. Late bids will not be accepted.

If a Bid is sent by mail or other delivery system, the sealed envelope containing the Bid shall be enclosed in a separate package plainly marked on the outside with the notation "**BID ENCLOSED – Town Hall & Police Station Renovation Bid**" and shall be addressed to the Town of Canton, Lisa Stinnett, 85 Summer St., Canton, NC 28716. The Town is not responsible for any bids not received prior to bid opening that are delivered to the Town. All Bids shall be in (2) two envelopes with the bid documents (for both Town Hall and Police Station) in one envelope and the bid bond is in a separate envelope with both envelopes being clearly marked as stated above.

A Mandatory Pre-Bid/Site Visit meeting was held on **March 24,2026, at 1:00 PM** local time at 138 Academy St., Canton, NC. The meeting will start at the future Town Hall, and we will walk down the block to the future Police Station.

Scope of Work: A major renovation of the existing historic building with approximately 5,600 SF. The existing masonry structure and foundation will be upgraded to align with the requirements of a risk category IV structure. Once completed, the facility will include additional SF in the basement and second floor of the building. New windows, finishes, roofing, building systems, and emergency systems will be incorporated into the renovated facility. Exterior repairs and improvements will be needed to align with the requirements of the State Historic Preservation Office as well as the functional & aesthetic needs of the Police Department.

The Issuing Office for the Bidding Documents is:

Town of Canton website. Bidding Documents are available in electronic form from the town website.

Partial sets of Bidding Documents will not be available from the Issuing Office. Neither Owner nor Architect will be responsible for full or partial sets of Bidding Documents, including Addenda if any, obtained from sources other than the Issuing Office.

All questions about the meaning or intent of the Bidding Documents are to be submitted in writing to the Architect of Creech & Associates listed on the cover page (msupino@creechassociates.com**). Deadline for questions is 12:00 PM local time on Tuesday, April 7, 2026.** Questions will be addressed via Addenda no later than 4 days prior to bid date and will be posted on the county website.

Bids will be received for a single prime, lump sum Contract.

Bidders must have a license to do work as a contractor in the State of North Carolina, as set forth under Article 1 chapter 87 of the North Carolina General statutes. The bidder's North Carolina Contractor license number shall be designated on the outside of the sealed envelope containing the Bid.

Bidders are required to provide a non-collusion affidavit, as set forth in the bidding documents.

As provided by statute, a deposit of cash, cashier's check or certified check on some bank or trust company insured by the Federal Deposit insurance Company, or a bid bond executed by corporate surety licensed under the laws of North Carolina to execute such bonds in the amount of 5% of the bid must accompany each bid. The payee shall be "**Town of Canton**". Said deposit shall guarantee that the Agreement will be entered into by the successful bidder if

award is made. Such deposit may be held by the Town of Canton until the successful bidder has executed and delivered all required Contract documents to the Town of Canton.

Unless otherwise directed, the Contractor shall furnish performance and payment bonds, as hereinafter specified, on only those forms enclosed herein. A performance bond, satisfactory to the Town of Canton, will be required of the successful bidder or bidders within ten (10) business days after notice of award, in an amount equal to one hundred percent (100%) of the contract price, conditioned that he shall comply in all respects with the terms and conditions of his contract and his obligations thereunder including, but not limited to, the specifications, and shall indemnify and save harmless the Town of Canton, North Carolina, against or from all cost, expense, injury or loss to which the Town may be subjected by reason of wrong doing, misconduct, want of care or skill, negligence, or default upon the part of the Contractor, his agents, or employees, in or about the execution or performance of said contract, and shall save and keep the Town harmless against and from all claims or losses to it or from any cause whatever, in the matter of the performance of said contract, and including also any patent infringements because of designed operating methods on the project and/or the use of any patented thing, equipment, and/or apparatus installed by him therein. The performance bond shall remain in full force and effect for a minimum of twelve (12) months after project completion, but for not less than the guarantee period established by the Architect upon project completion and acceptance.

A payment bond, satisfactory to the Town of Canton will be required of the successful bidder or bidders within ten (10) business days after notice of award, in an amount equal to one hundred percent (100%) of the contract amount, conditioned that he shall comply in all respects with the terms and conditions of his contract; and also conditioned upon the prompt payment for all labor or materials for which the Contractor or Subcontractor is liable. The payment bond shall be for the protection of the persons furnishing materials or performing labor and to save the Town harmless from and against any and all legal recourse resulting from the Town's owning and/or accepting construction for which labor and materials have not been paid in full.

Whenever the surety or sureties on the bonds so furnished shall be deemed by the Town to be insufficient or unsatisfactory, the Contractor, within ten (10) business days after notice thereof, shall furnish and deliver new bonds to the Town in the same penalty and on the same conditions with a surety satisfactory to the Town. This duty shall continue on the part of the Contractor whenever and so long as the Town may require.

If the Contractor shall fail to furnish such bonds within ten (10) business days after said notice is mailed to his address, the Town of Canton, North Carolina, through its proper agents, may stop all further work under said contract and re-let the unfinished work at the expense of the Contractor.

The Town of Canton is committed to retaining Vendors from diverse backgrounds, and it invites and encourages participation in the procurement process by businesses owned by minorities, women, disabled, disabled business enterprises and non-profit work centers for the blind and severely disabled. In particular, the Town encourages participation by Vendors certified by the State Office of Historically Underutilized Businesses, as well as the use of HUB-certified vendors as subcontractors on Town contracts.

As provided in G.S. 147-86.59 and G.S. 147-86.82, the following companies are ineligible to contract with the State of North Carolina or any political subdivision of the State: a) any company identified as engaging in investment activities in Iran, as determined by appearing on the Final Divestment List created by the State Treasurer pursuant to G.S. 147-86.58, and b) any company identified as engaged in a boycott of Israel as determined by appearing on the List of restricted companies created by the State Treasurer pursuant to G.S. 14786.81. A contract with the Town of Canton by any company identified in a) or b) above shall be void ab initio.

To the extent permitted by applicable statutes and rules, the Town will maintain as confidential trade secrets in its proposal that the Contractor does not wish disclosed. As a condition to confidential treatment, each page containing trade secret information shall be identified in boldface at the top and bottom as "CONFIDENTIAL" by the Contractor, with specific trade secret information enclosed in boxes, marked in a distinctive color or by similar indication. Cost information shall not be deemed confidential under any circumstances. Regardless of what a Contractor may label as

a trade secret, the determination whether it is or is not entitled to protection will be determined in accordance with G.S. 132-1.2. Any material labeled as confidential constitutes a representation by the Contractor that it has made a reasonable effort in good faith to determine that such material is, in fact, a trade secret under G.S. 132-1.2. Contractors are urged and cautioned to limit the marking of information as a trade secret or as confidential so far as is possible. If a legal action is brought to require the disclosure of any material so marked as confidential, the Town will notify the Contractor of such action and allow the Contractor to defend the confidential status of its information.

Any gender-specific pronouns used herein, whether masculine or feminine, shall be read and construed as gender neutral, and the singular of any word or phrase shall be read to include the plural and vice versa.

Any costs incurred by the Contractor in preparing or submitting offers are the Contractor's sole responsibility; the Town of Canton will not reimburse any Contractor for any costs incurred or associated with the preparation of proposals.

Any and all payments to the Contractor shall be dependent upon and subject to the availability of funds to the agency for the purpose set forth in The Contract.

This Contract is made under and shall be governed and construed in accordance with the laws of the State of North Carolina, without regard to its conflict of laws rules, and within which State all matters, whether sounding in Contract or tort or otherwise, relating to its validity, construction, interpretation and enforcement shall be determined.

If a payment schedule is not part of The Contract, then payment terms will be Net 30 days after receipt of a correct invoice or acceptance of goods, whichever is later.

The Contractor will take necessary action to comply with all Federal and State requirements concerning fair employment and employment of people with disabilities and concerning the treatment of all employees without regard to discrimination on the basis of any prohibited grounds as defined by Federal and State law.

The Contractor agrees not to use the existence of The Contract or the name of the Town of Canton as part of any commercial advertising or marketing of products or Services. A Vendor may inquire whether the Town is willing to act as a reference by providing factual information directly to other prospective customers.

During the term of the Contract, the Contractor at its sole cost and expense shall provide commercial insurance of such type and with such terms and limits as may be reasonably associated with the Contract. As a minimum, the Contractor shall provide and maintain the following coverage and limits:

Commercial General Liability insurance in an amount not less than $1,000,000 each occurrence/$2,000,000 annual aggregate. Coverage shall not contain any endorsement(s) excluding nor limiting Product/Completed Operations or Contractual Liability.

Business Automobile Liability insurance covering all owned, non-owned, and hired vehicles with a minimum combined single limit of $1,000,000 each occurrence and shall include uninsured/underinsured motorist coverage per NC General Statute 20-279-21.

Workers Compensation coverage at the statutory limits in compliance with applicable State and Federal laws. Supplier shall ensure that any subcontractors also have workers compensation coverage at the statutory limits.

Employer's Liability coverage with minimum limits of $500,000 each accident and $500,000 each employee disease.

The Contractor shall agree these General Conditions constitute an insured contract and shall name the Town of Canton as an additional insured under the Commercial General Liability policy. Before commencing work and for any subsequent renewals, the Contractor shall furnish the Town with certificates of insurance evidencing the above

coverages and amounts on an approved form. Contractor hereby grants the Town a waiver of any right of subrogation which any insurer of said Contractor may acquire against the Town by virtue of payment of any loss under such insurance. Contractor agrees to obtain any endorsement that may be necessary to affect this waiver of subrogation. Each insurance policy required above shall state that coverage shall not be canceled, except with written notice to the Town and delivered in accordance with the policy provisions. All insurance shall be procured from reputable insurers authorized and qualified to do business in North Carolina and in a form acceptable to the Town. The limits of coverage under each insurance policy maintained by the Contractor shall not be interpreted as limiting the Supplier's liability and obligations.

The Contractor shall hold and save the Town of Canton, its officers, agents, and employees, harmless from liability of any kind, including all claims and losses accruing or resulting to any other person, firm, or corporation furnishing or supplying work, Services, materials, or supplies in connection with the performance of The Contract, and from any and all claims and losses accruing or resulting to any person, firm, or corporation that may be injured or damaged by the Contractor in the performance of The Contract and that are attributable to the negligence or intentionally tortious acts of the Contractor provided that the Contractor is notified in writing within 30 days from the date that the Contractor has knowledge of such claims. The Contractor represents and warrants that it shall make no claim of any kind or nature against the Town's agents who are involved in the delivery or processing of Contractor deliverables or Services to the Town. The representation and warranty in the preceding sentence shall survive the termination or expiration of The Contract.

Per N.C. General Statute 14-234, no public officer or employee who is involved in making or administering a contract on behalf of a public agency may derive a direct benefit from the contract. The statute defines "public officer" as an individual who is elected or appointed to serve or represent a public agency, other than an employee or independent contractor of a public agency. A public officer or employee is involved in administering a contract if he or she oversees the performance of the contract or has authority to make decisions regarding the contract or to interpret the contract; or if he or she participates in the development of specifications or terms or in the preparation or award of the contract. A public officer is also involved in making a contract if the board, commission, or other body of which he or she is a member takes action on the contract, whether or not the public officer actually participates in that action, unless the contract is approved under an exception to this section under which the public officer is allowed to benefit and is prohibited from voting.

There is a conflict of interest when a public officer or employee derives a direct benefit from a contract if the person or his or her spouse: (i) has more than a ten percent (10%) ownership or other interest in an entity that is a party to the contract; (ii) derives any income or commission directly from the contract; or (iii) acquires property under the contract.

Per NC Commerce, potential conflict of interest exists, as defined in 24 CFR Part 570.489 (h) and Bulletin 10-8, when a person involved with this potential CDBG project: (1) has family or business ties with any of the local government elected officials or local government staff; (2) requested or received an opinion about a potential conflict of interest from an attorney or from the North Carolina Ethics Commission; (3) has an ownership interest in an entity that is directly affected by activities proposed in the application; and/or (4) derive any income or commission as a direct result of action taken by the local government elected board or its staff.

Any Town information, data, instruments, documents, studies, or reports given to or prepared or assembled by or provided to the Contractor under The Contract shall be kept as confidential, used only for the purpose(s) required to perform The Contract and not divulged or made available to any individual or organization without the prior written approval by the Town of Canton.

Contractor shall comply with all laws, ordinances, codes, rules, regulations, and licensing requirements that are applicable to the conduct of its business and its performance in accordance with The Contract, including those of federal, state, and local agencies having jurisdiction and/or authority.

This RFP and any documents incorporated specifically by reference represent the entire agreement between the parties and supersede all prior oral or written statements or agreements. This RFP, any addenda hereto, and the Contractor's proposal are incorporated herein by reference as though set forth verbatim. All promises, requirements, terms, conditions, provisions, representations, guarantees, and warranties contained herein shall survive the contract expiration or termination date unless specifically provided otherwise herein, or unless superseded by applicable Federal or State statutes of limitation.

This Contract may be amended only by a written amendment duly executed by the Town and the Contractor.

Notwithstanding any other language or provision in The Contract, nothing herein is intended nor shall be interpreted as a waiver of any right or remedy otherwise available to the Town under applicable law. The waiver by the Town of any right or remedy on any one occasion or instance shall not constitute or be interpreted as a waiver of that or any other right or remedy on any other occasion or instance.

Neither party shall be deemed to be in default of its obligations hereunder if and so long as it is prevented from performing such obligations as a result of events beyond its reasonable control, including without limitation, fire, power failures, any act of war, hostile foreign action, nuclear explosion, riot, strikes or failures or refusals to perform under subcontracts, civil insurrection, earthquake, hurricane, tornado, or other catastrophic natural event or act of God.

The Contractor shall furnish all materials, qualified staff, equipment and tools necessary to conduct and complete the Project per the plans and specifications, and per regulatory agency permit requirements safely and efficiently. The Contractor shall always maintain an adequate workforce to ensure timely completion of the work and shall always utilize appropriate safety equipment, per industry standards and requirements. The Contractor shall work cooperatively with the Town staff and other designated parties during the Project. The Contractor shall implement the Project in compliance with all regulatory permits.

END OF DOCUMENT 00 11 13

1.1 INSTRUCTION TO BIDDERS

A. AIA Document A701-2018 Instructions to Bidders is attached at the end of this section.

END OF DOCUMENT 00 21 00

AIA® Document A701® – 2018

Instructions to Bidders

for the following Project:
(Name, location, and detailed description)

Canton Police Department Renovation
Canton, NC
A major renovation of the existing historic building with approximately 5,600 SF. The existing masonry structure and foundation will be upgraded to align with the requirements of a risk category IV structure. Once completed, the facility will include additional SF in the basement and second floor of the building. New windows, finishes, roofing, building systems, and emergency systems will be incorporated into the renovated facility. Exterior repairs and improvements will be needed to align with the requirements of the State Historic Preservation Office as well as the functional & aesthetic needs of the Police Department.

THE OWNER:
(Name, legal status, address, and other information)

Town of Canton
85 Summer St.
Canton, NC 28716
828.648.2363

THE ARCHITECT:
(Name, legal status, address, and other information)

Creech & Associates, PLLC
1000 W. Morehead St., Suite 120
Charlotte, NC 28208
704-376-6000

TABLE OF ARTICLES

1 DEFINITIONS

2 BIDDER'S REPRESENTATIONS

3 BIDDING DOCUMENTS

4 BIDDING PROCEDURES

5 CONSIDERATION OF BIDS

6 POST-BID INFORMATION

7 PERFORMANCE BOND AND PAYMENT BOND

8 ENUMERATION OF THE PROPOSED CONTRACT DOCUMENTS

ADDITIONS AND DELETIONS:
The author of this document may have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes revisions to the standard form text is available from the author and should be reviewed. A vertical line in the left margin of this document indicates where the author has added to or deleted from the original AIA text.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

FEDERAL, STATE, AND LOCAL LAWS MAY IMPOSE REQUIREMENTS ON PUBLIC PROCUREMENT CONTRACTS. CONSULT LOCAL AUTHORITIES OR AN ATTORNEY TO VERIFY REQUIREMENTS APPLICABLE TO THIS PROCUREMENT BEFORE COMPLETING THIS FORM.

It is intended that AIA Document G612™–2017, Owner's Instructions to the Architect, Parts A and B will be completed prior to using this document.

AIA Document A701 – 2018. Copyright © 1970, 1974, 1978, 1987, 1997 and 2018. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This document was produced at 15:06:44 EDT on 03/09/2026 under Subscription No.20250106709 which expires on 03/02/2027, is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (69aec14dff6f94382384205e)

ARTICLE 1 DEFINITIONS

§ 1.1 Bidding Documents include the Bidding Requirements and the Proposed Contract Documents. The Bidding Requirements consist of the advertisement or invitation to bid, Instructions to Bidders, supplementary instructions to bidders, the bid form, and any other bidding forms. The Proposed Contract Documents consist of the unexecuted form of Agreement between the Owner and Contractor and that Agreement's Exhibits, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, all Addenda, and all other documents enumerated in Article 8 of these Instructions.

§ 1.2 Definitions set forth in the General Conditions of the Contract for Construction, or in other Proposed Contract Documents apply to the Bidding Documents.

§ 1.3 Addenda are written or graphic instruments issued by the Architect, which, by additions, deletions, clarifications, or corrections, modify or interpret the Bidding Documents.

§ 1.4 A Bid is a complete and properly executed proposal to do the Work for the sums stipulated therein, submitted in accordance with the Bidding Documents.

§ 1.5 The Base Bid is the sum stated in the Bid for which the Bidder offers to perform the Work described in the Bidding Documents, to which Work may be added or deleted by sums stated in Alternate Bids.

§ 1.6 An Alternate Bid (or Alternate) is an amount stated in the Bid to be added to or deducted from, or that does not change, the Base Bid if the corresponding change in the Work, as described in the Bidding Documents, is accepted.

§ 1.7 A Unit Price is an amount stated in the Bid as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, as described in the Bidding Documents.

§ 1.8 A Bidder is a person or entity who submits a Bid and who meets the requirements set forth in the Bidding Documents.

§ 1.9 A Sub-bidder is a person or entity who submits a bid to a Bidder for materials, equipment, or labor for a portion of the Work.

ARTICLE 2 BIDDER'S REPRESENTATIONS

§ 2.1 By submitting a Bid, the Bidder represents that:

- **.1** the Bidder has read and understands the Bidding Documents;
- **.2** the Bidder understands how the Bidding Documents relate to other portions of the Project, if any, being bid concurrently or presently under construction;
- **.3** the Bid complies with the Bidding Documents;
- **.4** the Bidder has visited the site, become familiar with local conditions under which the Work is to be performed, and has correlated the Bidder's observations with the requirements of the Proposed Contract Documents;
- **.5** the Bid is based upon the materials, equipment, and systems required by the Bidding Documents without exception; and
- **.6** the Bidder has read and understands the provisions for liquidated damages, if any, set forth in the form of Agreement between the Owner and Contractor.

ARTICLE 3 BIDDING DOCUMENTS

§ 3.1 Distribution

§ 3.1.1 Bidders shall obtain complete Bidding Documents, as indicated below, from the issuing office designated in the advertisement or invitation to bid, for the deposit sum, if any, stated therein.
(Indicate how, such as by email, website, host site/platform, paper copy, or other method Bidders shall obtain Bidding Documents.)

Town of Canton's Website
https://www.cantonnc.com/rfqs-rfps-bids/

§ 3.1.2 Any required deposit shall be refunded to Bidders who submit a bona fide Bid and return the paper Bidding Documents in good condition within ten days after receipt of Bids. The cost to replace missing or damaged paper documents will be deducted from the deposit. A Bidder receiving a Contract award may retain the paper Bidding

AIA Document A701 – 2018. Copyright © 1970, 1974, 1978, 1987, 1997 and 2018. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This document was produced at 15:06:44 EDT on 03/09/2026 under Subscription No.20250106709 which expires on 03/02/2027, is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (69aec14dff6f94382384205e)

Documents, and the Bidder's deposit will be refunded.

§ 3.1.3 Bidding Documents will not be issued directly to Sub-bidders unless specifically offered in the advertisement or invitation to bid, or in supplementary instructions to bidders.

§ 3.1.4 Bidders shall use complete Bidding Documents in preparing Bids. Neither the Owner nor Architect assumes responsibility for errors or misinterpretations resulting from the use of incomplete Bidding Documents.

§ 3.1.5 The Bidding Documents will be available for the sole purpose of obtaining Bids on the Work. No license or grant of use is conferred by distribution of the Bidding Documents.

§ 3.2 Modification or Interpretation of Bidding Documents

§ 3.2.1 The Bidder shall carefully study the Bidding Documents, shall examine the site and local conditions, and shall notify the Architect of errors, inconsistencies, or ambiguities discovered and request clarification or interpretation pursuant to Section 3.2.2.

§ 3.2.2 Requests for clarification or interpretation of the Bidding Documents shall be submitted by the Bidder in writing and shall be received by the Architect at least seven days prior to the date for receipt of Bids.
(Indicate how, such as by email, website, host site/platform, paper copy, or other method Bidders shall submit requests for clarification and interpretation.)

Bidding RFI's shall be sent to the Architect, via email.
Michael Supino, AIA
msupino@creechassociates.com

§ 3.2.3 Modifications and interpretations of the Bidding Documents shall be made by Addendum. Modifications and interpretations of the Bidding Documents made in any other manner shall not be binding, and Bidders shall not rely upon them.

§ 3.3 Substitutions

§ 3.3.1 The materials, products, and equipment described in the Bidding Documents establish a standard of required function, dimension, appearance, and quality to be met by any proposed substitution.

§ 3.3.2 Substitution Process

§ 3.3.2.1 Written requests for substitutions shall be received by the Architect at least ten days prior to the date for receipt of Bids. Requests shall be submitted in the same manner as that established for submitting clarifications and interpretations in Section 3.2.2.

§ 3.3.2.2 Bidders shall submit substitution requests on a Substitution Request Form if one is provided in the Bidding Documents.

§ 3.3.2.3 If a Substitution Request Form is not provided, requests shall include (1) the name of the material or equipment specified in the Bidding Documents; (2) the reason for the requested substitution; (3) a complete description of the proposed substitution including the name of the material or equipment proposed as the substitute, performance and test data, and relevant drawings; and (4) any other information necessary for an evaluation. The request shall include a statement setting forth changes in other materials, equipment, or other portions of the Work, including changes in the work of other contracts or the impact on any Project Certifications (such as LEED), that will result from incorporation of the proposed substitution.

§ 3.3.3 The burden of proof of the merit of the proposed substitution is upon the proposer. The Architect's decision of approval or disapproval of a proposed substitution shall be final.

§ 3.3.4 If the Architect approves a proposed substitution prior to receipt of Bids, such approval shall be set forth in an Addendum. Approvals made in any other manner shall not be binding, and Bidders shall not rely upon them.

§ 3.3.5 No substitutions will be considered after the Contract award unless specifically provided for in the Contract Documents.

§ 3.4 Addenda

AIA Document A701 – 2018. Copyright © 1970, 1974, 1978, 1987, 1997 and 2018. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This document was produced at 15:06:44 EDT on 03/09/2026 under Subscription No.20250106709 which expires on 03/02/2027, is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (69aec14dff6f94382384205e)

§ 3.4.1 Addenda will be transmitted to Bidders known by the issuing office to have received complete Bidding Documents.
(Indicate how, such as by email, website, host site/platform, paper copy, or other method Addenda will be transmitted.)

All Addenda shall be issued via the town's website.
https://www.cantonnc.com/rfqs-rfps-bids/

§ 3.4.2 Addenda will be available where Bidding Documents are on file.

§ 3.4.3 Addenda will be issued no later than four days prior to the date for receipt of Bids, except an Addendum withdrawing the request for Bids or one which includes postponement of the date for receipt of Bids.

§ 3.4.4 Prior to submitting a Bid, each Bidder shall ascertain that the Bidder has received all Addenda issued, and the Bidder shall acknowledge their receipt in the Bid.

ARTICLE 4 BIDDING PROCEDURES

§ 4.1 Preparation of Bids

§ 4.1.1 Bids shall be submitted on the forms included with or identified in the Bidding Documents.

§ 4.1.2 All blanks on the bid form shall be legibly executed. Paper bid forms shall be executed in a non-erasable medium.

§ 4.1.3 Sums shall be expressed in both words and numbers, unless noted otherwise on the bid form. In case of discrepancy, the amount entered in words shall govern.

§ 4.1.4 Edits to entries made on paper bid forms must be initialed by the signer of the Bid.

§ 4.1.5 All requested Alternates shall be bid. If no change in the Base Bid is required, enter "No Change" or as required by the bid form.

§ 4.1.6 Where two or more Bids for designated portions of the Work have been requested, the Bidder may, without forfeiture of the bid security, state the Bidder's refusal to accept award of less than the combination of Bids stipulated by the Bidder. The Bidder shall neither make additional stipulations on the bid form nor qualify the Bid in any other manner.

§ 4.1.7 Each copy of the Bid shall state the legal name and legal status of the Bidder. As part of the documentation submitted with the Bid, the Bidder shall provide evidence of its legal authority to perform the Work in the jurisdiction where the Project is located. Each copy of the Bid shall be signed by the person or persons legally authorized to bind the Bidder to a contract. A Bid by a corporation shall further name the state of incorporation and have the corporate seal affixed. A Bid submitted by an agent shall have a current power of attorney attached, certifying the agent's authority to bind the Bidder.

§ 4.1.8 A Bidder shall incur all costs associated with the preparation of its Bid.

§ 4.2 Bid Security

§ 4.2.1 Each Bid shall be accompanied by the following bid security:
(Insert the form and amount of bid security.)

§ 4.2.2 The Bidder pledges to enter into a Contract with the Owner on the terms stated in the Bid and shall, if required, furnish bonds covering the faithful performance of the Contract and payment of all obligations arising thereunder. Should the Bidder refuse to enter into such Contract or fail to furnish such bonds if required, the amount of the bid security shall be forfeited to the Owner as liquidated damages, not as a penalty. In the event the Owner fails to comply with Section 6.2, the amount of the bid security shall not be forfeited to the Owner.

§ 4.2.3 If a surety bond is required as bid security, it shall be written on AIA Document A310™, Bid Bond, unless otherwise provided in the Bidding Documents. The attorney-in-fact who executes the bond on behalf of the surety shall affix to the bond a certified and current copy of an acceptable power of attorney. The Bidder shall provide surety bonds from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located.

AIA Document A701 – 2018. Copyright © 1970, 1974, 1978, 1987, 1997 and 2018. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This document was produced at 15:06:44 EDT on 03/09/2026 under Subscription No.20250106709 which expires on 03/02/2027, is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (69aec14dff6f94382384205e)

§ 4.2.4 The Owner will have the right to retain the bid security of Bidders to whom an award is being considered until (a) the Contract has been executed and bonds, if required, have been furnished; (b) the specified time has elapsed so that Bids may be withdrawn; or (c) all Bids have been rejected. However, if no Contract has been awarded or a Bidder has not been notified of the acceptance of its Bid, a Bidder may, beginningdays after the opening of Bids, withdraw its Bid and request the return of its bid security.

§ 4.3 Submission of Bids

§ 4.3.1 A Bidder shall submit its Bid as indicated below:
(Indicate how, such as by website, host site/platform, paper copy, or other method Bidders shall submit their Bid.)

Via mail or delivery to address listed in the Advertisement to bid.

§ 4.3.2 Paper copies of the Bid, the bid security, and any other documents required to be submitted with the Bid shall be enclosed in a sealed opaque envelope. The envelope shall be addressed to the party receiving the Bids and shall be identified with the Project name, the Bidder's name and address, and, if applicable, the designated portion of the Work for which the Bid is submitted. If the Bid is sent by mail, the sealed envelope shall be enclosed in a separate mailing envelope with the notation "SEALED BID ENCLOSED" on the face thereof.

§ 4.3.3 Bids shall be submitted by the date and time and at the place indicated in the invitation to bid. Bids submitted after the date and time for receipt of Bids, or at an incorrect place, will not be accepted.

§ 4.3.4 The Bidder shall assume full responsibility for timely delivery at the location designated for receipt of Bids.

§ 4.3.5 A Bid submitted by any method other than as provided in this Section 4.3 will not be accepted.

§ 4.4 Modification or Withdrawal of Bid

§ 4.4.1 Prior to the date and time designated for receipt of Bids, a Bidder may submit a new Bid to replace a Bid previously submitted, or withdraw its Bid entirely, by notice to the party designated to receive the Bids. Such notice shall be received and duly recorded by the receiving party on or before the date and time set for receipt of Bids. The receiving party shall verify that replaced or withdrawn Bids are removed from the other submitted Bids and not considered. Notice of submission of a replacement Bid or withdrawal of a Bid shall be worded so as not to reveal the amount of the original Bid.

§ 4.4.2 Withdrawn Bids may be resubmitted up to the date and time designated for the receipt of Bids in the same format as that established in Section 4.3, provided they fully conform with these Instructions to Bidders. Bid security shall be in an amount sufficient for the Bid as resubmitted.

§ 4.4.3 After the date and time designated for receipt of Bids, a Bidder who discovers that it made a clerical error in its Bid shall notify the Architect of such error within two days, or pursuant to a timeframe specified by the law of the jurisdiction where the Project is located, requesting withdrawal of its Bid. Upon providing evidence of such error to the reasonable satisfaction of the Architect, the Bid shall be withdrawn and not resubmitted. If a Bid is withdrawn pursuant to this Section 4.4.3, the bid security will be attended to as follows:
(State the terms and conditions, such as Bid rank, for returning or retaining the bid security.)

Any Bid may be withdrawn prior to the date and time set for the bid opening. Bids may also be withdrawn after the public opening if an unintentional, substantial error is made by the Bidder, and it can be proven that the error was arithmetic or an omission as opposed to judgment. The request to withdraw a bid must be made in writing within (3) calendar days after the opening of the bids.

ARTICLE 5 CONSIDERATION OF BIDS

§ 5.1 Opening of Bids

If stipulated in an advertisement or invitation to bid, or when otherwise required by law, Bids properly identified and received within the specified time limits will be publicly opened and read aloud. A summary of the Bids may be made available to Bidders.

§ 5.2 Rejection of Bids

Unless otherwise prohibited by law, the Owner shall have the right to reject any or all Bids.

§ 5.3 Acceptance of Bid (Award)

AIA Document A701 – 2018. Copyright © 1970, 1974, 1978, 1987, 1997 and 2018. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This document was produced at 15:06:44 EDT on 03/09/2026 under Subscription No.20250106709 which expires on 03/02/2027, is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (69aec14dff6f94382384205e)

§ 5.3.1 It is the intent of the Owner to award a Contract to the lowest responsive and responsible Bidder, provided the Bid has been submitted in accordance with the requirements of the Bidding Documents. Unless otherwise prohibited by law, the Owner shall have the right to waive informalities and irregularities in a Bid received and to accept the Bid which, in the Owner's judgment, is in the Owner's best interests.

§ 5.3.2 Unless otherwise prohibited by law, the Owner shall have the right to accept Alternates in any order or combination, unless otherwise specifically provided in the Bidding Documents, and to determine the lowest responsive and responsible Bidder on the basis of the sum of the Base Bid and Alternates accepted.

ARTICLE 6 POST-BID INFORMATION

§ 6.1 Contractor's Qualification Statement

Bidders to whom award of a Contract is under consideration shall submit to the Architect, upon request and within the timeframe specified by the Architect, a properly executed AIA Document A305™, Contractor's Qualification Statement, unless such a Statement has been previously required and submitted for this Bid.

§ 6.2 Owner's Financial Capability

A Bidder to whom award of a Contract is under consideration may request in writing, fourteen days prior to the expiration of the time for withdrawal of Bids, that the Owner furnish to the Bidder reasonable evidence that financial arrangements have been made to fulfill the Owner's obligations under the Contract. The Owner shall then furnish such reasonable evidence to the Bidder no later than seven days prior to the expiration of the time for withdrawal of Bids. Unless such reasonable evidence is furnished within the allotted time, the Bidder will not be required to execute the Agreement between the Owner and Contractor.

§ 6.3 Submittals

§ 6.3.1 After notification of selection for the award of the Contract, the Bidder shall, as soon as practicable or as stipulated in the Bidding Documents, submit in writing to the Owner through the Architect:

- **.1** a designation of the Work to be performed with the Bidder's own forces;
- **.2** names of the principal products and systems proposed for the Work and the manufacturers and suppliers of each; and
- **.3** names of persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for the principal portions of the Work.

§ 6.3.2 The Bidder will be required to establish to the satisfaction of the Architect and Owner the reliability and responsibility of the persons or entities proposed to furnish and perform the Work described in the Bidding Documents.

§ 6.3.3 Prior to the execution of the Contract, the Architect will notify the Bidder if either the Owner or Architect, after due investigation, has reasonable objection to a person or entity proposed by the Bidder. If the Owner or Architect has reasonable objection to a proposed person or entity, the Bidder may, at the Bidder's option, withdraw the Bid or submit an acceptable substitute person or entity. The Bidder may also submit any required adjustment in the Base Bid or Alternate Bid to account for the difference in cost occasioned by such substitution. The Owner may accept the adjusted bid price or disqualify the Bidder. In the event of either withdrawal or disqualification, bid security will not be forfeited.

§ 6.3.4 Persons and entities proposed by the Bidder and to whom the Owner and Architect have made no reasonable objection must be used on the Work for which they were proposed and shall not be changed except with the written consent of the Owner and Architect.

ARTICLE 7 PERFORMANCE BOND AND PAYMENT BOND

§ 7.1 Bond Requirements

§ 7.1.1 If stipulated in the Bidding Documents, the Bidder shall furnish bonds covering the faithful performance of the Contract and payment of all obligations arising thereunder.

§ 7.1.2 If the furnishing of such bonds is stipulated in the Bidding Documents, the cost shall be included in the Bid. If the furnishing of such bonds is required after receipt of bids and before execution of the Contract, the cost of such bonds shall be added to the Bid in determining the Contract Sum.

§ 7.1.3 The Bidder shall provide surety bonds from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located.

§ 7.1.4 Unless otherwise indicated below, the Penal Sum of the Payment and Performance Bonds shall be the amount of

AIA Document A701 – 2018. Copyright © 1970, 1974, 1978, 1987, 1997 and 2018. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This document was produced at 15:06:44 EDT on 03/09/2026 under Subscription No.20250106709 which expires on 03/02/2027, is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (69aec14dff6f94382384205e)

the Contract Sum.
(If Payment or Performance Bonds are to be in an amount other than 100% of the Contract Sum, indicate the dollar amount or percentage of the Contract Sum.)

N/A

§ 7.2 Time of Delivery and Form of Bonds

§ 7.2.1 The Bidder shall deliver the required bonds to the Owner not later than three days following the date of execution of the Contract. If the Work is to commence sooner in response to a letter of intent, the Bidder shall, prior to commencement of the Work, submit evidence satisfactory to the Owner that such bonds will be furnished and delivered in accordance with this Section 7.2.1.

§ 7.2.2 Unless otherwise provided, the bonds shall be written on AIA Document A312, Performance Bond and Payment Bond.

§ 7.2.3 The bonds shall be dated on or after the date of the Contract.

§ 7.2.4 The Bidder shall require the attorney-in-fact who executes the required bonds on behalf of the surety to affix to the bond a certified and current copy of the power of attorney.

ARTICLE 8 ENUMERATION OF THE PROPOSED CONTRACT DOCUMENTS

§ 8.1 Copies of the proposed Contract Documents have been made available to the Bidder and consist of the following documents:

.1 AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor, unless otherwise stated below.
(Insert the complete AIA Document number, including year, and Document title.)

N/A

.2 AIA Document A101™–2017, Exhibit A, Insurance and Bonds, unless otherwise stated below.
(Insert the complete AIA Document number, including year, and Document title.)

N/A

.3 AIA Document A201™–2017, General Conditions of the Contract for Construction, unless otherwise stated below.
(Insert the complete AIA Document number, including year, and Document title.)

N/A

.4 Building Information Modeling Exhibit, if completed:

N/A

.5 Drawings

Number	Title	Date
1	Construction Documents	

.6 Specifications

Section	Title	Date	Pages
1	Police Station Renovation Specifications	07-07-2025	

.7 Addenda:

Number	Date	Pages

AIA Document A701 – 2018. Copyright © 1970, 1974, 1978, 1987, 1997 and 2018. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This document was produced at 15:06:44 EDT on 03/09/2026 under Subscription No.20250106709 which expires on 03/02/2027, is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (69aec14dff6f94382384205e)

.8 Other Exhibits:
(Check all boxes that apply and include appropriate information identifying the exhibit where required.)

[ ] AIA Document E204™–2017, Sustainable Projects Exhibit, dated as indicated below:
(Insert the date of the E204-2017.)

N/A

[ ] The Sustainability Plan:

Title	Date	Pages

[ ] Supplementary and other Conditions of the Contract:

Document	Title	Date	Pages

.9 Other documents listed below:
(List here any additional documents that are intended to form part of the Proposed Contract Documents.)

N/A

AIA Document A701 – 2018. Copyright © 1970, 1974, 1978, 1987, 1997 and 2018. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This document was produced at 15:06:44 EDT on 03/09/2026 under Subscription No.20250106709 which expires on 03/02/2027, is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (69aec14dff6f94382384205e)

BID INFORMATION

Name of Bidder: _____

Date: _____

Project Name: Canton Police Station Renovation

Owner: Town of Canton

Designer: Creech and Associates

Designer Project Number: 2023-001-01

CERTIFICATIONS OF BASE BID

The undersigned Bidder, hereby declares that he has carefully investigated the scope of work and having thoroughly familiarized himself with the Contract Documents relative hereto, and has read all special provisions furnished prior to the opening of the bids; that he has satisfied himself relative to the work to be performed. The bidder further declares that he and his sub-contractors have fully complied with NCGS 64, Article 2 in regards to E-Verification as required by N.C. General Statute 143-129(j).

The bidder proposes and agrees if this proposal is accepted, to contract with Buncombe County Government, in the form of contract specified, to provide all necessary labor, equipment, materials, machinery, tools, apparatus, transportation, services, fees, permits, etc., to complete the construction Buncombe County Human Resources Training Room Expansion and Renovation Project, all in accordance with the aforementioned Contract Documents to the full and entire satisfaction of Buncombe County Government, with definite understanding that no money will be allowed for extra work except as set forth in the General Conditions and the Contract Documents for the lump sum of:

Provide a 5% contingency to your base bid number below as an owner contingency allowance and provide a Total Base Bid Price. Any funds not used from this allowance will deducted from the overall contract in the final payment application.

BASE BID PRICE:

_____ Dollars ($ _____).

TOTAL BASE BID PRICE WITH OWNER CONTENGENCY:

_____ Dollars ($ _____).

SUB-CONTRACTOR LIST:

The following shall execute subcontracts with the Bidder for the portion of the work indicated:

Electrical Sub-Contractor (Name & License No.):
_____ License No. _____

Plumbing Sub-Contractor (Name & License No.):
_____ License No. _____

TIME OF COMPLETION

The undersigned Bidder proposes and agrees hereby to commence the Work of the Contract Documents on a date specified in a written Notice to Proceed to be issues by Architect and shall fully complete the Work within **_____calendar days**.

BID SECURITY:
Accompanying this proposal is a bid security five percent (5%) of the Total Bid Price Sum in accordance with Instructions to Bidders in the form of (check one):

☐ Bid Bond (AIA Document A310-2010), or

☐ Cash, or

☐ Cashier's Check, or Certified Check.

RECIEPT OF ADDENDA:
The undersigned acknowledges receipt of the following addenda which will be considered as part of the contract Documents:

Addendum No. _____ Dated _____ Addendum No. _____ Dated _____
Addendum No. _____ Dated _____ Addendum No. _____ Dated _____
Addendum No. _____ Dated _____ Addendum No. _____ Dated _____
Addendum No. _____ Dated _____ Addendum No. _____ Dated _____

CONTRACTOR'S LICENSE:

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

ACKNOWLEDGEMENT AND REPRESENTATIONS:

If notice of acceptance of this bid is given to the undersigned within 90 days after the date of opening of bids, or any time thereafter before this bid is withdrawn, the undersigned will execute and deliver an Agreement in the prescribed form promptly after is has been presented to him for signature. Certificates of Insurance and Performance and Payment bonds shall be furnished to the Owner at the execution of this agreement and as required by North Carolina General Statutes.

Upon request of the Owner, the undersigned bidder agrees to submit evidence in affidavit form of applicable experience, adequate financial resources, work in hand capacity, adequate organization, and acceptable past performance. Submittal will be in the form of AIA Document A305 Contractor's Qualification Statement. Bidder's qualifications information shall be considered confidential.

The undersigned bidder certifies the neither he/she, nor any official, agent or employee has entered into any agreement, participated in any collusion, or otherwise taken any action which is in restraint of free competitive bidding in conjunction with this bid. The person signing this bid form represents that he/she has full authority and representative capacity to execute this Bid Form in the capacity indicated below.

The undersigned agrees that in the case of failure on his part to execute the said contract and the bond within ten (10) consecutive calendar days after written notice being given of the award of contract, the certified check, cash or bid bond accompanying this bid shall be paid into the funds of the Owner's account set aside for the Project, as liquidated damages for such failure; otherwise, the certified check, cash or bid bond accompanying the Proposal shall be returned to the undersigned.

The undersigned bidder agrees that they are expected to act as Project Expediter and coordinate work of all other contractors.

The firm signing this bid and registered under that name is legally qualified to perform all work included in the scope of the contract as determined by the State of North Carolina, in granting the registration.

PROPOSAL SIGNATURE:

Respectfully submitted this _____ day of _____ , 20___ .

_____

(Name of firm or corporation making bid)

By: _____

Signature and Typed Name

Title: _____

Address of Bidder: _____

_____

Bidders N.C. Contractor License No. _____

Type of License: _____

Limitations: _____

Attest:

By: _____

Title: _____

END OF DOCUMENT 00 41 13

1.1 GENERAL CONDITIONS

A. The required Bid Security form for the Project is AIA Document A310-2010 Bid Bond.
B. The Bidder shall obtain the form, complete and submit with the Bid.
C. Copies of AIA standard forms may be obtained from:
    1. American Institute of Architects, Charlotte, NC: 704.377.3610.

END OF DOCUMENT 00 43 13

NON-COLLUSION AFFIDAVIT

STATE OF NORTH CAROLINA
TOWN OF CANTON, NC

I_____, being first duly sworn, deposes and says that:

1. He/She is the_____of _____,
   the Bidder that has submitted the attached Bid;

2. He/She is fully informed respecting the preparation and contents of the attached Bid and of all pertinent circumstances respecting such Bid;

3. Such Bid is genuine and is not a collusive or sham bid;

4. Neither the said Bidder nor any of its officers, partners, owners agents, representatives, employees or parties of interest, including this affiant, has in any way colluded, conspired, connived or agreed, directly or indirectly, with any other bidder, firm or person to submit a collusive or sham bid in connection with the contract for which the attached Bid has been submitted or to refrain from bidding in connection with such contract, or has in any manner, directly or indirectly, sought by agreement or collusion or communication or conference with any other bidder, firm or person to fix the price or prices in the attached bid or of any other bidder, or to fix any overhead, profit or cost element of the bid price of any other bidder or to secure through collusion, conspiracy, connivance or unlawful agreement any advantage against the Owner or any person interested in the proposed contract; and

5. The price or prices quoted in the attached Bid are fair and proper and are not tainted by any collusion, conspiracy, connivance or unlawful agreement on the part of the Bidder or any of its agents, representatives, owners, employees, or parties in interest, including this affiant.

_____
TITLE

Subscribed and sworn before me, this _____day of _____, 20____

Notary Public

My Commission Expires _____

END OF DOCUMENT 00 45 19

STATE OF NORTH CAROLINA

AFFIDAVIT

TOWN OF CANTON, NC

NOW COMES Affiant, first being sworn, deposes and says as follows:

1. I, being duly authorized by and on behalf of _____ ("Contractor"), have bid on an agreement with the Town of Canton, North Carolina ("Canton") _____;

2. As part of my duties and responsibilities pursuant to said agreement, I attest that I am aware of and in compliance with the requirements of E-Verify, Article 2 of Chapter 64 of the North Carolina General Statutes, to include (mark which applies):

___ After hiring an employee to work in North Carolina, I verify the work authorization of said employee through E-Verify and retain the record of the verification of work authorization while the employee is employed and for one year thereafter; or

___ I employ fewer than twenty-five (25) employees in the State of North Carolina.

3. As part of my duties and responsibilities pursuant to said agreement, I attest that to the best of my knowledge any subcontractors employed as a part of this agreement are in compliance with the requirements of E-Verify, Article 2 of Chapter 64 of the North Carolina General Statutes, to include (mark which applies):

___ After hiring an employee to work in North Carolina, the subcontractor verifies the work authorization of said employee through E-Verify and retains the record of the verification of work authorization while the employee is employed and for one year thereafter; or

___ The subcontractor employs fewer than twenty-five (25) employees in the State of North Carolina. Specify subcontractor: _____

This the _____ day of _____, 20___.

_____
Affiant

_____
Printed Name

Sworn to and subscribed before me, this the _____ day of _____, 20____.

_____

[OFFICIAL SEAL]

_____, Notary Public

My Commission Expires: _____

END OF DOCUMENT 00 45 36

1.1 FORM OF AGREEMENT

A. The following form of Owner/Contractor Agreements shall be utilized for this Project and are attached at the end of this section.

1. AIA Document A101, Owner-Contractor Agreement Form, Stipulated Sum, 2017 Edition
2. AIA Document A101 Exhibit A, Insurance and Bonds

END OF DOCUMENT 00 52 00

AIA® Document A101® – 2017

Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum

AGREEMENT made as of the day of in the year
(In words, indicate day, month and year.)

BETWEEN the Owner:
(Name, legal status, address and other information)

and the Contractor:
(Name, legal status, address and other information)

for the following Project:
(Name, location and detailed description)

The Architect:
(Name, legal status, address and other information)

The Owner and Contractor agree as follows.

ADDITIONS AND DELETIONS:
The author of this document may have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes revisions to the standard form text is available from the author and should be reviewed. A vertical line in the left margin of this document indicates where the author has added to or deleted from the original AIA text.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

The parties should complete A101®–2017, Exhibit A, Insurance and Bonds, contemporaneously with this Agreement. AIA Document A201®–2017, General Conditions of the Contract for Construction, is adopted in this document by reference. Do not use with other general conditions unless this document is modified.

ELECTRONIC COPYING of any portion of this AIA® Document to another electronic file is prohibited and constitutes a violation of copyright laws as set forth in the footer of this document.

AIA Document A101 – 2017. Copyright © 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1967, 1974, 1977, 1987, 1991, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:34:34 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967f6)

TABLE OF ARTICLES

1 THE CONTRACT DOCUMENTS

2 THE WORK OF THIS CONTRACT

3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

4 CONTRACT SUM

5 PAYMENTS

6 DISPUTE RESOLUTION

7 TERMINATION OR SUSPENSION

8 MISCELLANEOUS PROVISIONS

9 ENUMERATION OF CONTRACT DOCUMENTS

EXHIBIT A INSURANCE AND BONDS

ARTICLE 1 THE CONTRACT DOCUMENTS

The Contract Documents consist of this Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, Addenda issued prior to execution of this Agreement, other documents listed in this Agreement, and Modifications issued after execution of this Agreement, all of which form the Contract, and are as fully a part of the Contract as if attached to this Agreement or repeated herein. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. An enumeration of the Contract Documents, other than a Modification, appears in Article 9.

ARTICLE 2 THE WORK OF THIS CONTRACT

The Contractor shall fully execute the Work described in the Contract Documents, except as specifically indicated in the Contract Documents to be the responsibility of others.

ARTICLE 3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

§ 3.1 The date of commencement of the Work shall be:
(Check one of the following boxes.)

[ ] The date of this Agreement.

[ ] A date set forth in a notice to proceed issued by the Owner.

[ ] Established as follows:
(Insert a date or a means to determine the date of commencement of the Work.)

If a date of commencement of the Work is not selected, then the date of commencement shall be the date of this Agreement.

§ 3.2 The Contract Time shall be measured from the date of commencement of the Work.

§ 3.3 Substantial Completion

§ 3.3.1 Subject to adjustments of the Contract Time as provided in the Contract Documents, the Contractor shall achieve

AIA Document A101 – 2017. Copyright © 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1967, 1974, 1977, 1987, 1991, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:34:34 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967f6)

Substantial Completion of the entire Work:
(Check one of the following boxes and complete the necessary information.)

[ ] Not later than ( ) calendar days from the date of commencement of the Work.

[ ] By the following date:

§ 3.3.2 Subject to adjustments of the Contract Time as provided in the Contract Documents, if portions of the Work are to be completed prior to Substantial Completion of the entire Work, the Contractor shall achieve Substantial Completion of such portions by the following dates:

Portion of Work	Substantial Completion Date

§ 3.3.3 If the Contractor fails to achieve Substantial Completion as provided in this Section 3.3, liquidated damages, if any, shall be assessed as set forth in Section 4.5.

ARTICLE 4 CONTRACT SUM

§ 4.1 The Owner shall pay the Contractor the Contract Sum in current funds for the Contractor's performance of the Contract. The Contract Sum shall be ($), subject to additions and deductions as provided in the Contract Documents.

§ 4.2 Alternates

§ 4.2.1 Alternates, if any, included in the Contract Sum:

Item	Price

§ 4.2.2 Subject to the conditions noted below, the following alternates may be accepted by the Owner following execution of this Agreement. Upon acceptance, the Owner shall issue a Modification to this Agreement.
(Insert below each alternate and the conditions that must be met for the Owner to accept the alternate.)

Item	Price	Conditions for Acceptance

§ 4.3 Allowances, if any, included in the Contract Sum:
(Identify each allowance.)

Item	Price

§ 4.4 Unit prices, if any:
(Identify the item and state the unit price and quantity limitations, if any, to which the unit price will be applicable.)

Item	Units and Limitations	Price per Unit ($0.00)

§ 4.5 Liquidated damages, if any:
(Insert terms and conditions for liquidated damages, if any.)

§ 4.6 Other:
(Insert provisions for bonus or other incentives, if any, that might result in a change to the Contract Sum.)

AIA Document A101 – 2017. Copyright © 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1967, 1974, 1977, 1987, 1991, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:34:34 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967f6)

ARTICLE 5 PAYMENTS

§ 5.1 Progress Payments

§ 5.1.1 Based upon Applications for Payment submitted to the Architect by the Contractor and Certificates for Payment issued by the Architect, the Owner shall make progress payments on account of the Contract Sum to the Contractor as provided below and elsewhere in the Contract Documents.

§ 5.1.2 The period covered by each Application for Payment shall be one calendar month ending on the last day of the month, or as follows:

§ 5.1.3 Provided that an Application for Payment is received by the Architect not later than the day of a month, the Owner shall make payment of the amount certified to the Contractor not later than the day of the month. If an Application for Payment is received by the Architect after the application date fixed above, payment of the amount certified shall be made by the Owner not later than ( ) days after the Architect receives the Application for Payment. *(Federal, state or local laws may require payment within a certain period of time.)*

§ 5.1.4 Each Application for Payment shall be based on the most recent schedule of values submitted by the Contractor in accordance with the Contract Documents. The schedule of values shall allocate the entire Contract Sum among the various portions of the Work. The schedule of values shall be prepared in such form, and supported by such data to substantiate its accuracy, as the Architect may require. This schedule of values shall be used as a basis for reviewing the Contractor's Applications for Payment.

§ 5.1.5 Applications for Payment shall show the percentage of completion of each portion of the Work as of the end of the period covered by the Application for Payment.

§ 5.1.6 In accordance with AIA Document A201™–2017, General Conditions of the Contract for Construction, and subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

§ 5.1.6.1 The amount of each progress payment shall first include:

- **.1** That portion of the Contract Sum properly allocable to completed Work;
- **.2** That portion of the Contract Sum properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction, or, if approved in advance by the Owner, suitably stored off the site at a location agreed upon in writing; and
- **.3** That portion of Construction Change Directives that the Architect determines, in the Architect's professional judgment, to be reasonably justified.

§ 5.1.6.2 The amount of each progress payment shall then be reduced by:

- **.1** The aggregate of any amounts previously paid by the Owner;
- **.2** The amount, if any, for Work that remains uncorrected and for which the Architect has previously withheld a Certificate for Payment as provided in Article 9 of AIA Document A201–2017;
- **.3** Any amount for which the Contractor does not intend to pay a Subcontractor or material supplier, unless the Work has been performed by others the Contractor intends to pay;
- **.4** For Work performed or defects discovered since the last payment application, any amount for which the Architect may withhold payment, or nullify a Certificate of Payment in whole or in part, as provided in Article 9 of AIA Document A201–2017; and
- **.5** Retainage withheld pursuant to Section 5.1.7.

§ 5.1.7 Retainage

§ 5.1.7.1 For each progress payment made prior to Substantial Completion of the Work, the Owner may withhold the following amount, as retainage, from the payment otherwise due:

AIA Document A101 – 2017. Copyright © 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1967, 1974, 1977, 1987, 1991, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:34:34 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967f6)

(Insert a percentage or amount to be withheld as retainage from each Application for Payment. The amount of retainage may be limited by governing law.)

§ 5.1.7.1.1 The following items are not subject to retainage:
(Insert any items not subject to the withholding of retainage, such as general conditions, insurance, etc.)

§ 5.1.7.2 Reduction or limitation of retainage, if any, shall be as follows:
(If the retainage established in Section 5.1.7.1 is to be modified prior to Substantial Completion of the entire Work, including modifications for Substantial Completion of portions of the Work as provided in Section 3.3.2, insert provisions for such modifications.)

§ 5.1.7.3 Except as set forth in this Section 5.1.7.3, upon Substantial Completion of the Work, the Contractor may submit an Application for Payment that includes the retainage withheld from prior Applications for Payment pursuant to this Section 5.1.7. The Application for Payment submitted at Substantial Completion shall not include retainage as follows:
(Insert any other conditions for release of retainage upon Substantial Completion.)

§ 5.1.8 If final completion of the Work is materially delayed through no fault of the Contractor, the Owner shall pay the Contractor any additional amounts in accordance with Article 9 of AIA Document A201–2017.

§ 5.1.9 Except with the Owner's prior approval, the Contractor shall not make advance payments to suppliers for materials or equipment which have not been delivered and stored at the site.

§ 5.2 Final Payment

§ 5.2.1 Final payment, constituting the entire unpaid balance of the Contract Sum, shall be made by the Owner to the Contractor when

.1 the Contractor has fully performed the Contract except for the Contractor's responsibility to correct Work as provided in Article 12 of AIA Document A201–2017, and to satisfy other requirements, if any, which extend beyond final payment; and

.2 a final Certificate for Payment has been issued by the Architect.

§ 5.2.2 The Owner's final payment to the Contractor shall be made no later than 30 days after the issuance of the Architect's final Certificate for Payment, or as follows:

§ 5.3 Interest

Payments due and unpaid under the Contract shall bear interest from the date payment is due at the rate stated below, or in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.
(Insert rate of interest agreed upon, if any.)

%

ARTICLE 6 DISPUTE RESOLUTION

§ 6.1 Initial Decision Maker

The Architect will serve as the Initial Decision Maker pursuant to Article 15 of AIA Document A201–2017, unless the parties appoint below another individual, not a party to this Agreement, to serve as the Initial Decision Maker.

AIA Document A101 – 2017. Copyright © 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1967, 1974, 1977, 1987, 1991, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:34:34 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967f6)

(If the parties mutually agree, insert the name, address and other contact information of the Initial Decision Maker, if other than the Architect.)

§ 6.2 Binding Dispute Resolution

For any Claim subject to, but not resolved by, mediation pursuant to Article 15 of AIA Document A201–2017, the method of binding dispute resolution shall be as follows:
(Check the appropriate box.)

[ ] Arbitration pursuant to Section 15.4 of AIA Document A201–2017

[ ] Litigation in a court of competent jurisdiction

[ ] Other *(Specify)*

If the Owner and Contractor do not select a method of binding dispute resolution, or do not subsequently agree in writing to a binding dispute resolution method other than litigation, Claims will be resolved by litigation in a court of competent jurisdiction.

ARTICLE 7 TERMINATION OR SUSPENSION

§ 7.1 The Contract may be terminated by the Owner or the Contractor as provided in Article 14 of AIA Document A201–2017.

§ 7.1.1 If the Contract is terminated for the Owner's convenience in accordance with Article 14 of AIA Document A201–2017, then the Owner shall pay the Contractor a termination fee as follows:
(Insert the amount of, or method for determining, the fee, if any, payable to the Contractor following a termination for the Owner's convenience.)

§ 7.2 The Work may be suspended by the Owner as provided in Article 14 of AIA Document A201–2017.

ARTICLE 8 MISCELLANEOUS PROVISIONS

§ 8.1 Where reference is made in this Agreement to a provision of AIA Document A201–2017 or another Contract Document, the reference refers to that provision as amended or supplemented by other provisions of the Contract Documents.

§ 8.2 The Owner's representative:
(Name, address, email address, and other information)

§ 8.3 The Contractor's representative:

AIA Document A101 – 2017. Copyright © 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1967, 1974, 1977, 1987, 1991, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:34:34 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967f6)

(Name, address, email address, and other information)

§ 8.4 Neither the Owner's nor the Contractor's representative shall be changed without ten days' prior notice to the other party.

§ 8.5 Insurance and Bonds

§ 8.5.1 The Owner and the Contractor shall purchase and maintain insurance as set forth in AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum, Exhibit A, Insurance and Bonds, and elsewhere in the Contract Documents.

§ 8.5.2 The Contractor shall provide bonds as set forth in AIA Document A101™–2017 Exhibit A, and elsewhere in the Contract Documents.

§ 8.6 Notice in electronic format, pursuant to Article 1 of AIA Document A201–2017, may be given in accordance with a building information modeling exhibit, if completed, or as otherwise set forth below:
(If other than in accordance with a building information modeling exhibit, insert requirements for delivering notice in electronic format such as name, title, and email address of the recipient and whether and how the system will be required to generate a read receipt for the transmission.)

§ 8.7 Other provisions:

ARTICLE 9 ENUMERATION OF CONTRACT DOCUMENTS

§ 9.1 This Agreement is comprised of the following documents:

.1 AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor

.2 AIA Document A101™–2017, Exhibit A, Insurance and Bonds

.3 AIA Document A201™–2017, General Conditions of the Contract for Construction

.4 Building information modeling exhibit, dated as indicated below:
(Insert the date of the building information modeling exhibit incorporated into this Agreement.)

.5 Drawings

Number	Title	Date

.6 Specifications

Section	Title	Date	Pages

.7 Addenda, if any:

AIA Document A101 – 2017. Copyright © 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1967, 1974, 1977, 1987, 1991, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:34:34 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967f6)

Number	Date	Pages

Portions of Addenda relating to bidding or proposal requirements are not part of the Contract Documents unless the bidding or proposal requirements are also enumerated in this Article 9.

.8 Other Exhibits:
(Check all boxes that apply and include appropriate information identifying the exhibit where required.)

[ ] AIA Document E204™–2017, Sustainable Projects Exhibit, dated as indicated below:
(Insert the date of the E204-2017 incorporated into this Agreement.)

[ ] The Sustainability Plan:

Title	Date	Pages

[ ] Supplementary and other Conditions of the Contract:

Document	Title	Date	Pages

.9 Other documents, if any, listed below:
(List here any additional documents that are intended to form part of the Contract Documents. AIA Document A201™–2017 provides that the advertisement or invitation to bid, Instructions to Bidders, sample forms, the Contractor's bid or proposal, portions of Addenda relating to bidding or proposal requirements, and other information furnished by the Owner in anticipation of receiving bids or proposals, are not part of the Contract Documents unless enumerated in this Agreement. Any such documents should be listed here only if intended to be part of the Contract Documents.)

This Agreement entered into as of the day and year first written above.

OWNER *(Signature)*	**CONTRACTOR** *(Signature)*
(Printed name and title)	*(Printed name and title)*

AIA Document A101 – 2017. Copyright © 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1967, 1974, 1977, 1987, 1991, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:34:34 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967f6)

AIA® Document A101® – 2017 Exhibit A

Insurance and Bonds

This Insurance and Bonds Exhibit is part of the Agreement, between the Owner and the Contractor, dated the day of in the year
(In words, indicate day, month and year.)

for the following **PROJECT**:
(Name and location or address)

THE OWNER:
(Name, legal status and address)

THE CONTRACTOR:
(Name, legal status and address)

TABLE OF ARTICLES

A.1 GENERAL

A.2 OWNER'S INSURANCE

A.3 CONTRACTOR'S INSURANCE AND BONDS

A.4 SPECIAL TERMS AND CONDITIONS

ARTICLE A.1 GENERAL

The Owner and Contractor shall purchase and maintain insurance, and provide bonds, as set forth in this Exhibit. As used in this Exhibit, the term General Conditions refers to AIA Document A201™–2017, General Conditions of the Contract for Construction.

ARTICLE A.2 OWNER'S INSURANCE

§ A.2.1 General

Prior to commencement of the Work, the Owner shall secure the insurance, and provide evidence of the coverage, required under this Article A.2 and, upon the Contractor's request, provide a copy of the property insurance policy or policies required by Section A.2.3. The copy of the policy or policies provided shall contain all applicable conditions, definitions, exclusions, and endorsements.

§ A.2.2 Liability Insurance

The Owner shall be responsible for purchasing and maintaining the Owner's usual

ADDITIONS AND DELETIONS:
The author of this document may have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes revisions to the standard form text is available from the author and should be reviewed. A vertical line in the left margin of this document indicates where the author has added to or deleted from the original AIA text.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

This document is intended to be used in conjunction with AIA Document A201®–2017, General Conditions of the Contract for Construction. Article 11 of A201®–2017 contains additional insurance provisions.

ELECTRONIC COPYING of any portion of this AIA® Document to another electronic file is prohibited and constitutes a violation of copyright laws as set forth in the footer of this document.

AIA Document A101 – 2017 Exhibit A. Copyright © 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:37:18 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fd)

general liability insurance.

§ A.2.3 Required Property Insurance

§ A.2.3.1 Unless this obligation is placed on the Contractor pursuant to Section A.3.3.2.1, the Owner shall purchase and maintain, from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located, property insurance written on a builder's risk "all-risks" completed value or equivalent policy form and sufficient to cover the total value of the entire Project on a replacement cost basis. The Owner's property insurance coverage shall be no less than the amount of the initial Contract Sum, plus the value of subsequent Modifications and labor performed and materials or equipment supplied by others. The property insurance shall be maintained until Substantial Completion and thereafter as provided in Section A.2.3.1.3, unless otherwise provided in the Contract Documents or otherwise agreed in writing by the parties to this Agreement. This insurance shall include the interests of the Owner, Contractor, Subcontractors, and Sub-subcontractors in the Project as insureds. This insurance shall include the interests of mortgagees as loss payees.

§ A.2.3.1.1 Causes of Loss. The insurance required by this Section A.2.3.1 shall provide coverage for direct physical loss or damage, and shall not exclude the risks of fire, explosion, theft, vandalism, malicious mischief, collapse, earthquake, flood, or windstorm. The insurance shall also provide coverage for ensuing loss or resulting damage from error, omission, or deficiency in construction methods, design, specifications, workmanship, or materials. Sub-limits, if any, are as follows:
(Indicate below the cause of loss and any applicable sub-limit.)

Causes of Loss	Sub-Limit

§ A.2.3.1.2 Specific Required Coverages. The insurance required by this Section A.2.3.1 shall provide coverage for loss or damage to falsework and other temporary structures, and to building systems from testing and startup. The insurance shall also cover debris removal, including demolition occasioned by enforcement of any applicable legal requirements, and reasonable compensation for the Architect's and Contractor's services and expenses required as a result of such insured loss, including claim preparation expenses. Sub-limits, if any, are as follows:
(Indicate below type of coverage and any applicable sub-limit for specific required coverages.)

Coverage	Sub-Limit

§ A.2.3.1.3 Unless the parties agree otherwise, upon Substantial Completion, the Owner shall continue the insurance required by Section A.2.3.1 or, if necessary, replace the insurance policy required under Section A.2.3.1 with property insurance written for the total value of the Project that shall remain in effect until expiration of the period for correction of the Work set forth in Section 12.2.2 of the General Conditions.

§ A.2.3.1.4 Deductibles and Self-Insured Retentions. If the insurance required by this Section A.2.3 is subject to deductibles or self-insured retentions, the Owner shall be responsible for all loss not covered because of such deductibles or retentions.

§ A.2.3.2 Occupancy or Use Prior to Substantial Completion. The Owner's occupancy or use of any completed or partially completed portion of the Work prior to Substantial Completion shall not commence until the insurance company or companies providing the insurance under Section A.2.3.1 have consented in writing to the continuance of coverage. The Owner and the Contractor shall take no action with respect to partial occupancy or use that would cause cancellation, lapse, or reduction of insurance, unless they agree otherwise in writing.

§ A.2.3.3 Insurance for Existing Structures

If the Work involves remodeling an existing structure or constructing an addition to an existing structure, the Owner shall purchase and maintain, until the expiration of the period for correction of Work as set forth in Section 12.2.2 of the General Conditions, "all-risks" property insurance, on a replacement cost basis, protecting the existing structure against direct physical loss or damage from the causes of loss identified in Section A.2.3.1, notwithstanding the undertaking of the Work. The Owner shall be responsible for all co-insurance penalties.

§ A.2.4 Optional Extended Property Insurance.

The Owner shall purchase and maintain the insurance selected and described below.

AIA Document A101 – 2017 Exhibit A. Copyright © 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:37:18 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fd)

(Select the types of insurance the Owner is required to purchase and maintain by placing an X in the box(es) next to the description(s) of selected insurance. For each type of insurance selected, indicate applicable limits of coverage or other conditions in the fill point below the selected item.)

[ ] **§ A.2.4.1 Loss of Use, Business Interruption, and Delay in Completion Insurance**, to reimburse the Owner for loss of use of the Owner's property, or the inability to conduct normal operations due to a covered cause of loss.

[ ] **§ A.2.4.2 Ordinance or Law Insurance**, for the reasonable and necessary costs to satisfy the minimum requirements of the enforcement of any law or ordinance regulating the demolition, construction, repair, replacement or use of the Project.

[ ] **§ A.2.4.3 Expediting Cost Insurance**, for the reasonable and necessary costs for the temporary repair of damage to insured property, and to expedite the permanent repair or replacement of the damaged property.

[ ] **§ A.2.4.4 Extra Expense Insurance**, to provide reimbursement of the reasonable and necessary excess costs incurred during the period of restoration or repair of the damaged property that are over and above the total costs that would normally have been incurred during the same period of time had no loss or damage occurred.

[ ] **§ A.2.4.5 Civil Authority Insurance**, for losses or costs arising from an order of a civil authority prohibiting access to the Project, provided such order is the direct result of physical damage covered under the required property insurance.

[ ] **§ A.2.4.6 Ingress/Egress Insurance**, for loss due to the necessary interruption of the insured's business due to physical prevention of ingress to, or egress from, the Project as a direct result of physical damage.

[ ] **§ A.2.4.7 Soft Costs Insurance**, to reimburse the Owner for costs due to the delay of completion of the Work, arising out of physical loss or damage covered by the required property insurance: including construction loan fees; leasing and marketing expenses; additional fees, including those of architects, engineers, consultants, attorneys and accountants, needed for the completion of the construction, repairs, or reconstruction; and carrying costs such as property taxes, building permits, additional interest on loans, realty taxes, and insurance premiums over and above normal expenses.

§ A.2.5 Other Optional Insurance.

The Owner shall purchase and maintain the insurance selected below.

(Select the types of insurance the Owner is required to purchase and maintain by placing an X in the box(es) next to the description(s) of selected insurance.)

[ ] **§ A.2.5.1 Cyber Security Insurance** for loss to the Owner due to data security and privacy breach, including costs of investigating a potential or actual breach of confidential or private information.

AIA Document A101 – 2017 Exhibit A. Copyright © 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:37:18 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fd)

(Indicate applicable limits of coverage or other conditions in the fill point below.)

[ ] **§ A.2.5.2 Other Insurance**

(List below any other insurance coverage to be provided by the Owner and any applicable limits.)

Coverage	Limits

ARTICLE A.3 CONTRACTOR'S INSURANCE AND BONDS

§ A.3.1 General

§ A.3.1.1 Certificates of Insurance. The Contractor shall provide certificates of insurance acceptable to the Owner evidencing compliance with the requirements in this Article A.3 at the following times: (1) prior to commencement of the Work; (2) upon renewal or replacement of each required policy of insurance; and (3) upon the Owner's written request. An additional certificate evidencing continuation of commercial liability coverage, including coverage for completed operations, shall be submitted with the final Application for Payment and thereafter upon renewal or replacement of such coverage until the expiration of the periods required by Section A.3.2.1 and Section A.3.3.1. The certificates will show the Owner as an additional insured on the Contractor's Commercial General Liability and excess or umbrella liability policy or policies.

§ A.3.1.2 Deductibles and Self-Insured Retentions. The Contractor shall disclose to the Owner any deductible or self- insured retentions applicable to any insurance required to be provided by the Contractor.

§ A.3.1.3 Additional Insured Obligations. To the fullest extent permitted by law, the Contractor shall cause the commercial general liability coverage to include (1) the Owner, the Architect, and the Architect's consultants as additional insureds for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's operations; and (2) the Owner as an additional insured for claims caused in whole or in part by the Contractor's negligent acts or omissions for which loss occurs during completed operations. The additional insured coverage shall be primary and non-contributory to any of the Owner's general liability insurance policies and shall apply to both ongoing and completed operations. To the extent commercially available, the additional insured coverage shall be no less than that provided by Insurance Services Office, Inc. (ISO) forms CG 20 10 07 04, CG 20 37 07 04, and, with respect to the Architect and the Architect's consultants, CG 20 32 07 04.

§ A.3.2 Contractor's Required Insurance Coverage

§ A.3.2.1 The Contractor shall purchase and maintain the following types and limits of insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Contractor shall maintain the required insurance until the expiration of the period for correction of Work as set forth in Section 12.2.2 of the General Conditions, unless a different duration is stated below:

(If the Contractor is required to maintain insurance for a duration other than the expiration of the period for correction of Work, state the duration.)

§ A.3.2.2 Commercial General Liability

§ A.3.2.2.1 Commercial General Liability insurance for the Project written on an occurrence form with policy limits of not less than ($) each occurrence, ($) general aggregate, and ($) aggregate for products-completed operations hazard, providing coverage for claims including

.1 damages because of bodily injury, sickness or disease, including occupational sickness or disease, and death of any person;

.2 personal injury and advertising injury;

.3 damages because of physical damage to or destruction of tangible property, including the loss of use of such property;

.4 bodily injury or property damage arising out of completed operations; and

.5 the Contractor's indemnity obligations under Section 3.18 of the General Conditions.

AIA Document A101 – 2017 Exhibit A. Copyright © 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:37:18 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fd)

§ A.3.2.2.2 The Contractor's Commercial General Liability policy under this Section A.3.2.2 shall not contain an exclusion or restriction of coverage for the following:

.1 Claims by one insured against another insured, if the exclusion or restriction is based solely on the fact that the claimant is an insured, and there would otherwise be coverage for the claim.

.2 Claims for property damage to the Contractor's Work arising out of the products-completed operations hazard where the damaged Work or the Work out of which the damage arises was performed by a Subcontractor.

.3 Claims for bodily injury other than to employees of the insured.

.4 Claims for indemnity under Section 3.18 of the General Conditions arising out of injury to employees of the insured.

.5 Claims or loss excluded under a prior work endorsement or other similar exclusionary language.

.6 Claims or loss due to physical damage under a prior injury endorsement or similar exclusionary language.

.7 Claims related to residential, multi-family, or other habitational projects, if the Work is to be performed on such a project.

.8 Claims related to roofing, if the Work involves roofing.

.9 Claims related to exterior insulation finish systems (EIFS), synthetic stucco or similar exterior coatings or surfaces, if the Work involves such coatings or surfaces.

.10 Claims related to earth subsidence or movement, where the Work involves such hazards.

.11 Claims related to explosion, collapse and underground hazards, where the Work involves such hazards.

§ A.3.2.3 Automobile Liability covering vehicles owned, and non-owned vehicles used, by the Contractor, with policy limits of not less than ($) per accident, for bodily injury, death of any person, and property damage arising out of the ownership, maintenance and use of those motor vehicles along with any other statutorily required automobile coverage.

§ A.3.2.4 The Contractor may achieve the required limits and coverage for Commercial General Liability and Automobile Liability through a combination of primary and excess or umbrella liability insurance, provided such primary and excess or umbrella insurance policies result in the same or greater coverage as the coverages required under Section A.3.2.2 and A.3.2.3, and in no event shall any excess or umbrella liability insurance provide narrower coverage than the primary policy. The excess policy shall not require the exhaustion of the underlying limits only through the actual payment by the underlying insurers.

§ A.3.2.5 Workers' Compensation at statutory limits.

§ A.3.2.6 Employers' Liability with policy limits not less than ($) each accident, ($) each employee, and ($) policy limit.

§ A.3.2.7 Jones Act, and the Longshore & Harbor Workers' Compensation Act, as required, if the Work involves hazards arising from work on or near navigable waterways, including vessels and docks

§ A.3.2.8 If the Contractor is required to furnish professional services as part of the Work, the Contractor shall procure Professional Liability insurance covering performance of the professional services, with policy limits of not less than ($) per claim and ($) in the aggregate.

§ A.3.2.9 If the Work involves the transport, dissemination, use, or release of pollutants, the Contractor shall procure Pollution Liability insurance, with policy limits of not less than ($) per claim and ($) in the aggregate.

§ A.3.2.10 Coverage under Sections A.3.2.8 and A.3.2.9 may be procured through a Combined Professional Liability and Pollution Liability insurance policy, with combined policy limits of not less than ($) per claim and ($) in the aggregate.

§ A.3.2.11 Insurance for maritime liability risks associated with the operation of a vessel, if the Work requires such activities, with policy limits of not less than ($) per claim and ($) in the aggregate.

§ A.3.2.12 Insurance for the use or operation of manned or unmanned aircraft, if the Work requires such activities, with policy limits of not less than ($) per claim and ($) in the aggregate.

AIA Document A101 – 2017 Exhibit A. Copyright © 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:37:18 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fd)

§ A.3.3 Contractor's Other Insurance Coverage

§ A.3.3.1 Insurance selected and described in this Section A.3.3 shall be purchased from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Contractor shall maintain the required insurance until the expiration of the period for correction of Work as set forth in Section 12.2.2 of the General Conditions, unless a different duration is stated below:

(If the Contractor is required to maintain any of the types of insurance selected below for a duration other than the expiration of the period for correction of Work, state the duration.)

§ A.3.3.2 The Contractor shall purchase and maintain the following types and limits of insurance in accordance with Section A.3.3.1.

(Select the types of insurance the Contractor is required to purchase and maintain by placing an X in the box(es) next to the description(s) of selected insurance. Where policy limits are provided, include the policy limit in the appropriate fill point.)

[ ] **§ A.3.3.2.1** Property insurance of the same type and scope satisfying the requirements identified in Section A.2.3, which, if selected in this section A.3.3.2.1, relieves the Owner of the responsibility to purchase and maintain such insurance except insurance required by Section A.2.3.1.3 and Section A.2.3.3. The Contractor shall comply with all obligations of the Owner under Section A.2.3 except to the extent provided below. The Contractor shall disclose to the Owner the amount of any deductible, and the Owner shall be responsible for losses within the deductible. Upon request, the Contractor shall provide the Owner with a copy of the property insurance policy or policies required. The Owner shall adjust and settle the loss with the insurer and be the trustee of the proceeds of the property insurance in accordance with Article 11 of the General Conditions unless otherwise set forth below:

(Where the Contractor's obligation to provide property insurance differs from the Owner's obligations as described under Section A.2.3, indicate such differences in the space below. Additionally, if a party other than the Owner will be responsible for adjusting and settling a loss with the insurer and acting as the trustee of the proceeds of property insurance in accordance with Article 11 of the General Conditions, indicate the responsible party below.)

[ ] **§ A.3.3.2.2 Railroad Protective Liability Insurance**, with policy limits of not less than ($) per claim and ($) in the aggregate, for Work within fifty (50) feet of railroad property.

[ ] **§ A.3.3.2.3 Asbestos Abatement Liability Insurance**, with policy limits of not less than ($) per claim and ($) in the aggregate, for liability arising from the encapsulation, removal, handling, storage, transportation, and disposal of asbestos-containing materials.

[ ] **§ A.3.3.2.4** Insurance for physical damage to property while it is in storage and in transit to the construction site on an "all-risks" completed value form.

[ ] **§ A.3.3.2.5** Property insurance on an "all-risks" completed value form, covering property owned by the Contractor and used on the Project, including scaffolding and other equipment.

[ ] **§ A.3.3.2.6 Other Insurance**

(List below any other insurance coverage to be provided by the Contractor and any applicable limits.)

Coverage	Limits

§ A.3.4 Performance Bond and Payment Bond

The Contractor shall provide surety bonds, from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located, as follows:

AIA Document A101 – 2017 Exhibit A. Copyright © 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:37:18 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fd)

(Specify type and penal sum of bonds.)

Type	Penal Sum ($0.00)
Payment Bond	
Performance Bond	

Payment and Performance Bonds shall be AIA Document A312™, Payment Bond and Performance Bond, or contain provisions identical to AIA Document A312™, current as of the date of this Agreement.

ARTICLE A.4 SPECIAL TERMS AND CONDITIONS

Special terms and conditions that modify this Insurance and Bonds Exhibit, if any, are as follows:

DRAFT

AIA Document A101 – 2017 Exhibit A. Copyright © 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:37:18 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fd)

1.1 BOND FORMS

A. Bond Forms for the Project are:
   1. AIA Document A312™-2010 Payment Bond.
   2. AIA Document A312™-2010 Performance Bond.

B. The Successful Bidder shall obtain the form, complete and submit with the draft Agreement to the Owner for review.

C. Copies of AIA standard forms may be obtained from:
   1. American Institute of Architects, Charlotte, NC: 704.377.3610.

END OF DOCUMENT 00 61 00

1.1 GENERAL CONDITIONS

A. General Conditions for the Project are AIA Document A201-2017 General Conditions of the Contract for Construction.

B. The above document is hereby incorporated into this Project Manual by reference.

END OF DOCUMENT 00 72 00

AIA® Document A201® – 2017

General Conditions of the Contract for Construction

for the following PROJECT:
(Name and location or address)

THE OWNER:
(Name, legal status and address)

THE ARCHITECT:
(Name, legal status and address)

TABLE OF ARTICLES

1 GENERAL PROVISIONS

2 OWNER

3 CONTRACTOR

4 ARCHITECT

5 SUBCONTRACTORS

6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

7 CHANGES IN THE WORK

8 TIME

9 PAYMENTS AND COMPLETION

10 PROTECTION OF PERSONS AND PROPERTY

11 INSURANCE AND BONDS

12 UNCOVERING AND CORRECTION OF WORK

13 MISCELLANEOUS PROVISIONS

ADDITIONS AND DELETIONS:
The author of this document may have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes revisions to the standard form text is available from the author and should be reviewed. A vertical line in the left margin of this document indicates where the author has added to or deleted from the original AIA text.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

For guidance in modifying this document to include supplementary conditions, see AIA Document A503™–2017, Guide for Supplementary Conditions.

ELECTRONIC COPYING of any portion of this AIA® Document to another electronic file is prohibited and constitutes a violation of copyright laws as set forth in the footer of this document.

AIA Document A201 – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:39:20 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fa)

14 TERMINATION OR SUSPENSION OF THE CONTRACT

15 CLAIMS AND DISPUTES

DRAFT

AIA Document A201 – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:39:20 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fa)

INDEX
(Topics and numbers in bold are Section headings.)

Acceptance of Nonconforming Work
9.6.6, 9.9.3, **12.3**
Acceptance of Work
9.6.6, 9.8.2, 9.9.3, 9.10.1, 9.10.3, 12.3
Access to Work
3.16, 6.2.1, 12.1
Accident Prevention
10
Acts and Omissions
3.2, 3.3.2, 3.12.8, 3.18, 4.2.3, 8.3.1, 9.5.1, 10.2.5, 10.2.8, 13.3.2, 14.1, 15.1.2, 15.2
Addenda
1.1.1
Additional Costs, Claims for
3.7.4, 3.7.5, 10.3.2, 15.1.5
Additional Inspections and Testing
9.4.2, 9.8.3, 12.2.1, **13.4**
Additional Time, Claims for
3.2.4, 3.7.4, 3.7.5, 3.10.2, 8.3.2, **15.1.6**
Administration of the Contract
3.1.3, **4.2**, 9.4, 9.5
Advertisement or Invitation to Bid
1.1.1
Aesthetic Effect
4.2.13
Allowances
3.8
Applications for Payment
4.2.5, 7.3.9, 9.2, **9.3**, 9.4, 9.5.1, 9.5.4, 9.6.3, 9.7, 9.10
Approvals
2.1.1, 2.3.1, 2.5, 3.1.3, 3.10.2, 3.12.8, 3.12.9, 3.12.10.1, 4.2.7, 9.3.2, 13.4.1
Arbitration
8.3.1, 15.3.2, **15.4**
ARCHITECT
4
Architect, Definition of
4.1.1
Architect, Extent of Authority
2.5, 3.12.7, 4.1.2, 4.2, 5.2, 6.3, 7.1.2, 7.3.4, 7.4, 9.2, 9.3.1, 9.4, 9.5, 9.6.3, 9.8, 9.10.1, 9.10.3, 12.1, 12.2.1, 13.4.1, 13.4.2, 14.2.2, 14.2.4, 15.1.4, 15.2.1
Architect, Limitations of Authority and Responsibility
2.1.1, 3.12.4, 3.12.8, 3.12.10, 4.1.2, 4.2.1, 4.2.2, 4.2.3, 4.2.6, 4.2.7, 4.2.10, 4.2.12, 4.2.13, 5.2.1, 7.4, 9.4.2, 9.5.4, 9.6.4, 15.1.4, 15.2
Architect's Additional Services and Expenses
2.5, 12.2.1, 13.4.2, 13.4.3, 14.2.4
Architect's Administration of the Contract
3.1.3, 3.7.4, 15.2, 9.4.1, 9.5
Architect's Approvals
2.5, 3.1.3, 3.5, 3.10.2, 4.2.7

AIA Document A201 – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:39:20 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fa)

Architect's Authority to Reject Work
3.5, 4.2.6, 12.1.2, 12.2.1
Architect's Copyright
1.1.7, 1.5
Architect's Decisions
3.7.4, 4.2.6, 4.2.7, 4.2.11, 4.2.12, 4.2.13, 4.2.14, 6.3, 7.3.4, 7.3.9, 8.1.3, 8.3.1, 9.2, 9.4.1, 9.5, 9.8.4, 9.9.1, 13.4.2, 15.2
Architect's Inspections
3.7.4, 4.2.2, 4.2.9, 9.4.2, 9.8.3, 9.9.2, 9.10.1, 13.4
Architect's Instructions
3.2.4, 3.3.1, 4.2.6, 4.2.7, 13.4.2
Architect's Interpretations
4.2.11, 4.2.12
Architect's Project Representative
4.2.10
Architect's Relationship with Contractor
1.1.2, 1.5, 2.3.3, 3.1.3, 3.2.2, 3.2.3, 3.2.4, 3.3.1, 3.4.2, 3.5, 3.7.4, 3.7.5, 3.9.2, 3.9.3, 3.10, 3.11, 3.12, 3.16, 3.18, 4.1.2, 4.2, 5.2, 6.2.2, 7, 8.3.1, 9.2, 9.3, 9.4, 9.5, 9.7, 9.8, 9.9, 10.2.6, 10.3, 11.3, 12, 13.3.2, 13.4, 15.2
Architect's Relationship with Subcontractors
1.1.2, 4.2.3, 4.2.4, 4.2.6, 9.6.3, 9.6.4, 11.3
Architect's Representations
9.4.2, 9.5.1, 9.10.1
Architect's Site Visits
3.7.4, 4.2.2, 4.2.9, 9.4.2, 9.5.1, 9.9.2, 9.10.1, 13.4
Asbestos
10.3.1
Attorneys' Fees
3.18.1, 9.6.8, 9.10.2, 10.3.3
Award of Separate Contracts
6.1.1, 6.1.2
Award of Subcontracts and Other Contracts for Portions of the Work
5.2
Basic Definitions
1.1
Bidding Requirements
1.1.1
Binding Dispute Resolution
8.3.1, 9.7, 11.5, 13.1, 15.1.2, 15.1.3, 15.2.1, 15.2.5, 15.2.6.1, 15.3.1, 15.3.2, 15.3.3, 15.4.1
Bonds, Lien
7.3.4.4, 9.6.8, 9.10.2, 9.10.3
Bonds, Performance, and Payment
7.3.4.4, 9.6.7, 9.10.3, **11.1.2**, 11.1.3, **11.5**
Building Information Models Use and Reliance
1.8
Building Permit
3.7.1
Capitalization
1.3
Certificate of Substantial Completion
9.8.3, 9.8.4, 9.8.5
Certificates for Payment
4.2.1, 4.2.5, 4.2.9, 9.3.3, **9.4**, 9.5, 9.6.1, 9.6.6, 9.7, 9.10.1, 9.10.3, 14.1.1.3, 14.2.4, 15.1.4
Certificates of Inspection, Testing or Approval
13.4.4

DRAFT

AIA Document A201 – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:39:20 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fa)

Certificates of Insurance
9.10.2
Change Orders
1.1.1, 3.4.2, 3.7.4, 3.8.2.3, 3.11, 3.12.8, 4.2.8, 5.2.3, 7.1.2, 7.1.3, **7.2**, 7.3.2, 7.3.7, 7.3.9, 7.3.10, 8.3.1, 9.3.1.1, 9.10.3, 10.3.2, 11.2, 11.5, 12.1.2
Change Orders, Definition of
7.2.1
CHANGES IN THE WORK
2.2.2, 3.11, 4.2.8, **7**, 7.2.1, 7.3.1, 7.4, 8.3.1, 9.3.1.1, 11.5
Claims, Definition of
15.1.1
Claims, Notice of
1.6.2, 15.1.3
CLAIMS AND DISPUTES
3.2.4, 6.1.1, 6.3, 7.3.9, 9.3.3, 9.10.4, 10.3.3, **15**, 15.4
Claims and Timely Assertion of Claims
15.4.1
Claims for Additional Cost
3.2.4, 3.3.1, 3.7.4, 7.3.9, 9.5.2, 10.2.5, 10.3.2, **15.1.5**
Claims for Additional Time
3.2.4, 3.3.1, 3.7.4, 6.1.1, 8.3.2, 9.5.2, 10.3.2, **15.1.6**
Concealed or Unknown Conditions, Claims for
3.7.4
Claims for Damages
3.2.4, 3.18, 8.3.3, 9.5.1, 9.6.7, 10.2.5, 10.3.3, 11.3, 11.3.2, 14.2.4, 15.1.7
Claims Subject to Arbitration
15.4.1
Cleaning Up
3.15, 6.3
Commencement of the Work, Conditions Relating to
2.2.1, 3.2.2, 3.4.1, 3.7.1, 3.10.1, 3.12.6, 5.2.1, 5.2.3, 6.2.2, 8.1.2, 8.2.2, 8.3.1, 11.1, 11.2, **15.1.5**
Commencement of the Work, Definition of
8.1.2
Communications
3.9.1, **4.2.4**
Completion, Conditions Relating to
3.4.1, 3.11, 3.15, 4.2.2, 4.2.9, 8.2, 9.4.2, 9.8, 9.9.1, 9.10, 12.2, 14.1.2, 15.1.2
COMPLETION, PAYMENTS AND
9
Completion, Substantial
3.10.1, 4.2.9, 8.1.1, 8.1.3, 8.2.3, 9.4.2, 9.8, 9.9.1, 9.10.3, 12.2, 15.1.2
Compliance with Laws
2.3.2, 3.2.3, 3.6, 3.7, 3.12.10, 3.13, 9.6.4, 10.2.2, 13.1, 13.3, 13.4.1, 13.4.2, 13.5, 14.1.1, 14.2.1.3, 15.2.8, 15.4.2, 15.4.3
Concealed or Unknown Conditions
3.7.4, 4.2.8, 8.3.1, 10.3
Conditions of the Contract
1.1.1, 6.1.1, 6.1.4
Consent, Written
3.4.2, 3.14.2, 4.1.2, 9.8.5, 9.9.1, 9.10.2, 9.10.3, 13.2, 15.4.4.2
Consolidation or Joinder
15.4.4
CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS
1.1.4, **6**

AIA Document A201 – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:39:20 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fa)

Construction Change Directive, Definition of
7.3.1
Construction Change Directives
1.1.1, 3.4.2, 3.11, 3.12.8, 4.2.8, 7.1.1, 7.1.2, 7.1.3, **7.3**, 9.3.1.1
Construction Schedules, Contractor's
3.10, 3.11, 3.12.1, 3.12.2, 6.1.3, 15.1.6.2
Contingent Assignment of Subcontracts
5.4, 14.2.2.2
Continuing Contract Performance
15.1.4
Contract, Definition of
1.1.2
CONTRACT, TERMINATION OR SUSPENSION OF THE
5.4.1.1, 5.4.2, 11.5, **14**
Contract Administration
3.1.3, 4, 9.4, 9.5
Contract Award and Execution, Conditions Relating to
3.7.1, 3.10, 5.2, 6.1
Contract Documents, Copies Furnished and Use of
1.5.2, 2.3.6, 5.3
Contract Documents, Definition of
1.1.1
Contract Sum
2.2.2, 2.2.4, 3.7.4, 3.7.5, 3.8, 3.10.2, 5.2.3, 7.3, 7.4, **9.1**, 9.2, 9.4.2, 9.5.1.4, 9.6.7, 9.7, 10.3.2, 11.5, 12.1.2, 12.3, 14.2.4, 14.3.2, 15.1.4.2, **15.1.5, 15.2.5**
Contract Sum, Definition of
9.1
Contract Time
1.1.4, 2.2.1, 2.2.2, 3.7.4, 3.7.5, 3.10.2, 5.2.3, 6.1.5, 7.2.1.3, 7.3.1, 7.3.5, 7.3.6, 7, 7, 7.3.10, 7.4, 8.1.1, 8.2.1, 8.2.3, 8.3.1, 9.5.1, 9.7, 10.3.2, 12.1.1, 12.1.2, 14.3.2, 15.1.4.2, 15.1.6.1, 15.2.5
Contract Time, Definition of
8.1.1
CONTRACTOR
3
Contractor, Definition of
3.1, 6.1.2
Contractor's Construction and Submittal Schedules
3.10, 3.12.1, 3.12.2, 4.2.3, 6.1.3, 15.1.6.2
Contractor's Employees
2.2.4, 3.3.2, 3.4.3, 3.8.1, 3.9, 3.18.2, 4.2.3, 4.2.6, 10.2, 10.3, 11.3, 14.1, 14.2.1.1
Contractor's Liability Insurance
11.1
Contractor's Relationship with Separate Contractors and Owner's Forces
3.12.5, 3.14.2, 4.2.4, 6, 11.3, 12.2.4
Contractor's Relationship with Subcontractors
1.2.2, 2.2.4, 3.3.2, 3.18.1, 3.18.2, 4.2.4, 5, 9.6.2, 9.6.7, 9.10.2, 11.2, 11.3, 11.4
Contractor's Relationship with the Architect
1.1.2, 1.5, 2.3.3, 3.1.3, 3.2.2, 3.2.3, 3.2.4, 3.3.1, 3.4.2, 3.5.1, 3.7.4, 3.10, 3.11, 3.12, 3.16, 3.18, 4.2, 5.2, 6.2.2, 7, 8.3.1, 9.2, 9.3, 9.4, 9.5, 9.7, 9.8, 9.9, 10.2.6, 10.3, 11.3, 12, 13.4, 15.1.3, 15.2.1
Contractor's Representations
3.2.1, 3.2.2, 3.5, 3.12.6, 6.2.2, 8.2.1, 9.3.3, 9.8.2
Contractor's Responsibility for Those Performing the Work
3.3.2, 3.18, 5.3, 6.1.3, 6.2, 9.5.1, 10.2.8

DRAFT

AIA Document A201 – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:39:20 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fa)

Contractor's Review of Contract Documents
3.2
Contractor's Right to Stop the Work
2.2.2, 9.7
Contractor's Right to Terminate the Contract
14.1
Contractor's Submittals
3.10, 3.11, 3.12, 4.2.7, 5.2.1, 5.2.3, 9.2, 9.3, 9.8.2, 9.8.3, 9.9.1, 9.10.2, 9.10.3
Contractor's Superintendent
3.9, 10.2.6
Contractor's Supervision and Construction Procedures
1.2.2, 3.3, 3.4, 3.12.10, 4.2.2, 4.2.7, 6.1.3, 6.2.4, 7.1.3, 7.3.4, 7.3.6, 8.2, 10, 12, 14, 15.1.4
Coordination and Correlation
1.2, 3.2.1, 3.3.1, 3.10, 3.12.6, 6.1.3, 6.2.1
Copies Furnished of Drawings and Specifications
1.5, 2.3.6, 3.11
Copyrights
1.5, **3.17**
Correction of Work
2.5, 3.7.3, 9.4.2, 9.8.2, 9.8.3, 9.9.1, 12.1.2, **12.2**, 12.3, 15.1.3.1, 15.1.3.2, 15.2.1
Correlation and Intent of the Contract Documents
1.2
Cost, Definition of
7.3.4
Costs
2.5, 3.2.4, 3.7.3, 3.8.2, 3.15.2, 5.4.2, 6.1.1, 6.2.3, 7.3.3.3, 7.3.4, 7.3.8, 7.3.9, 9.10.2, 10.3.2, 10.3.6, 11.2, 12.1.2, 12.2.1, 12.2.4, 13.4, 14
Cutting and Patching
3.14, 6.2.5
Damage to Construction of Owner or Separate Contractors
3.14.2, 6.2.4, 10.2.1.2, 10.2.5, 10.4, 12.2.4
Damage to the Work
3.14.2, 9.9.1, 10.2.1.2, 10.2.5, 10.4, 12.2.4
Damages, Claims for
3.2.4, 3.18, 6.1.1, 8.3.3, 9.5.1, 9.6.7, 10.3.3, 11.3.2, 11.3, 14.2.4, 15.1.7
Damages for Delay
6.2.3, 8.3.3, 9.5.1.6, 9.7, 10.3.2, 14.3.2
Date of Commencement of the Work, Definition of
8.1.2
Date of Substantial Completion, Definition of
8.1.3
Day, Definition of
8.1.4
Decisions of the Architect
3.7.4, 4.2.6, 4.2.7, 4.2.11, 4.2.12, 4.2.13, 6.3, 7.3.4, 7.3.9, 8.1.3, 8.3.1, 9.2, 9.4, 9.5.1, 9.8.4, 9.9.1, 13.4.2, 14.2.2, 14.2.4, 15.1, 15.2
Decisions to Withhold Certification
9.4.1, **9.5**, 9.7, 14.1.1.3
Defective or Nonconforming Work, Acceptance, Rejection and Correction of
2.5, 3.5, 4.2.6, 6.2.3, 9.5.1, 9.5.3, 9.6.6, 9.8.2, 9.9.3, 9.10.4, 12.2.1
Definitions
1.1, 2.1.1, 3.1.1, 3.5, 3.12.1, 3.12.2, 3.12.3, 4.1.1, 5.1, 6.1.2, 7.2.1, 7.3.1, 8.1, 9.1, 9.8.1, 15.1.1

DRAFT

AIA Document A201 – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:39:20 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fa)

Delays and Extensions of Time
3.2, **3.7.4**, 5.2.3, 7.2.1, 7.3.1, **7.4**, **8.3**, 9.5.1, **9.7**, 10.3.2, **10.4**, 14.3.2, **15.1.6**, 15.2.5
Digital Data Use and Transmission
1.7
Disputes
6.3, 7.3.9, 15.1, 15.2
Documents and Samples at the Site
3.11
Drawings, Definition of
1.1.5
Drawings and Specifications, Use and Ownership of
3.11
Effective Date of Insurance
8.2.2
Emergencies
10.4, 14.1.1.2, **15.1.5**
Employees, Contractor's
3.3.2, 3.4.3, 3.8.1, 3.9, 3.18.2, 4.2.3, 4.2.6, 10.2, 10.3.3, 11.3, 14.1, 14.2.1.1
Equipment, Labor, or Materials
1.1.3, 1.1.6, 3.4, 3.5, 3.8.2, 3.8.3, 3.12, 3.13, 3.15.1, 4.2.6, 4.2.7, 5.2.1, 6.2.1, 7.3.4, 9.3.2, 9.3.3, 9.5.1.3, 9.10.2, 10.2.1, 10.2.4, 14.2.1.1, 14.2.1.2
Execution and Progress of the Work
1.1.3, 1.2.1, 1.2.2, 2.3.4, 2.3.6, 3.1, 3.3.1, 3.4.1, 3.7.1, 3.10.1, 3.12, 3.14, 4.2, 6.2.2, 7.1.3, 7.3.6, 8.2, 9.5.1, 9.9.1, 10.2, 10.3, 12.1, 12.2, 14.2, 14.3.1, 15.1.4
Extensions of Time
3.2.4, 3.7.4, 5.2.3, 7.2.1, 7.3, 7.4, 9.5.1, 9.7, 10.3.2, 10.4, 14.3, 15.1.6, **15.2.5**
Failure of Payment
9.5.1.3, **9.7**, 9.10.2, 13.5, 14.1.1.3, 14.2.1.2
Faulty Work
(See Defective or Nonconforming Work)
Final Completion and Final Payment
4.2.1, 4.2.9, 9.8.2, **9.10**, 12.3, 14.2.4, 14.4.3
Financial Arrangements, Owner's
2.2.1, 13.2.2, 14.1.1.4
GENERAL PROVISIONS
1
Governing Law
13.1
Guarantees (See Warranty)
Hazardous Materials and Substances
10.2.4, **10.3**
Identification of Subcontractors and Suppliers
5.2.1
Indemnification
3.17, **3.18**, 9.6.8, 9.10.2, 10.3.3, 11.3
Information and Services Required of the Owner
2.1.2, **2.2**, 2.3, 3.2.2, 3.12.10.1, 6.1.3, 6.1.4, 6.2.5, 9.6.1, 9.9.2, 9.10.3, 10.3.3, 11.2, 13.4.1, 13.4.2, 14.1.1.4, 14.1.4, 15.1.4
Initial Decision
15.2
Initial Decision Maker, Definition of
1.1.8
Initial Decision Maker, Decisions
14.2.4, 15.1.4.2, 15.2.1, 15.2.2, 15.2.3, 15.2.4, 15.2.5

DRAFT

AIA Document A201 – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:39:20 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fa)

Initial Decision Maker, Extent of Authority
14.2.4, 15.1.4.2, 15.2.1, 15.2.2, 15.2.3, 15.2.4, 15.2.5
Injury or Damage to Person or Property
10.2.8, 10.4
Inspections
3.1.3, 3.3.3, 3.7.1, 4.2.2, 4.2.6, 4.2.9, 9.4.2, 9.8.3, 9.9.2, 9.10.1, 12.2.1, 13.4
Instructions to Bidders
1.1.1
Instructions to the Contractor
3.2.4, 3.3.1, 3.8.1, 5.2.1, 7, 8.2.2, 12, 13.4.2
Instruments of Service, Definition of
1.1.7
Insurance
6.1.1, 7.3.4, 8.2.2, 9.3.2, 9.8.4, 9.9.1, 9.10.2, 10.2.5, **11**
Insurance, Notice of Cancellation or Expiration
11.1.4, 11.2.3
Insurance, Contractor's Liability
11.1
Insurance, Effective Date of
8.2.2, 14.4.2
Insurance, Owner's Liability
11.2
Insurance, Property
10.2.5, 11.2, 11.4, 11.5
Insurance, Stored Materials
9.3.2
INSURANCE AND BONDS
11
Insurance Companies, Consent to Partial Occupancy
9.9.1
Insured loss, Adjustment and Settlement of
11.5
Intent of the Contract Documents
1.2.1, 4.2.7, 4.2.12, 4.2.13
Interest
13.5
Interpretation
1.1.8, 1.2.3, **1.4**, 4.1.1, 5.1, 6.1.2, 15.1.1
Interpretations, Written
4.2.11, 4.2.12
Judgment on Final Award
15.4.2
Labor and Materials, Equipment
1.1.3, 1.1.6, **3.4**, 3.5, 3.8.2, 3.8.3, 3.12, 3.13, 3.15.1, 5.2.1, 6.2.1, 7.3.4, 9.3.2, 9.3.3, 9.5.1.3, 9.10.2, 10.2.1, 10.2.4, 14.2.1.1, 14.2.1.2
Labor Disputes
8.3.1
Laws and Regulations
1.5, 2.3.2, 3.2.3, 3.2.4, 3.6, 3.7, 3.12.10, 3.13, 9.6.4, 9.9.1, 10.2.2, 13.1, 13.3.1, 13.4.2, 13.5, 14, 15.2.8, 15.4
Liens
2.1.2, 9.3.1, 9.3.3, 9.6.8, 9.10.2, 9.10.4, 15.2.8
Limitations, Statutes of
12.2.5, 15.1.2, 15.4.1.1

DRAFT

AIA Document A201 – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:39:20 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fa)

Limitations of Liability
3.2.2, 3.5, 3.12.10, 3.12.10.1, 3.17, 3.18.1, 4.2.6, 4.2.7, 6.2.2, 9.4.2, 9.6.4, 9.6.7, 9.6.8, 10.2.5, 10.3.3, 11.3, 12.2.5, 13.3.1
Limitations of Time
2.1.2, 2.2, 2.5, 3.2.2, 3.10, 3.11, 3.12.5, 3.15.1, 4.2.7, 5.2, 5.3, 5.4.1, 6.2.4, 7.3, 7.4, 8.2, 9.2, 9.3.1, 9.3.3, 9.4.1, 9.5, 9.6, 9.7, 9.8, 9.9, 9.10, 12.2, 13.4, 14, 15, 15.1.2, 15.1.3, 15.1.5
Materials, Hazardous
10.2.4, **10.3**
Materials, Labor, Equipment and
1.1.3, 1.1.6, 3.4.1, 3.5, 3.8.2, 3.8.3, 3.12, 3.13, 3.15.1, 5.2.1, 6.2.1, 7.3.4, 9.3.2, 9.3.3, 9.5.1.3, 9.10.2, 10.2.1.2, 10.2.4, 14.2.1.1, 14.2.1.2
Means, Methods, Techniques, Sequences and Procedures of Construction
3.3.1, 3.12.10, 4.2.2, 4.2.7, 9.4.2
Mechanic's Lien
2.1.2, 9.3.1, 9.3.3, 9.6.8, 9.10.2, 9.10.4, 15.2.8
Mediation
8.3.1, 15.1.3.2, 15.2.1, 15.2.5, 15.2.6, **15.3**, 15.4.1, 15.4.1.1
Minor Changes in the Work
1.1.1, 3.4.2, 3.12.8, 4.2.8, 7.1, **7.4**
MISCELLANEOUS PROVISIONS
13
Modifications, Definition of
1.1.1
Modifications to the Contract
1.1.1, 1.1.2, 2.5, 3.11, 4.1.2, 4.2.1, 5.2.3, 7, 8.3.1, 9.7, 10.3.2
Mutual Responsibility
6.2
Nonconforming Work, Acceptance of
9.6.6, 9.9.3, **12.3**
Nonconforming Work, Rejection and Correction of
2.4, 2.5, 3.5, 4.2.6, 6.2.4, 9.5.1, 9.8.2, 9.9.3, 9.10.4, 12.2
Notice
1.6, 1.6.1, 1.6.2, 2.1.2, 2.2.2., 2.2.3, 2.2.4, 2.5, 3.2.4, 3.3.1, 3.7.4, 3.7.5, 3.9.2, 3.12.9, 3.12.10, 5.2.1, 7.4, 8.2.2 9.6.8, 9.7, 9.10.1, 10.2.8, 10.3.2, 11.5, 12.2.2.1, 13.4.1, 13.4.2, 14.1, 14.2.2, 14.4.2, 15.1.3, 15.1.5, 15.1.6, 15.4.1
Notice of Cancellation or Expiration of Insurance
11.1.4, 11.2.3
Notice of Claims
1.6.2, 2.1.2, 3.7.4, 9.6.8, 10.2.8, **15.1.3**, 15.1.5, 15.1.6, 15.2.8, 15.3.2, 15.4.1
Notice of Testing and Inspections
13.4.1, 13.4.2
Observations, Contractor's
3.2, 3.7.4
Occupancy
2.3.1, 9.6.6, 9.8
Orders, Written
1.1.1, 2.4, 3.9.2, 7, 8.2.2, 11.5, 12.1, 12.2.2.1, 13.4.2, 14.3.1
OWNER
2
Owner, Definition of
2.1.1
Owner, Evidence of Financial Arrangements
2.2, 13.2.2, 14.1.1.4
Owner, Information and Services Required of the
2.1.2, **2.2**, 2.3, 3.2.2, 3.12.10, 6.1.3, 6.1.4, 6.2.5, 9.3.2, 9.6.1, 9.6.4, 9.9.2, 9.10.3, 10.3.3, 11.2, 13.4.1, 13.4.2, 14.1.1.4, 14.1.4,

AIA Document A201 – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:39:20 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fa)

15.1.4
Owner's Authority
1.5, 2.1.1, 2.3.32.4, 2.5, 3.4.2, 3.8.1, 3.12.10, 3.14.2, 4.1.2, 4.2.4, 4.2.9, 5.2.1, 5.2.4, 5.4.1, 6.1, 6.3, 7.2.1, 7.3.1, 8.2.2, 8.3.1, 9.3.2, 9.5.1, 9.6.4, 9.9.1, 9.10.2, 10.3.2, 11.4, 11.5, 12.2.2, 12.3, 13.2.2, 14.3, 14.4, 15.2.7
Owner's Insurance
11.2
Owner's Relationship with Subcontractors
1.1.2, 5.2, 5.3, 5.4, 9.6.4, 9.10.2, 14.2.2
Owner's Right to Carry Out the Work
2.5, 14.2.2
Owner's Right to Clean Up
6.3
Owner's Right to Perform Construction and to Award Separate Contracts
6.1
Owner's Right to Stop the Work
2.4
Owner's Right to Suspend the Work
14.3
Owner's Right to Terminate the Contract
14.2, 14.4
Ownership and Use of Drawings, Specifications and Other Instruments of Service
1.1.1, 1.1.6, 1.1.7, **1.5**, 2.3.6, 3.2.2, 3.11, 3.17, 4.2.12, 5.3
Partial Occupancy or Use
9.6.6, **9.9**
Patching, Cutting and
3.14, 6.2.5
Patents
3.17
Payment, Applications for
4.2.5, 7.3.9, 9.2, **9.3**, 9.4, 9.5, 9.6.3, 9.7, 9.8.5, 9.10.1, 14.2.3, 14.2.4, 14.4.3
Payment, Certificates for
4.2.5, 4.2.9, 9.3.3, **9.4**, 9.5, 9.6.1, 9.6.6, 9.7, 9.10.1, 9.10.3, 14.1.1.3, 14.2.4
Payment, Failure of
9.5.1.3, **9.7**, 9.10.2, 13.5, 14.1.1.3, 14.2.1.2
Payment, Final
4.2.1, 4.2.9, **9.10**, 12.3, 14.2.4, 14.4.3
Payment Bond, Performance Bond and
7.3.4.4, 9.6.7, 9.10.3, **11.1.2**
Payments, Progress
9.3, **9.6**, 9.8.5, 9.10.3, 14.2.3, 15.1.4
PAYMENTS AND COMPLETION
9
Payments to Subcontractors
5.4.2, 9.5.1.3, 9.6.2, 9.6.3, 9.6.4, 9.6.7, 14.2.1.2
PCB
10.3.1
Performance Bond and Payment Bond
7.3.4.4, 9.6.7, 9.10.3, **11.1.2**
Permits, Fees, Notices and Compliance with Laws
2.3.1, **3.7**, 3.13, 7.3.4.4, 10.2.2
PERSONS AND PROPERTY, PROTECTION OF
10

DRAFT

AIA Document A201 – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:39:20 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fa)

Polychlorinated Biphenyl
10.3.1
Product Data, Definition of
3.12.2
Product Data and Samples, Shop Drawings
3.11, **3.12**, 4.2.7
Progress and Completion
4.2.2, **8.2**, 9.8, 9.9.1, 14.1.4, 15.1.4
Progress Payments
9.3, **9.6**, 9.8.5, 9.10.3, 14.2.3, 15.1.4
Project, Definition of
1.1.4
Project Representatives
4.2.10
Property Insurance
10.2.5, **11.2**
Proposal Requirements
1.1.1
PROTECTION OF PERSONS AND PROPERTY
10
Regulations and Laws
1.5, 2.3.2, 3.2.3, 3.6, 3.7, 3.12.10, 3.13, 9.6.4, 9.9.1, 10.2.2, 13.1, 13.3, 13.4.1, 13.4.2, 13.5, 14, 15.2.8, 15.4
Rejection of Work
4.2.6, 12.2.1
Releases and Waivers of Liens
9.3.1, 9.10.2
Representations
3.2.1, 3.5, 3.12.6, 8.2.1, 9.3.3, 9.4.2, 9.5.1, 9.10.1
Representatives
2.1.1, 3.1.1, 3.9, 4.1.1, 4.2.10, 13.2.1
Responsibility for Those Performing the Work
3.3.2, 3.18, 4.2.2, 4.2.3, 5.3, 6.1.3, 6.2, 6.3, 9.5.1, 10
Retainage
9.3.1, 9.6.2, 9.8.5, 9.9.1, 9.10.2, 9.10.3
Review of Contract Documents and Field Conditions by Contractor
3.2, 3.12.7, 6.1.3
Review of Contractor's Submittals by Owner and Architect
3.10.1, 3.10.2, 3.11, 3.12, 4.2, 5.2, 6.1.3, 9.2, 9.8.2
Review of Shop Drawings, Product Data and Samples by Contractor
3.12
Rights and Remedies
1.1.2, 2.4, 2.5, 3.5, 3.7.4, 3.15.2, 4.2.6, 5.3, 5.4, 6.1, 6.3, 7.3.1, 8.3, 9.5.1, 9.7, 10.2.5, 10.3, 12.2.1, 12.2.2, 12.2.4, **13.3**, 14, 15.4
Royalties, Patents and Copyrights
3.17
Rules and Notices for Arbitration
15.4.1
Safety of Persons and Property
10.2, 10.4
Safety Precautions and Programs
3.3.1, 4.2.2, 4.2.7, 5.3, **10.1**, 10.2, 10.4
Samples, Definition of
3.12.3

DRAFT

AIA Document A201 – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:39:20 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fa)

Samples, Shop Drawings, Product Data and
3.11, **3.12**, 4.2.7
Samples at the Site, Documents and
3.11
Schedule of Values
9.2, 9.3.1
Schedules, Construction
3.10, 3.12.1, 3.12.2, 6.1.3, 15.1.6.2
Separate Contracts and Contractors
1.1.4, 3.12.5, 3.14.2, 4.2.4, 4.2.7, 6, 8.3.1, 12.1.2
Separate Contractors, Definition of
6.1.1
Shop Drawings, Definition of
3.12.1
Shop Drawings, Product Data and Samples
3.11, **3.12**, 4.2.7
Site, Use of
3.13, 6.1.1, 6.2.1
Site Inspections
3.2.2, 3.3.3, 3.7.1, 3.7.4, 4.2, 9.9.2, 9.4.2, 9.10.1, 13.4
Site Visits, Architect's
3.7.4, 4.2.2, 4.2.9, 9.4.2, 9.5.1, 9.9.2, 9.10.1, 13.4
Special Inspections and Testing
4.2.6, 12.2.1, 13.4
Specifications, Definition of
1.1.6
Specifications
1.1.1, **1.1.6**, 1.2.2, 1.5, 3.12.10, 3.17, 4.2.14
Statute of Limitations
15.1.2, 15.4.1.1
Stopping the Work
2.2.2, 2.4, 9.7, 10.3, 14.1
Stored Materials
6.2.1, 9.3.2, 10.2.1.2, 10.2.4
Subcontractor, Definition of
5.1.1
SUBCONTRACTORS
5
Subcontractors, Work by
1.2.2, 3.3.2, 3.12.1, 3.18, 4.2.3, 5.2.3, 5.3, 5.4, 9.3.1.2, 9.6.7
Subcontractual Relations
5.3, 5.4, 9.3.1.2, 9.6, 9.10, 10.2.1, 14.1, 14.2.1
Submittals
3.10, 3.11, 3.12, 4.2.7, 5.2.1, 5.2.3, 7.3.4, 9.2, 9.3, 9.8, 9.9.1, 9.10.2, 9.10.3
Submittal Schedule
3.10.2, 3.12.5, 4.2.7
Subrogation, Waivers of
6.1.1, **11.3**
Substances, Hazardous
10.3
Substantial Completion
4.2.9, 8.1.1, 8.1.3, 8.2.3, 9.4.2, **9.8**, 9.9.1, 9.10.3, 12.2, 15.1.2

DRAFT

AIA Document A201 – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:39:20 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fa)

Substantial Completion, Definition of
9.8.1
Substitution of Subcontractors
5.2.3, 5.2.4
Substitution of Architect
2.3.3
Substitutions of Materials
3.4.2, 3.5, 7.3.8
Sub-subcontractor, Definition of
5.1.2
Subsurface Conditions
3.7.4
Successors and Assigns
13.2
Superintendent
3.9, 10.2.6
Supervision and Construction Procedures
1.2.2, **3.3**, 3.4, 3.12.10, 4.2.2, 4.2.7, 6.1.3, 6.2.4, 7.1.3, 7.3.4, 8.2, 8.3.1, 9.4.2, 10, 12, 14, 15.1.4
Suppliers
1.5, 3.12.1, 4.2.4, 4.2.6, 5.2.1, 9.3, 9.4.2, 9.5.4, 9.6, 9.10.5, 14.2.1
Surety
5.4.1.2, 9.6.8, 9.8.5, 9.10.2, 9.10.3, 11.1.2, 14.2.2, 15.2.7
Surety, Consent of
9.8.5, 9.10.2, 9.10.3
Surveys
1.1.7, 2.3.4
Suspension by the Owner for Convenience
14.3
Suspension of the Work
3.7.5, 5.4.2, 14.3
Suspension or Termination of the Contract
5.4.1.1, 14
Taxes
3.6, 3.8.2.1, 7.3.4.4
Termination by the Contractor
14.1, 15.1.7
Termination by the Owner for Cause
5.4.1.1, **14.2,** 15.1.7
Termination by the Owner for Convenience
14.4
Termination of the Architect
2.3.3
Termination of the Contractor Employment
14.2.2

TERMINATION OR SUSPENSION OF THE CONTRACT
14
Tests and Inspections
3.1.3, 3.3.3, 3.7.1, 4.2.2, 4.2.6, 4.2.9, 9.4.2, 9.8.3, 9.9.2, 9.10.1, 10.3.2, 12.2.1, **13.4**
TIME
8
Time, Delays and Extensions of
3.2.4, 3.7.4, 5.2.3, 7.2.1, 7.3.1, 7.4, **8.3**, 9.5.1, 9.7, 10.3.2, 10.4, 14.3.2, 15.1.6, 15.2.5

DRAFT

AIA Document A201 – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:39:20 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fa)

Time Limits
2.1.2, 2.2, 2.5, 3.2.2, 3.10, 3.11, 3.12.5, 3.15.1, 4.2, 5.2, 5.3, 5.4, 6.2.4, 7.3, 7.4, 8.2, 9.2, 9.3.1, 9.3.3, 9.4.1, 9.5, 9.6, 9.7, 9.8, 9.9, 9.10, 12.2, 13.4, 14, 15.1.2, 15.1.3, 15.4
Time Limits on Claims
3.7.4, 10.2.8, 15.1.2, 15.1.3
Title to Work
9.3.2, 9.3.3
UNCOVERING AND CORRECTION OF WORK
12
Uncovering of Work
12.1
Unforeseen Conditions, Concealed or Unknown
3.7.4, 8.3.1, 10.3
Unit Prices
7.3.3.2, 9.1.2
Use of Documents
1.1.1, 1.5, 2.3.6, 3.12.6, 5.3
Use of Site
3.13, 6.1.1, 6.2.1
Values, Schedule of
9.2, 9.3.1
Waiver of Claims by the Architect
13.3.2
Waiver of Claims by the Contractor
9.10.5, 13.3.2, **15.1.7**
Waiver of Claims by the Owner
9.9.3, 9.10.3, 9.10.4, 12.2.2.1, 13.3.2, 14.2.4, **15.1.7**
Waiver of Consequential Damages
14.2.4, 15.1.7
Waiver of Liens
9.3, 9.10.2, 9.10.4
Waivers of Subrogation
6.1.1, **11.3**
Warranty
3.5, 4.2.9, 9.3.3, 9.8.4, 9.9.1, 9.10.2, 9.10.4, 12.2.2, 15.1.2
Weather Delays
8.3, 15.1.6.2
Work, Definition of
1.1.3
Written Consent
1.5.2, 3.4.2, 3.7.4, 3.12.8, 3.14.2, 4.1.2, 9.3.2, 9.10.3, 13.2, 13.3.2, 15.4.4.2
Written Interpretations
4.2.11, 4.2.12
Written Orders
1.1.1, 2.4, 3.9, 7, 8.2.2, 12.1, 12.2, 13.4.2, 14.3.1

DRAFT

AIA Document A201 – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017. All rights reserved. “The American Institute of Architects,” “American Institute of Architects,” “AIA,” the AIA Logo, and “AIA Contract Documents” are trademarks of The American Institute of Architects. This draft was produced at 15:39:20 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fa)

ARTICLE 1 GENERAL PROVISIONS

§ 1.1 Basic Definitions

§ 1.1.1 The Contract Documents

The Contract Documents are enumerated in the Agreement between the Owner and Contractor (hereinafter the Agreement) and consist of the Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of the Contract, other documents listed in the Agreement, and Modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a Construction Change Directive, or (4) a written order for a minor change in the Work issued by the Architect. Unless specifically enumerated in the Agreement, the Contract Documents do not include the advertisement or invitation to bid, Instructions to Bidders, sample forms, other information furnished by the Owner in anticipation of receiving bids or proposals, the Contractor's bid or proposal, or portions of Addenda relating to bidding or proposal requirements.

§ 1.1.2 The Contract

The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. The Contract may be amended or modified only by a Modification. The Contract Documents shall not be construed to create a contractual relationship of any kind (1) between the Contractor and the Architect or the Architect's consultants, (2) between the Owner and a Subcontractor or a Sub-subcontractor, (3) between the Owner and the Architect or the Architect's consultants, or (4) between any persons or entities other than the Owner and the Contractor. The Architect shall, however, be entitled to performance and enforcement of obligations under the Contract intended to facilitate performance of the Architect's duties.

§ 1.1.3 The Work

The term "Work" means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment, and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The Work may constitute the whole or a part of the Project.

§ 1.1.4 The Project

The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by the Owner and by Separate Contractors.

§ 1.1.5 The Drawings

The Drawings are the graphic and pictorial portions of the Contract Documents showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules, and diagrams.

§ 1.1.6 The Specifications

The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, systems, standards and workmanship for the Work, and performance of related services.

§ 1.1.7 Instruments of Service

Instruments of Service are representations, in any medium of expression now known or later developed, of the tangible and intangible creative work performed by the Architect and the Architect's consultants under their respective professional services agreements. Instruments of Service may include, without limitation, studies, surveys, models, sketches, drawings, specifications, and other similar materials.

§ 1.1.8 Initial Decision Maker

The Initial Decision Maker is the person identified in the Agreement to render initial decisions on Claims in accordance with Section 15.2. The Initial Decision Maker shall not show partiality to the Owner or Contractor and shall not be liable for results of interpretations or decisions rendered in good faith.

§ 1.2 Correlation and Intent of the Contract Documents

§ 1.2.1 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all; performance by the Contractor shall be required only to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results.

AIA Document A201 – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:39:20 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fa)

§ 1.2.1.1 The invalidity of any provision of the Contract Documents shall not invalidate the Contract or its remaining provisions. If it is determined that any provision of the Contract Documents violates any law, or is otherwise invalid or unenforceable, then that provision shall be revised to the extent necessary to make that provision legal and enforceable. In such case the Contract Documents shall be construed, to the fullest extent permitted by law, to give effect to the parties' intentions and purposes in executing the Contract.

§ 1.2.2 Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade.

§ 1.2.3 Unless otherwise stated in the Contract Documents, words that have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

§ 1.3 Capitalization

Terms capitalized in these General Conditions include those that are (1) specifically defined, (2) the titles of numbered articles, or (3) the titles of other documents published by the American Institute of Architects.

§ 1.4 Interpretation

In the interest of brevity the Contract Documents frequently omit modifying words such as "all" and "any" and articles such as "the" and "an," but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

§ 1.5 Ownership and Use of Drawings, Specifications, and Other Instruments of Service

§ 1.5.1 The Architect and the Architect's consultants shall be deemed the authors and owners of their respective Instruments of Service, including the Drawings and Specifications, and retain all common law, statutory, and other reserved rights in their Instruments of Service, including copyrights. The Contractor, Subcontractors, Sub-subcontractors, and suppliers shall not own or claim a copyright in the Instruments of Service. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with the Project is not to be construed as publication in derogation of the Architect's or Architect's consultants' reserved rights.

§ 1.5.2 The Contractor, Subcontractors, Sub-subcontractors, and suppliers are authorized to use and reproduce the Instruments of Service provided to them, subject to any protocols established pursuant to Sections 1.7 and 1.8, solely and exclusively for execution of the Work. All copies made under this authorization shall bear the copyright notice, if any, shown on the Instruments of Service. The Contractor, Subcontractors, Sub-subcontractors, and suppliers may not use the Instruments of Service on other projects or for additions to the Project outside the scope of the Work without the specific written consent of the Owner, Architect, and the Architect's consultants.

§ 1.6 Notice

§ 1.6.1 Except as otherwise provided in Section 1.6.2, where the Contract Documents require one party to notify or give notice to the other party, such notice shall be provided in writing to the designated representative of the party to whom the notice is addressed and shall be deemed to have been duly served if delivered in person, by mail, by courier, or by electronic transmission if a method for electronic transmission is set forth in the Agreement.

§ 1.6.2 Notice of Claims as provided in Section 15.1.3 shall be provided in writing and shall be deemed to have been duly served only if delivered to the designated representative of the party to whom the notice is addressed by certified or registered mail, or by courier providing proof of delivery.

§ 1.7 Digital Data Use and Transmission

The parties shall agree upon written protocols governing the transmission and use of, and reliance on, Instruments of Service or any other information or documentation in digital form.

§ 1.8 Building Information Models Use and Reliance

Any use of, or reliance on, all or a portion of a building information model without agreement to written protocols governing the use of, and reliance on, the information contained in the model shall be at the using or relying party's sole risk and without liability to the other party and its contractors or consultants, the authors of, or contributors to, the building information model,

AIA Document A201 – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:39:20 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fa)

and each of their agents and employees.

ARTICLE 2 OWNER

§ 2.1 General

§ 2.1.1 The Owner is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Owner shall designate in writing a representative who shall have express authority to bind the Owner with respect to all matters requiring the Owner's approval or authorization. Except as otherwise provided in Section 4.2.1, the Architect does not have such authority. The term "Owner" means the Owner or the Owner's authorized representative.

§ 2.1.2 The Owner shall furnish to the Contractor, within fifteen days after receipt of a written request, information necessary and relevant for the Contractor to evaluate, give notice of, or enforce mechanic's lien rights. Such information shall include a correct statement of the record legal title to the property on which the Project is located, usually referred to as the site, and the Owner's interest therein.

§ 2.2 Evidence of the Owner's Financial Arrangements

§ 2.2.1 Prior to commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract. The Contractor shall have no obligation to commence the Work until the Owner provides such evidence. If commencement of the Work is delayed under this Section 2.2.1, the Contract Time shall be extended appropriately.

§ 2.2.2 Following commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract only if (1) the Owner fails to make payments to the Contractor as the Contract Documents require; (2) the Contractor identifies in writing a reasonable concern regarding the Owner's ability to make payment when due; or (3) a change in the Work materially changes the Contract Sum. If the Owner fails to provide such evidence, as required, within fourteen days of the Contractor's request, the Contractor may immediately stop the Work and, in that event, shall notify the Owner that the Work has stopped. However, if the request is made because a change in the Work materially changes the Contract Sum under (3) above, the Contractor may immediately stop only that portion of the Work affected by the change until reasonable evidence is provided. If the Work is stopped under this Section 2.2.2, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided in the Contract Documents.

§ 2.2.3 After the Owner furnishes evidence of financial arrangements under this Section 2.2, the Owner shall not materially vary such financial arrangements without prior notice to the Contractor.

§ 2.2.4 Where the Owner has designated information furnished under this Section 2.2 as "confidential," the Contractor shall keep the information confidential and shall not disclose it to any other person. However, the Contractor may disclose "confidential" information, after seven (7) days' notice to the Owner, where disclosure is required by law, including a subpoena or other form of compulsory legal process issued by a court or governmental entity, or by court or arbitrator(s) order. The Contractor may also disclose "confidential" information to its employees, consultants, sureties, Subcontractors and their employees, Sub-subcontractors, and others who need to know the content of such information solely and exclusively for the Project and who agree to maintain the confidentiality of such information.

§ 2.3 Information and Services Required of the Owner

§ 2.3.1 Except for permits and fees that are the responsibility of the Contractor under the Contract Documents, including those required under Section 3.7.1, the Owner shall secure and pay for necessary approvals, easements, assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities.

§ 2.3.2 The Owner shall retain an architect lawfully licensed to practice architecture, or an entity lawfully practicing architecture, in the jurisdiction where the Project is located. That person or entity is identified as the Architect in the Agreement and is referred to throughout the Contract Documents as if singular in number.

§ 2.3.3 If the employment of the Architect terminates, the Owner shall employ a successor to whom the Contractor has no reasonable objection and whose status under the Contract Documents shall be that of the Architect.

AIA Document A201 – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:39:20 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fa)

§ 2.3.4 The Owner shall furnish surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. The Contractor shall be entitled to rely on the accuracy of information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work.

§ 2.3.5 The Owner shall furnish information or services required of the Owner by the Contract Documents with reasonable promptness. The Owner shall also furnish any other information or services under the Owner's control and relevant to the Contractor's performance of the Work with reasonable promptness after receiving the Contractor's written request for such information or services.

§ 2.3.6 Unless otherwise provided in the Contract Documents, the Owner shall furnish to the Contractor one copy of the Contract Documents for purposes of making reproductions pursuant to Section 1.5.2.

§ 2.4 Owner's Right to Stop the Work

If the Contractor fails to correct Work that is not in accordance with the requirements of the Contract Documents as required by Section 12.2 or repeatedly fails to carry out Work in accordance with the Contract Documents, the Owner may issue a written order to the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity, except to the extent required by Section 6.1.3.

§ 2.5 Owner's Right to Carry Out the Work

If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a ten-day period after receipt of notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to other remedies the Owner may have, correct such default or neglect. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Architect and the Architect may, pursuant to Section 9.5.1, withhold or nullify a Certificate for Payment in whole or in part, to the extent reasonably necessary to reimburse the Owner for the reasonable cost of correcting such deficiencies, including Owner's expenses and compensation for the Architect's additional services made necessary by such default, neglect, or failure. If current and future payments are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner. If the Contractor disagrees with the actions of the Owner or the Architect, or the amounts claimed as costs to the Owner, the Contractor may file a Claim pursuant to Article 15.

ARTICLE 3 CONTRACTOR

§ 3.1 General

§ 3.1.1 The Contractor is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Contractor shall be lawfully licensed, if required in the jurisdiction where the Project is located. The Contractor shall designate in writing a representative who shall have express authority to bind the Contractor with respect to all matters under this Contract. The term "Contractor" means the Contractor or the Contractor's authorized representative.

§ 3.1.2 The Contractor shall perform the Work in accordance with the Contract Documents.

§ 3.1.3 The Contractor shall not be relieved of its obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Architect in the Architect's administration of the Contract, or by tests, inspections or approvals required or performed by persons or entities other than the Contractor.

§ 3.2 Review of Contract Documents and Field Conditions by Contractor

§ 3.2.1 Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become generally familiar with local conditions under which the Work is to be performed, and correlated personal observations with requirements of the Contract Documents.

§ 3.2.2 Because the Contract Documents are complementary, the Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as the information furnished by the Owner pursuant to Section 2.3.4, shall take field measurements of any existing conditions related to that portion of the Work, and shall observe any conditions at the site affecting it. These obligations are for the purpose of

AIA Document A201 – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:39:20 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fa)

facilitating coordination and construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents; however, the Contractor shall promptly report to the Architect any errors, inconsistencies or omissions discovered by or made known to the Contractor as a request for information in such form as the Architect may require. It is recognized that the Contractor's review is made in the Contractor's capacity as a contractor and not as a licensed design professional, unless otherwise specifically provided in the Contract Documents.

§ 3.2.3 The Contractor is not required to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, but the Contractor shall promptly report to the Architect any nonconformity discovered by or made known to the Contractor as a request for information in such form as the Architect may require.

§ 3.2.4 If the Contractor believes that additional cost or time is involved because of clarifications or instructions the Architect issues in response to the Contractor's notices or requests for information pursuant to Sections 3.2.2 or 3.2.3, the Contractor shall submit Claims as provided in Article 15. If the Contractor fails to perform the obligations of Sections 3.2.2 or 3.2.3, the Contractor shall pay such costs and damages to the Owner, subject to Section 15.1.7, as would have been avoided if the Contractor had performed such obligations. If the Contractor performs those obligations, the Contractor shall not be liable to the Owner or Architect for damages resulting from errors, inconsistencies or omissions in the Contract Documents, for differences between field measurements or conditions and the Contract Documents, or for nonconformities of the Contract Documents to applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities.

§ 3.3 Supervision and Construction Procedures

§ 3.3.1 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for, and have control over, construction means, methods, techniques, sequences, and procedures, and for coordinating all portions of the Work under the Contract. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences, or procedures, the Contractor shall evaluate the jobsite safety thereof and shall be solely responsible for the jobsite safety of such means, methods, techniques, sequences, or procedures. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely notice to the Owner and Architect, and shall propose alternative means, methods, techniques, sequences, or procedures. The Architect shall evaluate the proposed alternative solely for conformance with the design intent for the completed construction. Unless the Architect objects to the Contractor's proposed alternative, the Contractor shall perform the Work using its alternative means, methods, techniques, sequences, or procedures.

§ 3.3.2 The Contractor shall be responsible to the Owner for acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons or entities performing portions of the Work for, or on behalf of, the Contractor or any of its Subcontractors.

§ 3.3.3 The Contractor shall be responsible for inspection of portions of Work already performed to determine that such portions are in proper condition to receive subsequent Work.

§ 3.4 Labor and Materials

§ 3.4.1 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

§ 3.4.2 Except in the case of minor changes in the Work approved by the Architect in accordance with Section 3.12.8 or ordered by the Architect in accordance with Section 7.4, the Contractor may make substitutions only with the consent of the Owner, after evaluation by the Architect and in accordance with a Change Order or Construction Change Directive.

§ 3.4.3 The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Work. The Contractor shall not permit employment of unfit persons or persons not properly skilled in tasks assigned to them.

§ 3.5 Warranty

§ 3.5.1 The Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract will be

AIA Document A201 – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:39:20 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fa)

of good quality and new unless the Contract Documents require or permit otherwise. The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements may be considered defective. The Contractor's warranty excludes remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage. If required by the Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

§ 3.5.2 All material, equipment, or other special warranties required by the Contract Documents shall be issued in the name of the Owner, or shall be transferable to the Owner, and shall commence in accordance with Section 9.8.4.

§ 3.6 Taxes

The Contractor shall pay sales, consumer, use and similar taxes for the Work provided by the Contractor that are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect.

§ 3.7 Permits, Fees, Notices and Compliance with Laws

§ 3.7.1 Unless otherwise provided in the Contract Documents, the Contractor shall secure and pay for the building permit as well as for other permits, fees, licenses, and inspections by government agencies necessary for proper execution and completion of the Work that are customarily secured after execution of the Contract and legally required at the time bids are received or negotiations concluded.

§ 3.7.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities applicable to performance of the Work.

§ 3.7.3 If the Contractor performs Work knowing it to be contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction.

§ 3.7.4 Concealed or Unknown Conditions

If the Contractor encounters conditions at the site that are (1) subsurface or otherwise concealed physical conditions that differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature that differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, the Contractor shall promptly provide notice to the Owner and the Architect before conditions are disturbed and in no event later than 14 days after first observance of the conditions. The Architect will promptly investigate such conditions and, if the Architect determines that they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend that an equitable adjustment be made in the Contract Sum or Contract Time, or both. If the Architect determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect shall promptly notify the Owner and Contractor, stating the reasons. If either party disputes the Architect's determination or recommendation, that party may submit a Claim as provided in Article 15.

§ 3.7.5 If, in the course of the Work, the Contractor encounters human remains or recognizes the existence of burial markers, archaeological sites or wetlands not indicated in the Contract Documents, the Contractor shall immediately suspend any operations that would affect them and shall notify the Owner and Architect. Upon receipt of such notice, the Owner shall promptly take any action necessary to obtain governmental authorization required to resume the operations. The Contractor shall continue to suspend such operations until otherwise instructed by the Owner but shall continue with all other operations that do not affect those remains or features. Requests for adjustments in the Contract Sum and Contract Time arising from the existence of such remains or features may be made as provided in Article 15.

§ 3.8 Allowances

§ 3.8.1 The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct, but the Contractor shall not be required to employ persons or entities to whom the Contractor has reasonable objection.

§ 3.8.2 Unless otherwise provided in the Contract Documents,

AIA Document A201 – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:39:20 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fa)

.1 allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;

.2 Contractor's costs for unloading and handling at the site, labor, installation costs, overhead, profit, and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum but not in the allowances; and

.3 whenever costs are more than or less than allowances, the Contract Sum shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect (1) the difference between actual costs and the allowances under Section 3.8.2.1 and (2) changes in Contractor's costs under Section 3.8.2.2.

§ 3.8.3 Materials and equipment under an allowance shall be selected by the Owner with reasonable promptness.

§ 3.9 Superintendent

§ 3.9.1 The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work. The superintendent shall represent the Contractor, and communications given to the superintendent shall be as binding as if given to the Contractor.

§ 3.9.2 The Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the name and qualifications of a proposed superintendent. Within 14 days of receipt of the information, the Architect may notify the Contractor, stating whether the Owner or the Architect (1) has reasonable objection to the proposed superintendent or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

§ 3.9.3 The Contractor shall not employ a proposed superintendent to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not change the superintendent without the Owner's consent, which shall not unreasonably be withheld or delayed.

§ 3.10 Contractor's Construction and Submittal Schedules

§ 3.10.1 The Contractor, promptly after being awarded the Contract, shall submit for the Owner's and Architect's information a Contractor's construction schedule for the Work. The schedule shall contain detail appropriate for the Project, including (1) the date of commencement of the Work, interim schedule milestone dates, and the date of Substantial Completion; (2) an apportionment of the Work by construction activity; and (3) the time required for completion of each portion of the Work. The schedule shall provide for the orderly progression of the Work to completion and shall not exceed time limits current under the Contract Documents. The schedule shall be revised at appropriate intervals as required by the conditions of the Work and Project.

§ 3.10.2 The Contractor, promptly after being awarded the Contract and thereafter as necessary to maintain a current submittal schedule, shall submit a submittal schedule for the Architect's approval. The Architect's approval shall not be unreasonably delayed or withheld. The submittal schedule shall (1) be coordinated with the Contractor's construction schedule, and (2) allow the Architect reasonable time to review submittals. If the Contractor fails to submit a submittal schedule, or fails to provide submittals in accordance with the approved submittal schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

§ 3.10.3 The Contractor shall perform the Work in general accordance with the most recent schedules submitted to the Owner and Architect.

§ 3.11 Documents and Samples at the Site

The Contractor shall make available, at the Project site, the Contract Documents, including Change Orders, Construction Change Directives, and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and the approved Shop Drawings, Product Data, Samples, and similar required submittals. These shall be in electronic form or paper copy, available to the Architect and Owner, and delivered to the Architect for submittal to the Owner upon completion of the Work as a record of the Work as constructed.

§ 3.12 Shop Drawings, Product Data and Samples

§ 3.12.1 Shop Drawings are drawings, diagrams, schedules, and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier, or distributor to illustrate some portion of the Work.

AIA Document A201 – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:39:20 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fa)

§ 3.12.2 Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

§ 3.12.3 Samples are physical examples that illustrate materials, equipment, or workmanship, and establish standards by which the Work will be judged.

§ 3.12.4 Shop Drawings, Product Data, Samples, and similar submittals are not Contract Documents. Their purpose is to demonstrate how the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents for those portions of the Work for which the Contract Documents require submittals. Review by the Architect is subject to the limitations of Section 4.2.7. Informational submittals upon which the Architect is not expected to take responsive action may be so identified in the Contract Documents. Submittals that are not required by the Contract Documents may be returned by the Architect without action.

§ 3.12.5 The Contractor shall review for compliance with the Contract Documents, approve, and submit to the Architect, Shop Drawings, Product Data, Samples, and similar submittals required by the Contract Documents, in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Owner or of Separate Contractors.

§ 3.12.6 By submitting Shop Drawings, Product Data, Samples, and similar submittals, the Contractor represents to the Owner and Architect that the Contractor has (1) reviewed and approved them, (2) determined and verified materials, field measurements and field construction criteria related thereto, or will do so, and (3) checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

§ 3.12.7 The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples, or similar submittals, until the respective submittal has been approved by the Architect.

§ 3.12.8 The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from the requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples, or similar submittals, unless the Contractor has specifically notified the Architect of such deviation at the time of submittal and (1) the Architect has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples, or similar submittals, by the Architect's approval thereof.

§ 3.12.9 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples, or similar submittals, to revisions other than those requested by the Architect on previous submittals. In the absence of such notice, the Architect's approval of a resubmission shall not apply to such revisions.

§ 3.12.10 The Contractor shall not be required to provide professional services that constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences, and procedures. The Contractor shall not be required to provide professional services in violation of applicable law.

§ 3.12.10.1 If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Architect will specify all performance and design criteria that such services must satisfy. The Contractor shall be entitled to rely upon the adequacy and accuracy of the performance and design criteria provided in the Contract Documents. The Contractor shall cause such services or certifications to be provided by an appropriately licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings, and other submittals prepared by such professional. Shop Drawings, and other submittals related to the Work, designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to the Architect. The Owner and the Architect shall be entitled to rely upon the adequacy and accuracy of the services, certifications, and approvals performed or provided by such design professionals, provided the Owner and Architect have specified to the Contractor the performance and design criteria that such

AIA Document A201 – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:39:20 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fa)

services must satisfy. Pursuant to this Section 3.12.10, the Architect will review and approve or take other appropriate action on submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents.

§ 3.12.10.2 If the Contract Documents require the Contractor's design professional to certify that the Work has been performed in accordance with the design criteria, the Contractor shall furnish such certifications to the Architect at the time and in the form specified by the Architect.

§ 3.13 Use of Site

The Contractor shall confine operations at the site to areas permitted by applicable laws, statutes, ordinances, codes, rules and regulations, lawful orders of public authorities, and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

§ 3.14 Cutting and Patching

§ 3.14.1 The Contractor shall be responsible for cutting, fitting, or patching required to complete the Work or to make its parts fit together properly. All areas requiring cutting, fitting, or patching shall be restored to the condition existing prior to the cutting, fitting, or patching, unless otherwise required by the Contract Documents.

§ 3.14.2 The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or Separate Contractors by cutting, patching, or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter construction by the Owner or a Separate Contractor except with written consent of the Owner and of the Separate Contractor. Consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold, from the Owner or a Separate Contractor, its consent to cutting or otherwise altering the Work.

§ 3.15 Cleaning Up

§ 3.15.1 The Contractor shall keep the premises and surrounding area free from accumulation of waste materials and rubbish caused by operations under the Contract. At completion of the Work, the Contractor shall remove waste materials, rubbish, the Contractor's tools, construction equipment, machinery, and surplus materials from and about the Project.

§ 3.15.2 If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and the Owner shall be entitled to reimbursement from the Contractor.

§ 3.16 Access to Work

The Contractor shall provide the Owner and Architect with access to the Work in preparation and progress wherever located.

§ 3.17 Royalties, Patents and Copyrights

The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of copyrights and patent rights and shall hold the Owner and Architect harmless from loss on account thereof, but shall not be responsible for defense or loss when a particular design, process, or product of a particular manufacturer or manufacturers is required by the Contract Documents, or where the copyright violations are contained in Drawings, Specifications, or other documents prepared by the Owner or Architect. However, if an infringement of a copyright or patent is discovered by, or made known to, the Contractor, the Contractor shall be responsible for the loss unless the information is promptly furnished to the Architect.

§ 3.18 Indemnification

§ 3.18.1 To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), but only to the extent caused by the negligent acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss, or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity that would otherwise exist as to a party or person described in this Section 3.18.

AIA Document A201 – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:39:20 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fa)

§ 3.18.2 In claims against any person or entity indemnified under this Section 3.18 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, the indemnification obligation under Section 3.18.1 shall not be limited by a limitation on amount or type of damages, compensation, or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefit acts, or other employee benefit acts.

ARTICLE 4 ARCHITECT

§ 4.1 General

§ 4.1.1 The Architect is the person or entity retained by the Owner pursuant to Section 2.3.2 and identified as such in the Agreement.

§ 4.1.2 Duties, responsibilities, and limitations of authority of the Architect as set forth in the Contract Documents shall not be restricted, modified, or extended without written consent of the Owner, Contractor, and Architect. Consent shall not be unreasonably withheld.

§ 4.2 Administration of the Contract

§ 4.2.1 The Architect will provide administration of the Contract as described in the Contract Documents and will be an Owner's representative during construction until the date the Architect issues the final Certificate for Payment. The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents.

§ 4.2.2 The Architect will visit the site at intervals appropriate to the stage of construction, or as otherwise agreed with the Owner, to become generally familiar with the progress and quality of the portion of the Work completed, and to determine in general if the Work observed is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. However, the Architect will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The Architect will not have control over, charge of, or responsibility for the construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents.

§ 4.2.3 On the basis of the site visits, the Architect will keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and promptly report to the Owner (1) known deviations from the Contract Documents, (2) known deviations from the most recent construction schedule submitted by the Contractor, and (3) defects and deficiencies observed in the Work. The Architect will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect will not have control over or charge of, and will not be responsible for acts or omissions of, the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.

§ 4.2.4 Communications

The Owner and Contractor shall include the Architect in all communications that relate to or affect the Architect's services or professional responsibilities. The Owner shall promptly notify the Architect of the substance of any direct communications between the Owner and the Contractor otherwise relating to the Project. Communications by and with the Architect's consultants shall be through the Architect. Communications by and with Subcontractors and suppliers shall be through the Contractor. Communications by and with Separate Contractors shall be through the Owner. The Contract Documents may specify other communication protocols.

§ 4.2.5 Based on the Architect's evaluations of the Contractor's Applications for Payment, the Architect will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts.

§ 4.2.6 The Architect has authority to reject Work that does not conform to the Contract Documents. Whenever the Architect considers it necessary or advisable, the Architect will have authority to require inspection or testing of the Work in accordance with Sections 13.4.2 and 13.4.3, whether or not the Work is fabricated, installed or completed. However, neither this authority of the Architect nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect to the Contractor, Subcontractors, suppliers, their agents or employees, or other persons or entities performing portions of the Work.

AIA Document A201 – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:39:20 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fa)

§ 4.2.7 The Architect will review and approve, or take other appropriate action upon, the Contractor's submittals such as Shop Drawings, Product Data, and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Architect's action will be taken in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness while allowing sufficient time in the Architect's professional judgment to permit adequate review. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect's review of the Contractor's submittals shall not relieve the Contractor of the obligations under Sections 3.3, 3.5, and 3.12. The Architect's review shall not constitute approval of safety precautions or of any construction means, methods, techniques, sequences, or procedures. The Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

§ 4.2.8 The Architect will prepare Change Orders and Construction Change Directives, and may order minor changes in the Work as provided in Section 7.4. The Architect will investigate and make determinations and recommendations regarding concealed and unknown conditions as provided in Section 3.7.4.

§ 4.2.9 The Architect will conduct inspections to determine the date or dates of Substantial Completion and the date of final completion; issue Certificates of Substantial Completion pursuant to Section 9.8; receive and forward to the Owner, for the Owner's review and records, written warranties and related documents required by the Contract and assembled by the Contractor pursuant to Section 9.10; and issue a final Certificate for Payment pursuant to Section 9.10.

§ 4.2.10 If the Owner and Architect agree, the Architect will provide one or more Project representatives to assist in carrying out the Architect's responsibilities at the site. The Owner shall notify the Contractor of any change in the duties, responsibilities and limitations of authority of the Project representatives.

§ 4.2.11 The Architect will interpret and decide matters concerning performance under, and requirements of, the Contract Documents on written request of either the Owner or Contractor. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness.

§ 4.2.12 Interpretations and decisions of the Architect will be consistent with the intent of, and reasonably inferable from, the Contract Documents and will be in writing or in the form of drawings. When making such interpretations and decisions, the Architect will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either, and will not be liable for results of interpretations or decisions rendered in good faith.

§ 4.2.13 The Architect's decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents.

§ 4.2.14 The Architect will review and respond to requests for information about the Contract Documents. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness. If appropriate, the Architect will prepare and issue supplemental Drawings and Specifications in response to the requests for information.

ARTICLE 5 SUBCONTRACTORS

§ 5.1 Definitions

§ 5.1.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or an authorized representative of the Subcontractor. The term "Subcontractor" does not include a Separate Contractor or the subcontractors of a Separate Contractor.

§ 5.1.2 A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the Work at the site. The term "Sub-subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Sub-subcontractor or an authorized representative of the Sub-subcontractor.

§ 5.2 Award of Subcontracts and Other Contracts for Portions of the Work

§ 5.2.1 Unless otherwise stated in the Contract Documents, the Contractor, as soon as practicable after award of the Contract,

AIA Document A201 – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:39:20 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fa)

shall notify the Owner and Architect of the persons or entities proposed for each principal portion of the Work, including those who are to furnish materials or equipment fabricated to a special design. Within 14 days of receipt of the information, the Architect may notify the Contractor whether the Owner or the Architect (1) has reasonable objection to any such proposed person or entity or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

§ 5.2.2 The Contractor shall not contract with a proposed person or entity to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.

§ 5.2.3 If the Owner or Architect has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Architect has no reasonable objection. If the proposed but rejected Subcontractor was reasonably capable of performing the Work, the Contract Sum and Contract Time shall be increased or decreased by the difference, if any, occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute Subcontractor's Work. However, no increase in the Contract Sum or Contract Time shall be allowed for such change unless the Contractor has acted promptly and responsively in submitting names as required.

§ 5.2.4 The Contractor shall not substitute a Subcontractor, person, or entity for one previously selected if the Owner or Architect makes reasonable objection to such substitution.

§ 5.3 Subcontractual Relations

By appropriate written agreement, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor's Work that the Contractor, by these Contract Documents, assumes toward the Owner and Architect. Each subcontract agreement shall preserve and protect the rights of the Owner and Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies, and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound, and, upon written request of the Subcontractor, identify to the Subcontractor terms and conditions of the proposed subcontract agreement that may be at variance with the Contract Documents. Subcontractors will similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors.

§ 5.4 Contingent Assignment of Subcontracts

§ 5.4.1 Each subcontract agreement for a portion of the Work is assigned by the Contractor to the Owner, provided that

- **.1** assignment is effective only after termination of the Contract by the Owner for cause pursuant to Section 14.2 and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor; and
- **.2** assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

When the Owner accepts the assignment of a subcontract agreement, the Owner assumes the Contractor's rights and obligations under the subcontract.

§ 5.4.2 Upon such assignment, if the Work has been suspended for more than 30 days, the Subcontractor's compensation shall be equitably adjusted for increases in cost resulting from the suspension.

§ 5.4.3 Upon assignment to the Owner under this Section 5.4, the Owner may further assign the subcontract to a successor contractor or other entity. If the Owner assigns the subcontract to a successor contractor or other entity, the Owner shall nevertheless remain legally responsible for all of the successor contractor's obligations under the subcontract.

ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

§ 6.1 Owner's Right to Perform Construction and to Award Separate Contracts

§ 6.1.1 The term "Separate Contractor(s)" shall mean other contractors retained by the Owner under separate agreements. The

AIA Document A201 – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:39:20 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fa)

Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and with Separate Contractors retained under Conditions of the Contract substantially similar to those of this Contract, including those provisions of the Conditions of the Contract related to insurance and waiver of subrogation.

§ 6.1.2 When separate contracts are awarded for different portions of the Project or other construction or operations on the site, the term "Contractor" in the Contract Documents in each case shall mean the Contractor who executes each separate Owner-Contractor Agreement.

§ 6.1.3 The Owner shall provide for coordination of the activities of the Owner's own forces and of each Separate Contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with any Separate Contractors and the Owner in reviewing their construction schedules. The Contractor shall make any revisions to its construction schedule deemed necessary after a joint review and mutual agreement. The construction schedules shall then constitute the schedules to be used by the Contractor, Separate Contractors, and the Owner until subsequently revised.

§ 6.1.4 Unless otherwise provided in the Contract Documents, when the Owner performs construction or operations related to the Project with the Owner's own forces or with Separate Contractors, the Owner or its Separate Contractors shall have the same obligations and rights that the Contractor has under the Conditions of the Contract, including, without excluding others, those stated in Article 3, this Article 6, and Articles 10, 11, and 12.

§ 6.2 Mutual Responsibility

§ 6.2.1 The Contractor shall afford the Owner and Separate Contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities, and shall connect and coordinate the Contractor's construction and operations with theirs as required by the Contract Documents.

§ 6.2.2 If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner or a Separate Contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly notify the Architect of apparent discrepancies or defects in the construction or operations by the Owner or Separate Contractor that would render it unsuitable for proper execution and results of the Contractor's Work. Failure of the Contractor to notify the Architect of apparent discrepancies or defects prior to proceeding with the Work shall constitute an acknowledgment that the Owner's or Separate Contractor's completed or partially completed construction is fit and proper to receive the Contractor's Work. The Contractor shall not be responsible for discrepancies or defects in the construction or operations by the Owner or Separate Contractor that are not apparent.

§ 6.2.3 The Contractor shall reimburse the Owner for costs the Owner incurs that are payable to a Separate Contractor because of the Contractor's delays, improperly timed activities or defective construction. The Owner shall be responsible to the Contractor for costs the Contractor incurs because of a Separate Contractor's delays, improperly timed activities, damage to the Work or defective construction.

§ 6.2.4 The Contractor shall promptly remedy damage that the Contractor wrongfully causes to completed or partially completed construction or to property of the Owner or Separate Contractor as provided in Section 10.2.5.

§ 6.2.5 The Owner and each Separate Contractor shall have the same responsibilities for cutting and patching as are described for the Contractor in Section 3.14.

§ 6.3 Owner's Right to Clean Up

If a dispute arises among the Contractor, Separate Contractors, and the Owner as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste materials and rubbish, the Owner may clean up and the Architect will allocate the cost among those responsible.

ARTICLE 7 CHANGES IN THE WORK

§ 7.1 General

§ 7.1.1 Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive or order for a minor change in the Work, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents.

AIA Document A201 – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:39:20 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fa)

§ 7.1.2 A Change Order shall be based upon agreement among the Owner, Contractor, and Architect. A Construction Change Directive requires agreement by the Owner and Architect and may or may not be agreed to by the Contractor. An order for a minor change in the Work may be issued by the Architect alone.

§ 7.1.3 Changes in the Work shall be performed under applicable provisions of the Contract Documents. The Contractor shall proceed promptly with changes in the Work, unless otherwise provided in the Change Order, Construction Change Directive, or order for a minor change in the Work.

§ 7.2 Change Orders

§ 7.2.1 A Change Order is a written instrument prepared by the Architect and signed by the Owner, Contractor, and Architect stating their agreement upon all of the following:

- **.1** The change in the Work;
- **.2** The amount of the adjustment, if any, in the Contract Sum; and
- **.3** The extent of the adjustment, if any, in the Contract Time.

§ 7.3 Construction Change Directives

§ 7.3.1 A Construction Change Directive is a written order prepared by the Architect and signed by the Owner and Architect, directing a change in the Work prior to agreement on adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions, or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

§ 7.3.2 A Construction Change Directive shall be used in the absence of total agreement on the terms of a Change Order.

§ 7.3.3 If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:

- **.1** Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
- **.2** Unit prices stated in the Contract Documents or subsequently agreed upon;
- **.3** Cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or
- **.4** As provided in Section 7.3.4.

§ 7.3.4 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect shall determine the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount for overhead and profit as set forth in the Agreement, or if no such amount is set forth in the Agreement, a reasonable amount. In such case, and also under Section 7.3.3.3, the Contractor shall keep and present, in such form as the Architect may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.3.4 shall be limited to the following:

- **.1** Costs of labor, including applicable payroll taxes, fringe benefits required by agreement or custom, workers' compensation insurance, and other employee costs approved by the Architect;
- **.2** Costs of materials, supplies, and equipment, including cost of transportation, whether incorporated or consumed;
- **.3** Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;
- **.4** Costs of premiums for all bonds and insurance, permit fees, and sales, use, or similar taxes, directly related to the change; and
- **.5** Costs of supervision and field office personnel directly attributable to the change.

§ 7.3.5 If the Contractor disagrees with the adjustment in the Contract Time, the Contractor may make a Claim in accordance with applicable provisions of Article 15.

§ 7.3.6 Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Architect of the Contractor's agreement or disagreement with the method, if any, provided in the

AIA Document A201 – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:39:20 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fa)

Construction Change Directive for determining the proposed adjustment in the Contract Sum or Contract Time.

§ 7.3.7 A Construction Change Directive signed by the Contractor indicates the Contractor's agreement therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order.

§ 7.3.8 The amount of credit to be allowed by the Contractor to the Owner for a deletion or change that results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Architect. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change.

§ 7.3.9 Pending final determination of the total cost of a Construction Change Directive to the Owner, the Contractor may request payment for Work completed under the Construction Change Directive in Applications for Payment. The Architect will make an interim determination for purposes of monthly certification for payment for those costs and certify for payment the amount that the Architect determines, in the Architect's professional judgment, to be reasonably justified. The Architect's interim determination of cost shall adjust the Contract Sum on the same basis as a Change Order, subject to the right of either party to disagree and assert a Claim in accordance with Article 15.

§ 7.3.10 When the Owner and Contractor agree with a determination made by the Architect concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and the Architect will prepare a Change Order. Change Orders may be issued for all or any part of a Construction Change Directive.

§ 7.4 Minor Changes in the Work

The Architect may order minor changes in the Work that are consistent with the intent of the Contract Documents and do not involve an adjustment in the Contract Sum or an extension of the Contract Time. The Architect's order for minor changes shall be in writing. If the Contractor believes that the proposed minor change in the Work will affect the Contract Sum or Contract Time, the Contractor shall notify the Architect and shall not proceed to implement the change in the Work. If the Contractor performs the Work set forth in the Architect's order for a minor change without prior notice to the Architect that such change will affect the Contract Sum or Contract Time, the Contractor waives any adjustment to the Contract Sum or extension of the Contract Time.

ARTICLE 8 TIME

§ 8.1 Definitions

§ 8.1.1 Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.

§ 8.1.2 The date of commencement of the Work is the date established in the Agreement.

§ 8.1.3 The date of Substantial Completion is the date certified by the Architect in accordance with Section 9.8.

§ 8.1.4 The term "day" as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.

§ 8.2 Progress and Completion

§ 8.2.1 Time limits stated in the Contract Documents are of the essence of the Contract. By executing the Agreement, the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

§ 8.2.2 The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, commence the Work prior to the effective date of insurance required to be furnished by the Contractor and Owner.

§ 8.2.3 The Contractor shall proceed expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time.

AIA Document A201 – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:39:20 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fa)

§ 8.3 Delays and Extensions of Time

§ 8.3.1 If the Contractor is delayed at any time in the commencement or progress of the Work by (1) an act or neglect of the Owner or Architect, of an employee of either, or of a Separate Contractor; (2) by changes ordered in the Work; (3) by labor disputes, fire, unusual delay in deliveries, unavoidable casualties, adverse weather conditions documented in accordance with Section 15.1.6.2, or other causes beyond the Contractor's control; (4) by delay authorized by the Owner pending mediation and binding dispute resolution; or (5) by other causes that the Contractor asserts, and the Architect determines, justify delay, then the Contract Time shall be extended for such reasonable time as the Architect may determine.

§ 8.3.2 Claims relating to time shall be made in accordance with applicable provisions of Article 15.

§ 8.3.3 This Section 8.3 does not preclude recovery of damages for delay by either party under other provisions of the Contract Documents.

ARTICLE 9 PAYMENTS AND COMPLETION

§ 9.1 Contract Sum

§ 9.1.1 The Contract Sum is stated in the Agreement and, including authorized adjustments, is the total amount payable by the Owner to the Contractor for performance of the Work under the Contract Documents.

§ 9.1.2 If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are materially changed so that application of such unit prices to the actual quantities causes substantial inequity to the Owner or Contractor, the applicable unit prices shall be equitably adjusted.

§ 9.2 Schedule of Values

Where the Contract is based on a stipulated sum or Guaranteed Maximum Price, the Contractor shall submit a schedule of values to the Architect before the first Application for Payment, allocating the entire Contract Sum to the various portions of the Work. The schedule of values shall be prepared in the form, and supported by the data to substantiate its accuracy, required by the Architect. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment. Any changes to the schedule of values shall be submitted to the Architect and supported by such data to substantiate its accuracy as the Architect may require, and unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's subsequent Applications for Payment.

§ 9.3 Applications for Payment

§ 9.3.1 At least ten days before the date established for each progress payment, the Contractor shall submit to the Architect an itemized Application for Payment prepared in accordance with the schedule of values, if required under Section 9.2, for completed portions of the Work. The application shall be notarized, if required, and supported by all data substantiating the Contractor's right to payment that the Owner or Architect require, such as copies of requisitions, and releases and waivers of liens from Subcontractors and suppliers, and shall reflect retainage if provided for in the Contract Documents.

§ 9.3.1.1 As provided in Section 7.3.9, such applications may include requests for payment on account of changes in the Work that have been properly authorized by Construction Change Directives, or by interim determinations of the Architect, but not yet included in Change Orders.

§ 9.3.1.2 Applications for Payment shall not include requests for payment for portions of the Work for which the Contractor does not intend to pay a Subcontractor or supplier, unless such Work has been performed by others whom the Contractor intends to pay.

§ 9.3.2 Unless otherwise provided in the Contract Documents, payments shall be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the Owner, payment may similarly be made for materials and equipment suitably stored off the site at a location agreed upon in writing. Payment for materials and equipment stored on or off the site shall be conditioned upon compliance by the Contractor with procedures satisfactory to the Owner to establish the Owner's title to such materials and equipment or otherwise protect the Owner's interest, and shall include the costs of applicable insurance, storage, and transportation to the site, for such materials and equipment stored off the site.

§ 9.3.3 The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later

AIA Document A201 – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:39:20 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fa)

than the time of payment. The Contractor further warrants that upon submittal of an Application for Payment all Work for which Certificates for Payment have been previously issued and payments received from the Owner shall, to the best of the Contractor's knowledge, information, and belief, be free and clear of liens, claims, security interests, or encumbrances, in favor of the Contractor, Subcontractors, suppliers, or other persons or entities that provided labor, materials, and equipment relating to the Work.

§ 9.4 Certificates for Payment

§ 9.4.1 The Architect will, within seven days after receipt of the Contractor's Application for Payment, either (1) issue to the Owner a Certificate for Payment in the full amount of the Application for Payment, with a copy to the Contractor; or (2) issue to the Owner a Certificate for Payment for such amount as the Architect determines is properly due, and notify the Contractor and Owner of the Architect's reasons for withholding certification in part as provided in Section 9.5.1; or (3) withhold certification of the entire Application for Payment, and notify the Contractor and Owner of the Architect's reason for withholding certification in whole as provided in Section 9.5.1.

§ 9.4.2 The issuance of a Certificate for Payment will constitute a representation by the Architect to the Owner, based on the Architect's evaluation of the Work and the data in the Application for Payment, that, to the best of the Architect's knowledge, information, and belief, the Work has progressed to the point indicated, the quality of the Work is in accordance with the Contract Documents, and that the Contractor is entitled to payment in the amount certified. The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor deviations from the Contract Documents prior to completion, and to specific qualifications expressed by the Architect. However, the issuance of a Certificate for Payment will not be a representation that the Architect has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work; (2) reviewed construction means, methods, techniques, sequences, or procedures; (3) reviewed copies of requisitions received from Subcontractors and suppliers and other data requested by the Owner to substantiate the Contractor's right to payment; or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

§ 9.5 Decisions to Withhold Certification

§ 9.5.1 The Architect may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect's opinion the representations to the Owner required by Section 9.4.2 cannot be made. If the Architect is unable to certify payment in the amount of the Application, the Architect will notify the Contractor and Owner as provided in Section 9.4.1. If the Contractor and Architect cannot agree on a revised amount, the Architect will promptly issue a Certificate for Payment for the amount for which the Architect is able to make such representations to the Owner. The Architect may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment previously issued, to such extent as may be necessary in the Architect's opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from acts and omissions described in Section 3.3.2, because of

- **.1** defective Work not remedied;
- **.2** third party claims filed or reasonable evidence indicating probable filing of such claims, unless security acceptable to the Owner is provided by the Contractor;
- **.3** failure of the Contractor to make payments properly to Subcontractors or suppliers for labor, materials or equipment;
- **.4** reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
- **.5** damage to the Owner or a Separate Contractor;
- **.6** reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or
- **.7** repeated failure to carry out the Work in accordance with the Contract Documents.

§ 9.5.2 When either party disputes the Architect's decision regarding a Certificate for Payment under Section 9.5.1, in whole or in part, that party may submit a Claim in accordance with Article 15.

§ 9.5.3 When the reasons for withholding certification are removed, certification will be made for amounts previously withheld.

§ 9.5.4 If the Architect withholds certification for payment under Section 9.5.1.3, the Owner may, at its sole option, issue joint

AIA Document A201 – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:39:20 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fa)

checks to the Contractor and to any Subcontractor or supplier to whom the Contractor failed to make payment for Work properly performed or material or equipment suitably delivered. If the Owner makes payments by joint check, the Owner shall notify the Architect and the Contractor shall reflect such payment on its next Application for Payment.

§ 9.6 Progress Payments

§ 9.6.1 After the Architect has issued a Certificate for Payment, the Owner shall make payment in the manner and within the time provided in the Contract Documents, and shall so notify the Architect.

§ 9.6.2 The Contractor shall pay each Subcontractor, no later than seven days after receipt of payment from the Owner, the amount to which the Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of the Subcontractor's portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to Sub-subcontractors in a similar manner.

§ 9.6.3 The Architect will, on request, furnish to a Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the Architect and Owner on account of portions of the Work done by such Subcontractor.

§ 9.6.4 The Owner has the right to request written evidence from the Contractor that the Contractor has properly paid Subcontractors and suppliers amounts paid by the Owner to the Contractor for subcontracted Work. If the Contractor fails to furnish such evidence within seven days, the Owner shall have the right to contact Subcontractors and suppliers to ascertain whether they have been properly paid. Neither the Owner nor Architect shall have an obligation to pay, or to see to the payment of money to, a Subcontractor or supplier, except as may otherwise be required by law.

§ 9.6.5 The Contractor's payments to suppliers shall be treated in a manner similar to that provided in Sections 9.6.2, 9.6.3 and 9.6.4.

§ 9.6.6 A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

§ 9.6.7 Unless the Contractor provides the Owner with a payment bond in the full penal sum of the Contract Sum, payments received by the Contractor for Work properly performed by Subcontractors or provided by suppliers shall be held by the Contractor for those Subcontractors or suppliers who performed Work or furnished materials, or both, under contract with the Contractor for which payment was made by the Owner. Nothing contained herein shall require money to be placed in a separate account and not commingled with money of the Contractor, create any fiduciary liability or tort liability on the part of the Contractor for breach of trust, or entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision.

§ 9.6.8 Provided the Owner has fulfilled its payment obligations under the Contract Documents, the Contractor shall defend and indemnify the Owner from all loss, liability, damage or expense, including reasonable attorney's fees and litigation expenses, arising out of any lien claim or other claim for payment by any Subcontractor or supplier of any tier. Upon receipt of notice of a lien claim or other claim for payment, the Owner shall notify the Contractor. If approved by the applicable court, when required, the Contractor may substitute a surety bond for the property against which the lien or other claim for payment has been asserted.

§ 9.7 Failure of Payment

If the Architect does not issue a Certificate for Payment, through no fault of the Contractor, within seven days after receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within seven days after the date established in the Contract Documents, the amount certified by the Architect or awarded by binding dispute resolution, then the Contractor may, upon seven additional days' notice to the Owner and Architect, stop the Work until payment of the amount owing has been received. The Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided for in the Contract Documents.

§ 9.8 Substantial Completion

§ 9.8.1 Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is

AIA Document A201 – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:39:20 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fa)

sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use.

§ 9.8.2 When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall prepare and submit to the Architect a comprehensive list of items to be completed or corrected prior to final payment. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

§ 9.8.3 Upon receipt of the Contractor's list, the Architect will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Architect's inspection discloses any item, whether or not included on the Contractor's list, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work or designated portion thereof for its intended use, the Contractor shall, before issuance of the Certificate of Substantial Completion, complete or correct such item upon notification by the Architect. In such case, the Contractor shall then submit a request for another inspection by the Architect to determine Substantial Completion.

§ 9.8.4 When the Work or designated portion thereof is substantially complete, the Architect will prepare a Certificate of Substantial Completion that shall establish the date of Substantial Completion; establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance; and fix the time within which the Contractor shall finish all items on the list accompanying the Certificate. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.

§ 9.8.5 The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in the Certificate. Upon such acceptance, and consent of surety if any, the Owner shall make payment of retainage applying to the Work or designated portion thereof. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

§ 9.9 Partial Occupancy or Use

§ 9.9.1 The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, provided such occupancy or use is consented to by the insurer and authorized by public authorities having jurisdiction over the Project. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage, if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. When the Contractor considers a portion substantially complete, the Contractor shall prepare and submit a list to the Architect as provided under Section 9.8.2. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by written agreement between the Owner and Contractor or, if no agreement is reached, by decision of the Architect.

§ 9.9.2 Immediately prior to such partial occupancy or use, the Owner, Contractor, and Architect shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

§ 9.9.3 Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

§ 9.10 Final Completion and Final Payment

§ 9.10.1 Upon receipt of the Contractor's notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect will promptly make such inspection. When the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect will promptly issue a final Certificate for Payment stating that to the best of the Architect's knowledge, information and belief, and on the basis of the Architect's on-site visits and inspections, the Work has been completed in accordance with the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Architect's final Certificate for Payment will constitute a further representation that conditions listed in Section 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled.

AIA Document A201 – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:39:20 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fa)

§ 9.10.2 Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Architect (1) an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect, (3) a written statement that the Contractor knows of no reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment, (5) documentation of any special warranties, such as manufacturers' warranties or specific Subcontractor warranties, and (6) if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts and releases and waivers of liens, claims, security interests, or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against such lien, claim, security interest, or encumbrance. If a lien, claim, security interest, or encumbrance remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging the lien, claim, security interest, or encumbrance, including all costs and reasonable attorneys' fees.

§ 9.10.3 If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by issuance of Change Orders affecting final completion, and the Architect so confirms, the Owner shall, upon application by the Contractor and certification by the Architect, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed, corrected, and accepted. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of the surety to payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Architect prior to certification of such payment. Such payment shall be made under terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

§ 9.10.4 The making of final payment shall constitute a waiver of Claims by the Owner except those arising from

- **.1** liens, Claims, security interests, or encumbrances arising out of the Contract and unsettled;
- **.2** failure of the Work to comply with the requirements of the Contract Documents;
- **.3** terms of special warranties required by the Contract Documents; or
- **.4** audits performed by the Owner, if permitted by the Contract Documents, after final payment.

§ 9.10.5 Acceptance of final payment by the Contractor, a Subcontractor, or a supplier, shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.

ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

§ 10.1 Safety Precautions and Programs

The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Contract.

§ 10.2 Safety of Persons and Property

§ 10.2.1 The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury, or loss to

- **.1** employees on the Work and other persons who may be affected thereby;
- **.2** the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody, or control of the Contractor, a Subcontractor, or a Sub-subcontractor; and
- **.3** other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.

§ 10.2.2 The Contractor shall comply with, and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities, bearing on safety of persons or property or their protection from damage, injury, or loss.

§ 10.2.3 The Contractor shall implement, erect, and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards; promulgating safety regulations; and notifying the owners and users of adjacent sites and utilities of the safeguards.

AIA Document A201 – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:39:20 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fa)

§ 10.2.4 When use or storage of explosives or other hazardous materials or equipment, or unusual methods are necessary for execution of the Work, the Contractor shall exercise utmost care and carry on such activities under supervision of properly qualified personnel.

§ 10.2.5 The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Sections 10.2.1.2 and 10.2.1.3 caused in whole or in part by the Contractor, a Subcontractor, a Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Sections 10.2.1.2 and 10.2.1.3. The Contractor may make a Claim for the cost to remedy the damage or loss to the extent such damage or loss is attributable to acts or omissions of the Owner or Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Section 3.18.

§ 10.2.6 The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner and Architect.

§ 10.2.7 The Contractor shall not permit any part of the construction or site to be loaded so as to cause damage or create an unsafe condition.

§ 10.2.8 Injury or Damage to Person or Property

If either party suffers injury or damage to person or property because of an act or omission of the other party, or of others for whose acts such party is legally responsible, notice of the injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 21 days after discovery. The notice shall provide sufficient detail to enable the other party to investigate the matter.

§ 10.3 Hazardous Materials and Substances

§ 10.3.1 The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials or substances. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance, including but not limited to asbestos or polychlorinated biphenyl (PCB), encountered on the site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and notify the Owner and Architect of the condition.

§ 10.3.2 Upon receipt of the Contractor's notice, the Owner shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to cause it to be rendered harmless. Unless otherwise required by the Contract Documents, the Owner shall furnish in writing to the Contractor and Architect the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of the material or substance or who are to perform the task of removal or safe containment of the material or substance. The Contractor and the Architect will promptly reply to the Owner in writing stating whether or not either has reasonable objection to the persons or entities proposed by the Owner. If either the Contractor or Architect has an objection to a person or entity proposed by the Owner, the Owner shall propose another to whom the Contractor and the Architect have no reasonable objection. When the material or substance has been rendered harmless, Work in the affected area shall resume upon written agreement of the Owner and Contractor. By Change Order, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable additional costs of shutdown, delay, and start-up.

§ 10.3.3 To the fullest extent permitted by law, the Owner shall indemnify and hold harmless the Contractor, Subcontractors, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work in the affected area if in fact the material or substance presents the risk of bodily injury or death as described in Section 10.3.1 and has not been rendered harmless, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), except to the extent that such damage, loss, or expense is due to the fault or negligence of the party seeking indemnity.

AIA Document A201 – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:39:20 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fa)

§ 10.3.4 The Owner shall not be responsible under this Section 10.3 for hazardous materials or substances the Contractor brings to the site unless such materials or substances are required by the Contract Documents. The Owner shall be responsible for hazardous materials or substances required by the Contract Documents, except to the extent of the Contractor's fault or negligence in the use and handling of such materials or substances.

§ 10.3.5 The Contractor shall reimburse the Owner for the cost and expense the Owner incurs (1) for remediation of hazardous materials or substances the Contractor brings to the site and negligently handles, or (2) where the Contractor fails to perform its obligations under Section 10.3.1, except to the extent that the cost and expense are due to the Owner's fault or negligence.

§ 10.3.6 If, without negligence on the part of the Contractor, the Contractor is held liable by a government agency for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the Contract Documents, the Owner shall reimburse the Contractor for all cost and expense thereby incurred.

§ 10.4 Emergencies

In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury, or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in Article 15 and Article 7.

ARTICLE 11 INSURANCE AND BONDS

§ 11.1 Contractor's Insurance and Bonds

§ 11.1.1 The Contractor shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Contractor shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Owner, Architect, and Architect's consultants shall be named as additional insureds under the Contractor's commercial general liability policy or as otherwise described in the Contract Documents.

§ 11.1.2 The Contractor shall provide surety bonds of the types, for such penal sums, and subject to such terms and conditions as required by the Contract Documents. The Contractor shall purchase and maintain the required bonds from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located.

§ 11.1.3 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall authorize a copy to be furnished.

§ 11.1.4 Notice of Cancellation or Expiration of Contractor's Required Insurance. Within three (3) business days of the date the Contractor becomes aware of an impending or actual cancellation or expiration of any insurance required by the Contract Documents, the Contractor shall provide notice to the Owner of such impending or actual cancellation or expiration. Upon receipt of notice from the Contractor, the Owner shall, unless the lapse in coverage arises from an act or omission of the Owner, have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by the Contractor. The furnishing of notice by the Contractor shall not relieve the Contractor of any contractual obligation to provide any required coverage.

§ 11.2 Owner's Insurance

§ 11.2.1 The Owner shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Owner shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located.

§ 11.2.2 Failure to Purchase Required Property Insurance. If the Owner fails to purchase and maintain the required property insurance, with all of the coverages and in the amounts described in the Agreement or elsewhere in the Contract Documents, the Owner shall inform the Contractor in writing prior to commencement of the Work. Upon receipt of notice from the Owner, the Contractor may delay commencement of the Work and may obtain insurance that will protect the interests of the Contractor, Subcontractors, and Sub-Subcontractors in the Work. When the failure to provide coverage has been cured or resolved, the Contract Sum and Contract Time shall be equitably adjusted. In the event the Owner fails to procure coverage,

AIA Document A201 – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:39:20 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fa)

the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent the loss to the Owner would have been covered by the insurance to have been procured by the Owner. The cost of the insurance shall be charged to the Owner by a Change Order. If the Owner does not provide written notice, and the Contractor is damaged by the failure or neglect of the Owner to purchase or maintain the required insurance, the Owner shall reimburse the Contractor for all reasonable costs and damages attributable thereto.

§ 11.2.3 Notice of Cancellation or Expiration of Owner's Required Property Insurance. Within three (3) business days of the date the Owner becomes aware of an impending or actual cancellation or expiration of any property insurance required by the Contract Documents, the Owner shall provide notice to the Contractor of such impending or actual cancellation or expiration. Unless the lapse in coverage arises from an act or omission of the Contractor: (1) the Contractor, upon receipt of notice from the Owner, shall have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by either the Owner or the Contractor; (2) the Contract Time and Contract Sum shall be equitably adjusted; and (3) the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent any loss to the Owner would have been covered by the insurance had it not expired or been cancelled. If the Contractor purchases replacement coverage, the cost of the insurance shall be charged to the Owner by an appropriate Change Order. The furnishing of notice by the Owner shall not relieve the Owner of any contractual obligation to provide required insurance.

§ 11.3 Waivers of Subrogation

§ 11.3.1 The Owner and Contractor waive all rights against (1) each other and any of their subcontractors, sub-subcontractors, agents, and employees, each of the other; (2) the Architect and Architect's consultants; and (3) Separate Contractors, if any, and any of their subcontractors, sub-subcontractors, agents, and employees, for damages caused by fire, or other causes of loss, to the extent those losses are covered by property insurance required by the Agreement or other property insurance applicable to the Project, except such rights as they have to proceeds of such insurance. The Owner or Contractor, as appropriate, shall require similar written waivers in favor of the individuals and entities identified above from the Architect, Architect's consultants, Separate Contractors, subcontractors, and sub-subcontractors. The policies of insurance purchased and maintained by each person or entity agreeing to waive claims pursuant to this section 11.3.1 shall not prohibit this waiver of subrogation. This waiver of subrogation shall be effective as to a person or entity (1) even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, (2) even though that person or entity did not pay the insurance premium directly or indirectly, or (3) whether or not the person or entity had an insurable interest in the damaged property.

§ 11.3.2 If during the Project construction period the Owner insures properties, real or personal or both, at or adjacent to the site by property insurance under policies separate from those insuring the Project, or if after final payment property insurance is to be provided on the completed Project through a policy or policies other than those insuring the Project during the construction period, to the extent permissible by such policies, the Owner waives all rights in accordance with the terms of Section 11.3.1 for damages caused by fire or other causes of loss covered by this separate property insurance.

§ 11.4 Loss of Use, Business Interruption, and Delay in Completion Insurance

The Owner, at the Owner's option, may purchase and maintain insurance that will protect the Owner against loss of use of the Owner's property, or the inability to conduct normal operations, due to fire or other causes of loss. The Owner waives all rights of action against the Contractor and Architect for loss of use of the Owner's property, due to fire or other hazards however caused.

§11.5 Adjustment and Settlement of Insured Loss

§ 11.5.1 A loss insured under the property insurance required by the Agreement shall be adjusted by the Owner as fiduciary and made payable to the Owner as fiduciary for the insureds, as their interests may appear, subject to requirements of any applicable mortgagee clause and of Section 11.5.2. The Owner shall pay the Architect and Contractor their just shares of insurance proceeds received by the Owner, and by appropriate agreements the Architect and Contractor shall make payments to their consultants and Subcontractors in similar manner.

§ 11.5.2 Prior to settlement of an insured loss, the Owner shall notify the Contractor of the terms of the proposed settlement as well as the proposed allocation of the insurance proceeds. The Contractor shall have 14 days from receipt of notice to object to the proposed settlement or allocation of the proceeds. If the Contractor does not object, the Owner shall settle the loss and the Contractor shall be bound by the settlement and allocation. Upon receipt, the Owner shall deposit the insurance proceeds in a separate account and make the appropriate distributions. Thereafter, if no other agreement is made or the Owner does not terminate the Contract for convenience, the Owner and Contractor shall execute a Change Order for reconstruction of the

AIA Document A201 – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:39:20 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fa)

damaged or destroyed Work in the amount allocated for that purpose. If the Contractor timely objects to either the terms of the proposed settlement or the allocation of the proceeds, the Owner may proceed to settle the insured loss, and any dispute between the Owner and Contractor arising out of the settlement or allocation of the proceeds shall be resolved pursuant to Article 15. Pending resolution of any dispute, the Owner may issue a Construction Change Directive for the reconstruction of the damaged or destroyed Work.

ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

§ 12.1 Uncovering of Work

§ 12.1.1 If a portion of the Work is covered contrary to the Architect's request or to requirements specifically expressed in the Contract Documents, it must, if requested in writing by the Architect, be uncovered for the Architect's examination and be replaced at the Contractor's expense without change in the Contract Time.

§ 12.1.2 If a portion of the Work has been covered that the Architect has not specifically requested to examine prior to its being covered, the Architect may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, the Contractor shall be entitled to an equitable adjustment to the Contract Sum and Contract Time as may be appropriate. If such Work is not in accordance with the Contract Documents, the costs of uncovering the Work, and the cost of correction, shall be at the Contractor's expense.

§ 12.2 Correction of Work

§ 12.2.1 Before Substantial Completion

The Contractor shall promptly correct Work rejected by the Architect or failing to conform to the requirements of the Contract Documents, discovered before Substantial Completion and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections, the cost of uncovering and replacement, and compensation for the Architect's services and expenses made necessary thereby, shall be at the Contractor's expense.

§ 12.2.2 After Substantial Completion

§ 12.2.2.1 In addition to the Contractor's obligations under Section 3.5, if, within one year after the date of Substantial Completion of the Work or designated portion thereof or after the date for commencement of warranties established under Section 9.9.1, or by terms of any applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of notice from the Owner to do so, unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition. During the one-year period for correction of Work, if the Owner fails to notify the Contractor and give the Contractor an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor and to make a claim for breach of warranty. If the Contractor fails to correct nonconforming Work within a reasonable time during that period after receipt of notice from the Owner or Architect, the Owner may correct it in accordance with Section 2.5.

§ 12.2.2.2 The one-year period for correction of Work shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual completion of that portion of the Work.

§ 12.2.2.3 The one-year period for correction of Work shall not be extended by corrective Work performed by the Contractor pursuant to this Section 12.2.

§ 12.2.3 The Contractor shall remove from the site portions of the Work that are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

§ 12.2.4 The Contractor shall bear the cost of correcting destroyed or damaged construction of the Owner or Separate Contractors, whether completed or partially completed, caused by the Contractor's correction or removal of Work that is not in accordance with the requirements of the Contract Documents.

§ 12.2.5 Nothing contained in this Section 12.2 shall be construed to establish a period of limitation with respect to other obligations the Contractor has under the Contract Documents. Establishment of the one-year period for correction of Work as described in Section 12.2.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor

AIA Document A201 – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:39:20 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fa)

to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

§ 12.3 Acceptance of Nonconforming Work

If the Owner prefers to accept Work that is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

ARTICLE 13 MISCELLANEOUS PROVISIONS

§ 13.1 Governing Law

The Contract shall be governed by the law of the place where the Project is located, excluding that jurisdiction's choice of law rules. If the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 15.4.

§ 13.2 Successors and Assigns

§ 13.2.1 The Owner and Contractor respectively bind themselves, their partners, successors, assigns, and legal representatives to covenants, agreements, and obligations contained in the Contract Documents. Except as provided in Section 13.2.2, neither party to the Contract shall assign the Contract as a whole without written consent of the other. If either party attempts to make an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

§ 13.2.2 The Owner may, without consent of the Contractor, assign the Contract to a lender providing construction financing for the Project, if the lender assumes the Owner's rights and obligations under the Contract Documents. The Contractor shall execute all consents reasonably required to facilitate the assignment.

§ 13.3 Rights and Remedies

§ 13.3.1 Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights, and remedies otherwise imposed or available by law.

§ 13.3.2 No action or failure to act by the Owner, Architect, or Contractor shall constitute a waiver of a right or duty afforded them under the Contract, nor shall such action or failure to act constitute approval of or acquiescence in a breach thereunder, except as may be specifically agreed upon in writing.

§ 13.4 Tests and Inspections

§ 13.4.1 Tests, inspections, and approvals of portions of the Work shall be made as required by the Contract Documents and by applicable laws, statutes, ordinances, codes, rules, and regulations or lawful orders of public authorities. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections, and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections, and approvals. The Contractor shall give the Architect timely notice of when and where tests and inspections are to be made so that the Architect may be present for such procedures. The Owner shall bear costs of tests, inspections, or approvals that do not become requirements until after bids are received or negotiations concluded. The Owner shall directly arrange and pay for tests, inspections, or approvals where building codes or applicable laws or regulations so require.

§ 13.4.2 If the Architect, Owner, or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection, or approval not included under Section 13.4.1, the Architect will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection, or approval, by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Architect of when and where tests and inspections are to be made so that the Architect may be present for such procedures. Such costs, except as provided in Section 13.4.3, shall be at the Owner's expense.

§ 13.4.3 If procedures for testing, inspection, or approval under Sections 13.4.1 and 13.4.2 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure, including those of repeated procedures and compensation for the Architect's services and expenses, shall be at the Contractor's expense.

AIA Document A201 – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:39:20 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fa)

§ 13.4.4 Required certificates of testing, inspection, or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Architect.

§ 13.4.5 If the Architect is to observe tests, inspections, or approvals required by the Contract Documents, the Architect will do so promptly and, where practicable, at the normal place of testing.

§ 13.4.6 Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

§ 13.5 Interest

Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due at the rate the parties agree upon in writing or, in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

§ 14.1 Termination by the Contractor

§ 14.1.1 The Contractor may terminate the Contract if the Work is stopped for a period of 30 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, for any of the following reasons:

- **.1** Issuance of an order of a court or other public authority having jurisdiction that requires all Work to be stopped;
- **.2** An act of government, such as a declaration of national emergency, that requires all Work to be stopped;
- **.3** Because the Architect has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Section 9.4.1, or because the Owner has not made payment on a Certificate for Payment within the time stated in the Contract Documents; or
- **.4** The Owner has failed to furnish to the Contractor reasonable evidence as required by Section 2.2.

§ 14.1.2 The Contractor may terminate the Contract if, through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, repeated suspensions, delays, or interruptions of the entire Work by the Owner as described in Section 14.3, constitute in the aggregate more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is less.

§ 14.1.3 If one of the reasons described in Section 14.1.1 or 14.1.2 exists, the Contractor may, upon seven days' notice to the Owner and Architect, terminate the Contract and recover from the Owner payment for Work executed, as well as reasonable overhead and profit on Work not executed, and costs incurred by reason of such termination.

§ 14.1.4 If the Work is stopped for a period of 60 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, or their agents or employees or any other persons or entities performing portions of the Work because the Owner has repeatedly failed to fulfill the Owner's obligations under the Contract Documents with respect to matters important to the progress of the Work, the Contractor may, upon seven additional days' notice to the Owner and the Architect, terminate the Contract and recover from the Owner as provided in Section 14.1.3.

§ 14.2 Termination by the Owner for Cause

§ 14.2.1 The Owner may terminate the Contract if the Contractor

- **.1** repeatedly refuses or fails to supply enough properly skilled workers or proper materials;
- **.2** fails to make payment to Subcontractors or suppliers in accordance with the respective agreements between the Contractor and the Subcontractors or suppliers;
- **.3** repeatedly disregards applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority; or
- **.4** otherwise is guilty of substantial breach of a provision of the Contract Documents.

§ 14.2.2 When any of the reasons described in Section 14.2.1 exist, and upon certification by the Architect that sufficient cause exists to justify such action, the Owner may, without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor's surety, if any, seven days' notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:

AIA Document A201 – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:39:20 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fa)

.1 Exclude the Contractor from the site and take possession of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;

.2 Accept assignment of subcontracts pursuant to Section 5.4; and

.3 Finish the Work by whatever reasonable method the Owner may deem expedient. Upon written request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

§ 14.2.3 When the Owner terminates the Contract for one of the reasons stated in Section 14.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.

§ 14.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect's services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Initial Decision Maker, upon application, and this obligation for payment shall survive termination of the Contract.

§ 14.3 Suspension by the Owner for Convenience

§ 14.3.1 The Owner may, without cause, order the Contractor in writing to suspend, delay or interrupt the Work, in whole or in part for such period of time as the Owner may determine.

§ 14.3.2 The Contract Sum and Contract Time shall be adjusted for increases in the cost and time caused by suspension, delay, or interruption under Section 14.3.1. Adjustment of the Contract Sum shall include profit. No adjustment shall be made to the extent

.1 that performance is, was, or would have been, so suspended, delayed, or interrupted, by another cause for which the Contractor is responsible; or

.2 that an equitable adjustment is made or denied under another provision of the Contract.

§ 14.4 Termination by the Owner for Convenience

§ 14.4.1 The Owner may, at any time, terminate the Contract for the Owner's convenience and without cause.

§ 14.4.2 Upon receipt of notice from the Owner of such termination for the Owner's convenience, the Contractor shall

.1 cease operations as directed by the Owner in the notice;

.2 take actions necessary, or that the Owner may direct, for the protection and preservation of the Work; and

.3 except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

§ 14.4.3 In case of such termination for the Owner's convenience, the Owner shall pay the Contractor for Work properly executed; costs incurred by reason of the termination, including costs attributable to termination of Subcontracts; and the termination fee, if any, set forth in the Agreement.

ARTICLE 15 CLAIMS AND DISPUTES

§ 15.1 Claims

§ 15.1.1 Definition

A Claim is a demand or assertion by one of the parties seeking, as a matter of right, payment of money, a change in the Contract Time, or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract. The responsibility to substantiate Claims shall rest with the party making the Claim. This Section 15.1.1 does not require the Owner to file a Claim in order to impose liquidated damages in accordance with the Contract Documents.

§ 15.1.2 Time Limits on Claims

The Owner and Contractor shall commence all Claims and causes of action against the other and arising out of or related to the Contract, whether in contract, tort, breach of warranty or otherwise, in accordance with the requirements of the binding dispute resolution method selected in the Agreement and within the period specified by applicable law, but in any case not

AIA Document A201 – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:39:20 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fa)

more than 10 years after the date of Substantial Completion of the Work. The Owner and Contractor waive all Claims and causes of action not commenced in accordance with this Section 15.1.2.

§ 15.1.3 Notice of Claims

§ 15.1.3.1 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered prior to expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party and to the Initial Decision Maker with a copy sent to the Architect, if the Architect is not serving as the Initial Decision Maker. Claims by either party under this Section 15.1.3.1 shall be initiated within 21 days after occurrence of the event giving rise to such Claim or within 21 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later.

§ 15.1.3.2 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party. In such event, no decision by the Initial Decision Maker is required.

§ 15.1.4 Continuing Contract Performance

§ 15.1.4.1 Pending final resolution of a Claim, except as otherwise agreed in writing or as provided in Section 9.7 and Article 14, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents.

§ 15.1.4.2 The Contract Sum and Contract Time shall be adjusted in accordance with the Initial Decision Maker's decision, subject to the right of either party to proceed in accordance with this Article 15. The Architect will issue Certificates for Payment in accordance with the decision of the Initial Decision Maker.

§ 15.1.5 Claims for Additional Cost

If the Contractor wishes to make a Claim for an increase in the Contract Sum, notice as provided in Section 15.1.3 shall be given before proceeding to execute the portion of the Work that is the subject of the Claim. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Section 10.4.

§ 15.1.6 Claims for Additional Time

§ 15.1.6.1 If the Contractor wishes to make a Claim for an increase in the Contract Time, notice as provided in Section 15.1.3 shall be given. The Contractor's Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay, only one Claim is necessary.

§ 15.1.6.2 If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time, could not have been reasonably anticipated, and had an adverse effect on the scheduled construction.

§ 15.1.7 Waiver of Claims for Consequential Damages

The Contractor and Owner waive Claims against each other for consequential damages arising out of or relating to this Contract. This mutual waiver includes

- **.1** damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and
- **.2** damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit, except anticipated profit arising directly from the Work.

This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination in accordance with Article 14. Nothing contained in this Section 15.1.7 shall be deemed to preclude assessment of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents.

§ 15.2 Initial Decision

§ 15.2.1 Claims, excluding those where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2 or arising under Sections 10.3, 10.4, and 11.5, shall be referred to the Initial Decision Maker for initial decision. The Architect will serve as the Initial Decision Maker, unless otherwise indicated in the Agreement. Except for those Claims excluded by this Section 15.2.1, an initial decision shall be required as a condition

AIA Document A201 – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:39:20 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fa)

precedent to mediation of any Claim. If an initial decision has not been rendered within 30 days after the Claim has been referred to the Initial Decision Maker, the party asserting the Claim may demand mediation and binding dispute resolution without a decision having been rendered. Unless the Initial Decision Maker and all affected parties agree, the Initial Decision Maker will not decide disputes between the Contractor and persons or entities other than the Owner.

§ 15.2.2 The Initial Decision Maker will review Claims and within ten days of the receipt of a Claim take one or more of the following actions: (1) request additional supporting data from the claimant or a response with supporting data from the other party, (2) reject the Claim in whole or in part, (3) approve the Claim, (4) suggest a compromise, or (5) advise the parties that the Initial Decision Maker is unable to resolve the Claim if the Initial Decision Maker lacks sufficient information to evaluate the merits of the Claim or if the Initial Decision Maker concludes that, in the Initial Decision Maker's sole discretion, it would be inappropriate for the Initial Decision Maker to resolve the Claim.

§ 15.2.3 In evaluating Claims, the Initial Decision Maker may, but shall not be obligated to, consult with or seek information from either party or from persons with special knowledge or expertise who may assist the Initial Decision Maker in rendering a decision. The Initial Decision Maker may request the Owner to authorize retention of such persons at the Owner's expense.

§ 15.2.4 If the Initial Decision Maker requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond, within ten days after receipt of the request, and shall either (1) provide a response on the requested supporting data, (2) advise the Initial Decision Maker when the response or supporting data will be furnished, or (3) advise the Initial Decision Maker that no supporting data will be furnished. Upon receipt of the response or supporting data, if any, the Initial Decision Maker will either reject or approve the Claim in whole or in part.

§ 15.2.5 The Initial Decision Maker will render an initial decision approving or rejecting the Claim, or indicating that the Initial Decision Maker is unable to resolve the Claim. This initial decision shall (1) be in writing; (2) state the reasons therefor; and (3) notify the parties and the Architect, if the Architect is not serving as the Initial Decision Maker, of any change in the Contract Sum or Contract Time or both. The initial decision shall be final and binding on the parties but subject to mediation and, if the parties fail to resolve their dispute through mediation, to binding dispute resolution.

§ 15.2.6 Either party may file for mediation of an initial decision at any time, subject to the terms of Section 15.2.6.1.

§ 15.2.6.1 Either party may, within 30 days from the date of receipt of an initial decision, demand in writing that the other party file for mediation. If such a demand is made and the party receiving the demand fails to file for mediation within 30 days after receipt thereof, then both parties waive their rights to mediate or pursue binding dispute resolution proceedings with respect to the initial decision.

§ 15.2.7 In the event of a Claim against the Contractor, the Owner may, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim. If the Claim relates to a possibility of a Contractor's default, the Owner may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.

§ 15.2.8 If a Claim relates to or is the subject of a mechanic's lien, the party asserting such Claim may proceed in accordance with applicable law to comply with the lien notice or filing deadlines.

§ 15.3 Mediation

§ 15.3.1 Claims, disputes, or other matters in controversy arising out of or related to the Contract, except those waived as provided for in Sections 9.10.4, 9.10.5, and 15.1.7, shall be subject to mediation as a condition precedent to binding dispute resolution.

§ 15.3.2 The parties shall endeavor to resolve their Claims by mediation which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Mediation Procedures in effect on the date of the Agreement. A request for mediation shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the mediation. The request may be made concurrently with the filing of binding dispute resolution proceedings but, in such event, mediation shall proceed in advance of binding dispute resolution proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or court order. If an arbitration is stayed pursuant to this Section 15.3.2, the parties may nonetheless proceed to the selection of the arbitrator(s) and agree upon a schedule for later proceedings.

AIA Document A201 – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:39:20 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fa)

§ 15.3.3 Either party may, within 30 days from the date that mediation has been concluded without resolution of the dispute or 60 days after mediation has been demanded without resolution of the dispute, demand in writing that the other party file for binding dispute resolution. If such a demand is made and the party receiving the demand fails to file for binding dispute resolution within 60 days after receipt thereof, then both parties waive their rights to binding dispute resolution proceedings with respect to the initial decision.

§ 15.3.4 The parties shall share the mediator's fee and any filing fees equally. The mediation shall be held in the place where the Project is located, unless another location is mutually agreed upon. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof.

§ 15.4 Arbitration

§ 15.4.1 If the parties have selected arbitration as the method for binding dispute resolution in the Agreement, any Claim subject to, but not resolved by, mediation shall be subject to arbitration which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Arbitration Rules in effect on the date of the Agreement. The Arbitration shall be conducted in the place where the Project is located, unless another location is mutually agreed upon. A demand for arbitration shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the arbitration. The party filing a notice of demand for arbitration must assert in the demand all Claims then known to that party on which arbitration is permitted to be demanded.

§ 15.4.1.1 A demand for arbitration shall be made no earlier than concurrently with the filing of a request for mediation, but in no event shall it be made after the date when the institution of legal or equitable proceedings based on the Claim would be barred by the applicable statute of limitations. For statute of limitations purposes, receipt of a written demand for arbitration by the person or entity administering the arbitration shall constitute the institution of legal or equitable proceedings based on the Claim.

§ 15.4.2 The award rendered by the arbitrator or arbitrators shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof.

§ 15.4.3 The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity duly consented to by parties to the Agreement, shall be specifically enforceable under applicable law in any court having jurisdiction thereof.

§ 15.4.4 Consolidation or Joinder

§ 15.4.4.1 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may consolidate an arbitration conducted under this Agreement with any other arbitration to which it is a party provided that (1) the arbitration agreement governing the other arbitration permits consolidation, (2) the arbitrations to be consolidated substantially involve common questions of law or fact, and (3) the arbitrations employ materially similar procedural rules and methods for selecting arbitrator(s).

§ 15.4.4.2 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may include by joinder persons or entities substantially involved in a common question of law or fact whose presence is required if complete relief is to be accorded in arbitration, provided that the party sought to be joined consents in writing to such joinder. Consent to arbitration involving an additional person or entity shall not constitute consent to arbitration of any claim, dispute or other matter in question not described in the written consent.

§ 15.4.4.3 The Owner and Contractor grant to any person or entity made a party to an arbitration conducted under this Section 15.4, whether by joinder or consolidation, the same rights of joinder and consolidation as those of the Owner and Contractor under this Agreement.

AIA Document A201 – 2017. Copyright © 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1970, 1976, 1987, 1997, 2007 and 2017. All rights reserved. "The American Institute of Architects," "American Institute of Architects," "AIA," the AIA Logo, and "AIA Contract Documents" are trademarks of The American Institute of Architects. This draft was produced at 15:39:20 EDT on 03/09/2026 under Subscription No.20250106709 which expires on , is not for resale, is licensed for one-time use only, and may only be used in accordance with the AIA Contract Documents® Terms of Service. To report copyright violations, e-mail docinfo@aiacontracts.com.
User Notes: (640e2aedf442e4498d0967fa)

SECTION 03 30 00 CAST-IN-PLACE CONCRETE

PART 1: GENERAL

1.01 SCOPE OF WORK

This section includes cast-in-place concrete as shown on Drawings, and as specified herein. In general, this work includes providing cast-in-place concrete consisting of Portland Cement, fine and course aggregate, selected admixtures, mixing, transporting, placing, finishing, and curing as herein specified. This section further includes related items of quality control, testing, and evaluation of concrete strength.

1.02 STANDARDS

A. Some products and execution are specified in this section by reference to published specifications or standards of the following with respect abbreviations used.

1. American Concrete Institute .....ACI

2. The American Society for Testing and Materials .....ASTM

B. The current edition of the following standard references shall apply to the work of this Section as indicated. Suffixes indicating issue date are omitted from reference numerals elsewhere in the text. Concrete work shall comply with the following standards and codes except as indicated otherwise on the Drawings or herein.

1. ACI 301 "Specifications for Structural Concrete"

2. ACI 304 "Recommended Practice for Measuring, Mixing Transporting, and Placing Concrete"

3. ACI 305 "Recommended Practice for Hot Weather Concreting"

4. ACI 306 "Recommended Practice for Cold Weather Concreting"

5. ACI 308 "Recommended Practice for Curing Concrete"

6. ACI 309 "Recommended Practice for Consolidation of Concrete"

7. ACI 311 "Recommended Practice for Concrete Inspection"

8. ACI 214 "Recommended Practice for Evaluation of Compressive Test Results of Field Concrete"

9. ACI 211.1 "Recommended Practice for Selecting Proportions 70 for Normal Weight Concrete"

10. ACI 211.2 "Recommended Practice for Selecting Proportions for Structural light-weight Concrete"

11. ACI 212 "Guide for Use of Admixtures in Concrete"

12. ACI 214 "Recommended Practice for Evaluation of Compression Test Results of Field Concrete"

1.03 QUALITY ASSURANCE

A. If the average strength of the laboratory control cylinders shows the concrete to be below the specified design strength, the aggregate proportions and water content may be changed by the Engineer, who, in addition to such changes, may require core tests. Tests confirming concrete strengths on hardened concrete, which was poured without testing, shall be paid for by the Contractor.

B. Prepare design mixes for each class of concrete used in accordance with ACI 311.1. The Contractor shall pay for all design mix costs. Submit written reports to the Engineer for each proposed mix for each class of concrete prior to start of work. Do not begin concrete production until mixes have been reviewed by the Engineer.

C. Strength data for establishing standard deviation and required overstrength factor will be considered suitable if the concrete production facility has certified records consisting of at least 30 consecutive tests in one group or the statistical average for two groups totaling 30 or more tests representing similar materials and project conditions. Records of these tests shall be submitted with the proposed design mix.

D. If standard deviation exceeds 800 psi or if no suitable records are available, selected proportions to produce an average strength of at least 1200 psi greater than the required compressive strength of concrete. If standard deviations are less than 600 psi, the minimum overstrength factor required in the design mix shall be in accordance with ACI 318, Section 4.3.1.

E. Design mixes shall be proportioned using the maximum specified slump and temperature. Laboratory test date for revised mix designs and strength results must be submitted to and accepted by the Engineer before using in the work. Admixtures shall be used in strict accordance with the manufacturer's written instructions. Design mix shall be proportioned using the proposed admixtures at optimum recommended dosages. The manufacturer of the mixture shall prepare and submit test date used to determine the optimum dosage.

1.04 SUBMITTALS

The Contractor shall submit four copies of the proposed design mix for each class of concrete specified herein in accordance with the requirements herein. Design mixes shall be submitted two weeks prior to placement of concrete. The cost of the design mix shall be paid for by the contractor. Submit records of all concrete pours showing exact location of pour, date of pour, quantity of pour, and class of concrete poured to the Engineer each month. Temperature at time of pour should also be recorded. Submit to the Engineer chemical and physical analysis of all cement and fly ash delivered to the batch plant seven (7) days prior to use of the cement or fly ash.

PART 2: PRODUCTS

2.01 MATERIALS

A. PORTLAND CEMENT shall be fresh stock of an approved standard brand meeting the requirements of ASTM C-150, of Type II and shall be 4000 PSI unless otherwise specified. Only one brand of cement shall be used except when otherwise approved by the Engineer, and the Contractor shall inform the Engineer of the brand name of the cement proposed for use. The Contractor shall submit a copy of mill test reports on all cement delivered to the job 7 days prior to use of the cement. Cube strength from mill tests shall have a tolerance of ±600 psi. The fineness of cement used shall not have more than l0% retained on a #325 mesh screen when tested in accordance with ASTM C-430.

B. FLY ASH shall have a high fineness and low carbon content and shall exceed the requirements of ASTM C-618. Specifications for Fly Ash and Raw or Calcined Natural for use in Portland Cement Concretes for Class 7, except that the loss of ignition shall be less than 3%, and all fly ash shall be a classified processed material. Fly ash shall be obtained from one source for the concrete delivered to the project. Complete chemical and physical analysis of each carload of fly ash shall be submitted to the Engineer ten (10) days prior to use of each carload delivered. Concrete mixes proportioned with fly ash shall contain not less than 10% nor more than 20% by weight of cement of fly ash.

C. CONCRETE AGGREGATE for stone concrete shall consist of clean crushed stone or gravel having hard, strong, uncoated particles free from injurious amounts of soft, thin, elongated or laminated pieces, alkali, organic or other deleterious matter. Maximum aggregate size shall be 3/4" of slabs, columns, etc. The maximum permissible percentage of elongated particles shall not exceed 5% by weight. Elongated particles are those defined as having a length equal to or greater than 5 times the width. Samples of coarse aggregate shall be submitted to the testing laboratory for testing and approval prior to use. The fineness modulus of the coarse aggregate shall not vary for more than ±0.3%.

D. FINE AGGREGATE shall consist of sand, stone screening, or other inert materials with similar characteristics having clean, strong, durable, uncoated grains and free from lumps, soft or flaky particles, clay, shale, alkali, organic

matter or other deleterious substances. Fine aggregate shall be submitted for testing and approval to the testing laboratory. The laboratory shall verify that fine aggregate conforms to ASTM standards by making standard colormetric, sediment, and comparative tensile tests, and by sieve analysis. The fineness modules of the sand shall not vary by more than ±0.2%. Color shall be standard as determined from colormetric tests.

E. CONCRETE ADMIXTURES, when required or permitted shall conform to the appropriate specification listed. Do not use admixtures, which have not been incorporated and tested in the accepted mixes unless otherwise authorized in writing by the Engineer. Air-entraining admixtures shall exceed the requirements of ASTM C-260, "Specifications for Air-Entraining Admixtures for Concrete". Water reducing admixtures shall be hydroxolated polymer type exceeding the requirements of ASTM C-494, Type A.

F. PREMOLDED EXPANSION JOINT FILLERS shall conform to ASTM D1751.

G. LIQUID CURING MATERIAL for concrete shall exceed the requirements of ASTM C-309, Type I. Products acceptable shall provide water retention not exceeding a loss of 0.020 grams per sq. cm. when tested at a coverage of 200 sq. ft. per gallon and tested in accordance with ASTM C-156. Submit test data verifying these requirements for approval.

H. BURLAP shall be free of sizing or any substance that is injurious to cement or can cause discoloration. Burlap shall be rinsed in water prior to use. Burlap shall be sufficient thickness to retain water without requiring wetting.

I. STEEL FOR EMBEDDED ANGLES AND PLATE CAST IN CONCRETE shall conform to ASTM A-36. Plates and angles shall receive a commercial sand blast and be painted with an inorganic zinc base paint equal to Carbomastic #11, or an approved equal.

J. CRUSHED STONE FILL, 4" in depth, shall be placed under all concrete floors in contact with the ground. Stone shall be uniform 3/4" stone, no fines, compacted as thoroughly as possible by tamping and rolling. Stone fill shall conform to ASTM C-33.

K. VAPOR BARRIER shall be a minimum of a 6 mil polyethylene.

L. WATERSTOPS shall be Sealtight PVC waterstrips as manufactured by the W.R. Meadows Co., or an approved equal. All waterstops shall be Type 6316. Water bars shall be located in all expansive joints in the concrete and in all construction joints in concrete walls.

M. JOINT SEALING COMPOUND shall be a two-part mineral filled epoxy polyurethane, and shall be used for all exposed joints in exterior paving slabs,

sidewalks, where concrete slabs abut concrete walls, and in exposed joints in slabs on grade.

N. SURFACE COATING for all exposed concrete except where otherwise shown shall be a masonry water proofer or sealer.

O. AIR ENTRAINMENT: Air-entraining admixtures shall be used for all concrete exposed to freezing and thawing or subjected to hydraulic pressure. Entrained air shall conform to the air control limits of Table 3.4.1 of ACI 301. The water-cement ratio for all air-entrained concrete exposed to freezing and thawing shall not exceed 0.53.

P. SLUMPS: All concrete shall be proportioned and produced to have a maximum slump of 4" and a minimum slump of 2" as per ASTM C143. A tolerance of up to but not exceeding 1" above the indicated maximum shall be allowed for individual batches in any one day's pour provided the average of the most recent ten batches within the same pour does not exceed the maximum limits. No tolerance will be permitted for individual batches when less than ten (10) batches are delivered for one day's pour.

Q. CONCRETE MIXING

1. Concrete shall be mixed at batch plants or it may be transit mixed as specified herein. Concrete batch plants must comply with the requirements of ASTM C-94 for ready-mixed concrete, ASTM C33 for aggregates and ACI-304 with sufficient capacity of producing concrete of the quantity and quality as specified herein. All plant facilities are subject to inspection by the Engineer. Ready-mix concrete shall comply with requirements of ASTM C-94, and as specified herein, unless otherwise noted. During hot weather or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C-94 will be required as follows:

    a. When air temperatures are between 80°F. and 90°F., reduce the mixing and delivery time from 1-1/2 hours to 1 hour

    b. When outside air temperatures are above 90°F, reduce the mixing and delivery time from 1-1/2 hours to 45 minutes.

2. Addition of water at the site for concrete mix with insufficient slumps, slumps less than the maximum specified herein, will not be permitted. Concrete delivered to the project with slump less than the minimum or greater than the maximum specified shall be rejected and discarded off site.

3. Batch tickets for each load of concrete shall be submitted to the Engineer. The following information shall be provided on each batch ticket:

a. Design mix designation

b. Exact time cement, water and aggregate were discharged into the mix

c. Compressive strength of mix

d. Amount of water added to the mix

4. Maintain equipment in proper operating condition, with drums cleaned before charging of each batch. Schedule delivery of trucks in order to prevent delay of placing after mixing.

5. CONCRETE TYPE AND STRENGTHS

Location	Maximum Size Aggregate	*28 Day Compressive Strength
Slabs on Grade	3/4"	4000 psi
Walls	3/4"	4000 psi
Walks and Steps	3/4"	4000 psi

*Twenty-eight day strength shall be as determined from concrete sampled in accordance with ASTM C-172 and standard 6" x 12" molded cylinders tested in accordance with ASTM C-31 and C-39.

**See notes on plans for required concrete strengths.

PART 3: EXECUTION

3.01 PREPARATION

Before placing concrete, all equipment for mixing and transporting and placing concrete shall be cleaned, all debris and ice removed from spaces to be occupied by the concrete, forms thoroughly cleaned of soil, ice, or other coatings which will prevent proper bond, reinforcement shall be securely tied in place and expansion joint material, anchors, and other embedded items shall be securely positioned. Hardened concrete and foreign materials shall be removed from the conveying equipment.

3.02 CONCRETE PLACEMENT

A. Place concrete in compliance with the practices and recommendations of ACI 304 or as herein specified. Concrete shall be handled from the mixer to the place of final deposit as rapidly as practical by methods, which will prevent separation or loss of ingredients and in a manner, which will assure that the required quality concrete, is obtained. Conveying equipment shall be of size and design to insure a continuous flow of concrete at the delivery end.

B. Concrete shall be deposited continuous, or in layers of such thickness that no concrete will be deposited on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within the section. If a section cannot be placed continuously, construction joints shall be located at points as provided for in the drawings or as approved. Placing shall be carried on at such a rate that the concrete, which is being integrated, with fresh concrete is still plastic. Deposit concrete as nearly as possible to its final location to avoid segregation due to rehandling or flowing. Do not subject concrete to any procedure, which will cause segregation.

C. Concrete shall not be allowed to "freefall" a distance greater than 3'-0". All concrete placed in columns and walls shall be placed through a tremie with the bottom or outlet of the tremie being held at maximum of 3'-0" above the surface where concrete is being placed.

D. Screed concrete which is to receive other construction to the proper level to avoid excessive skimming or grouting.

E. Do not use concrete which has become non-plastic and unworkable or does not meet the required quality control limits, or which has become contaminated by foreign material. Remove rejected concrete from the project site and dispose of in an acceptable location. Consolidate concrete placed in forms by mechanical vibrating equipment supplemented by hand spading, rodding, and tamping. Vibration of forms and reinforcing steel will not be permitted.

F. Do not use vibrators to transport concrete inside forms. Insert and withdraw vertically at uniformly spaced locations not further than the visible effectiveness of the vibrator. Do not insert vibrators into lower levels of concrete that have begun to set. At each insertion, limit the duration of vibration to the time necessary to consolidate the concrete and complete embedment of reinforcing and other embedded items without causing segregation of the mix.

G. Deposit and consolidate concrete in slabs in a continuous operation, within the limits of construction joints until the placing of the entire section is complete.

H. Bring surface of slabs to the correct elevations with a straight edge and strike off. Use bull floats or darbies to smooth the surface, leaving it free of lumps and hollows. Do not sprinkle water on the plastic surface. Do not disturb the surface prior to beginning the finish operation.

I. Concrete placed by plumbing shall conform to the recommendations of ACI Publication, "Placing Concrete by Pumping Methods."

3.03 CONSTRUCTION JOINTS

Joints not shown on the drawings shall be made at locations that will least impair the strength of the structure and shall be approved by the Engineer. In general, they shall be located near the middle of the span of members. Joints in walls and columns shall be located at the underside of floors or slabs, and the tops of foundation walls. Roughen surfaces of hardened concrete at all vertical construction joints. Clean surface of laitance, coatings, loose particles, and foreign matter to expose aggregate. Prepare for bonding of fresh concrete to new concrete that has hardened; at joints between foundation systems and walls dampen, but do not saturate, the roughened and cleaned surface of set concrete immediately before placing fresh concrete. In lieu of neat cement grout, bonding grout may be a commercial bonding agent. Apply to cleaned concrete surfaces in accordance with the printed instruction of this bonding material manufacturer. Provide keyways at least 1-1/2" deep in all construction joints in walls, slabs, and between walls, and foundation systems. Provide PVC Waterstops in all construction joints in concrete walls and in concrete beams and slabs. PVC waterstops shall also be provided between concrete beams and slabs at all expansion joints.

3.04 COLD WEATHER PLACING AND CURING REQUIREMENTS

A. No concrete is to be placed when the air temperature is 40° F or below and the predicted low temperature for the succeeding 24-hour period is less than 32° F.

B. All Concrete when placed in the forms shall have a temperature of between 50° and 90° F and shall be maintained at a temperature of not less than 50° F for at least 72 hours for normal concrete and 24 hours for high early strength concrete, or for as much time as is necessary to secure proper rate of curing and designed compressive strength.

3.05 HOT WEATHER PLACING

An approved admixture designed to retard the rate of set shall be used for all concrete placed when temperatures exceed 75°F. Set retarding admixtures shall conform to ASTM C-494, Type D, water reducing and retarding. Wet forms thoroughly before placing. Cool reinforcing by wetting sufficiently so that steel temperatures will be nearly equal to the ambient air temperature. Provide windbreaks around the perimeter of the area where concrete is being placed. Fresh concrete with temperatures of 90°F. or above shall be discarded off site. The amount of cement used in the job is computed for the temperature indicated on the approved design mix. For higher concrete mix temperature, the weight of the cement shall be increased at the rate of 12 lbs. per cubic yard for each 10°F. above the concrete mix temperature.

3.06 CURING AND PROTECTION

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures, and maintain without drying at a relatively constant temperature for the period of time necessary for hydration of the cement and proper hardening of the concrete.

B. Curing for all horizontal slab surfaces, except those to receive a bonded finish material, during periods when the outside air temperature does not exceed 60ºF. shall be provided by applying a membrane-forming curing compound to concrete surfaces as soon as the final troweling or floating operation has been completed. Apply uniformly with a roller brush at a rate not to exceed 200 sq. ft. per gallon. Maintain the continuity of the coating and repair damage to the coat during the entire curing period. Curing for surfaces to receive a bonded finish material shall be as noted below. Curing for all horizontal surfaces during period when the outside air temperature will exceed 60ºF. shall be provided by covering the entire surface with burlap. The burlap shall be lapped 1/2 width in order to provide a double thickness of burlap. Immediately following the placement of the burlap, the entire surface shall be maintained continuously wet for a period of 7 days. Do not permit surfaces to dry at any period during the required curing period.

C. Cure formed surfaces by moist curing with the forms in place for the full curing period, or until forms are removed. If forms are removed before the curing period is complete, apply a membrane-forming curing compound to damp surfaces as soon as the water film has disappeared. Apply uniformly in continuous operation by roller brushes in accordance with the manufacturer's directions.

D. Do not use membrane curing compounds on surfaces which are to be covered with a coating material applied directly to the concrete or with any other cover or finish material which shall be bonded to the concrete. These surfaces must be watercured with a full coverage of burlap kept continuously moist for a period of 7 days.

E. During the curing period, protect concrete from damaging mechanical disturbances, including load stresses, shocks, excessive vibration and from change caused by subsequent construction operations.

3.07 SURFACE REPAIRS

A. Repair and patch defective areas immediately after removal of forms as directed by the Engineer. Cut out honeycombs, rock pockets, voids over 1/2" in diameter and holes left by tie rods and bolts down to solid concrete, but in no case to a depth of less than 1". Make edges of cuts perpendicular to the concrete surfaces. Exposed reinforcing steel with at least 3/4" clearance all around. Dampen all concrete surfaces in contact with patching concrete, and brush with a neat cement grout coating or concrete bonding agent. Place patching concrete before grout takes its initial set. Mix patching concrete of the same materials to provide concrete of the same type or class as the original adjacent concrete. Place, compact, and finish as required to blend with adjacent finished concrete. Cure in the same manner as adjacent concrete.

B. Fill holes extending through concrete by means of a plunger type gun or other suitable device from the least exposed face to insure complete filling. Remove stains and other discolorations that cannot be removed by cleaning for all exposed

surfaces. Repair isolated random cracks and single holes not over 1" in diameter by the dry-pack method. Groove the top of cracks and cut out holes to sound concrete and clean of dust, dirt, and loose particles. Dampen all cleaned concrete surfaces and brush with a neat cement grout coating. Place dry-pack, consisting of 1 part Portland cement to 2-1/2 parts fine aggregate passing a #16 mesh sieve using only enough water as required for handling and placing. Compact dry-pack mixture in place and finish to match the existing surface.

C. Fill in holes and openings left in concrete structures for the passage of work by other trades, unless otherwise shown or directed, after the work of other trades is in place. Mix, place, and cure concrete as herein specified, to blend with in-place construction. Provide all other miscellaneous concrete filling shown or required to complete work.

D. Correct high areas in unformed surfaces by grinding, after the concrete has cured at least 14 days. Correct low areas in unformed surfaces during, or immediately after, completion of surface finishing operations by cutting out the low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Proprietary patching compounds may be used when acceptable to the Engineer.

3.08 SLABS ON GRADE

A. PREPARATION OF SUBGRADE

The subgrade shall be well drained and of adequate and uniform loadbearing nature. The in-place density of the subgrade soils shall be at least the minimum required in the specifications. The bottom of an undrained granular base course shall not be lower than the adjacent finished grade. The subgrade shall be free of frost before concrete placing begins. If the temperature inside a building where concrete is to be placed is below freezing, it shall be raised and maintained above 50ºF. long enough to remove all frost from the subgrade. The subgrade shall be moist at the time of concreting. If necessary, it shall be dampened with water in advance of concreting, but there shall be no free water standing on the subgrade nor any muddy or soft spots when the concrete is placed.

B. JOINTS

Joints in slabs on grade shall be located as to divide the slab in areas not in excess of 800 sq. ft. The maximum distance between joints in slabs on grade at all points of contact between slabs on grade and vertical surfaces such as foundation walls and elsewhere as indicated. At exposed joints, recess the premolded fill on a minimum of 1/2”, and fill the remaining section with a joint seal and as specified herein. All exposed construction joints in the slabs on grade shall have the edges tooled and the crack and groove formed by the edging tool filled with a polyurethane joint sealant. No kold-key or metal form joints will be permitted.

3.09 SIDEWALKS

A. Brooming of the concrete surface shall be done transverse to the direction of traffic. Joint spacing shall not be less than 5'-0". Where existing sidewalks are being widened, transverse joints shall be located so as to line up with existing joints in the adjacent sidewalk. Joints shall not be sealed.

B. All sidewalks shall contain 6"x6" / 1.4x1.4 WWF. Chairs shall be installed or WWF lifted during placement to allow WWF to be within middle 1/3 of sidewalk cross section.

C. Backfill shall be compacted to a degree comparable to the adjacent undisturbed material.

3.10 CURB AND GUTTER

A. Concrete curb/curb and gutter shall meet the requirements of Section 846-3 of the NCDOT Standard Specifications for Roads and Structures (latest edition).

B. The concrete shall be given a light broom finish with the brush marks parallel to the curb line or gutter line.

C. No earth backfill or pavement shall be placed adjacent to the curb and gutter until at least three curing days have elapsed. Backfill shall be compacted to a degree satisfactory to the Engineer.

3.11 FINISHES

A. STANDARD ROUGH FORM FINISH

Provide a standard rough form finish to all concrete formed surfaces that are to be concealed in the finish work or other construction. (**NOTE:** Interior faces of walls of water retaining structures are not considered to be concealed.) Standard rough form finish shall consist of all defective areas repaired as specified and all holes or voids larger than 3/8" filled with cement grout.

B. STANDARD FINISH FOR EXPOSED SURFACES

Provide an applied surface finish of Masonry Water proofer or Sealer to all exposed interior and exterior concrete finishes unless otherwise noted. Interior faces of walls of water retaining structures, including areas which are normally submerged, are considered to be exposed surfaces and shall receive the specified standard finish for exposed surfaces. The surface finish shall consist of chopping and/or grinding down all high spots removing grinding of all burrs and/or other projections, filling all voids 3/8" and larger, and cutting out all unsound concrete and patching as specified herein. Before applying the finish, wet and clean the surface of all grease, oils, efflorescence, and other foreign material. Dampen surface immediately ahead of application. Apply the finish coat with a tampico

fiber brush by laying the finish coat on the wall in a thick coat of a minimum of 2 lbs. per sq. yard, and brush to a uniform level surface. Do not apply in temperatures 40°F or below, or when temperatures are likely to fall below 40°F within 24 hours after application. The finish coat shall be mixed in strict accordance with the manufacturer's written instructions. After the finish coat has cured, apply a finish coat of masonry water proofer or sealer at a minimum of 12 lb. per sq. yd. Trained technicians shall apply the masonry water proofer or sealer.

C. SMOOTH FORM FINISH

Provide a smooth form finish for all exposed interior concrete walls inside buildings, in pipe gallery areas, or as noted on the Drawings. Standard form finish shall produce a smooth, hard, uniform texture on the concrete. The arrangement of the forms and the number of seams and joints shall be kept to a minimum. Immediately after forms are removed, cut out all unsound concrete and patch as specified herein, and fill all pinholes and other voids larger than 1/4" with a cement grout. Compress mortar into voids with a firm rubber trowel or float. After mortar dries, wipe off surface with burlap.

D. SLAB FINISHES

1. Scratched Finish

After the concrete has been placed, consolidated, struck off, and leveled to a Class C tolerance, the surface shall be roughened with stiff brushes or rakes before a final set. A scratched finish shall be applied to all surfaces which are to receive a bonded surface finish.

2. Floated Finish

After the concrete has been placed, consolidated, struck off, and leveled, the concrete shall not be worked further until ready for floating. Floating shall begin when the water sheen has disappeared and when the surface has stiffened sufficiently to permit the operation. During or after the first floating, planeness of surface shall be checked with a 10’-0” straight edge applied at not less than two different angles. All high spots shall be cut down and all low spots filled during this procedure to produce a surface with Class B tolerance throughout. This slab shall then be floated immediately to a uniform sandy texture. A float finish shall be applied to all slab surfaces, which are to receive a waterproofing membrane.

3. Troweled Finish

The surface shall first be float-finished as specified. It shall next be power troweled, and finally hand troweled. The first troweling after power floating shall produce a smooth surface, which may still show some

trowel, marks. Additional troweling shall be done by hand after the surface has hardened sufficiently. The final troweling shall be done when a ringing sound is produced as the trowel is moved over the surface. The surface shall be thoroughly consolidated by the hand troweling operations. The finished surface shall be essentially free of trowel marks, uniform in texture, and appearance, and shall be planed to a Class tolerance. On surfaces intended to support floor coverings, any defects of sufficient magnitude to show through the floor covering shall be removed by grinding. A trowel finish shall be applied to all surfaces, which are exposed to view or are to receive a floor covering of carpet, vinyl, asbestos, tiles, etc.

4. Broom Finish

Immediately after the concrete has received a float finish as specified in Section B, it shall be given a coarse transverse scored texture by drawing a broom or burlap belt across the surface. A broom finish shall be applied to all parking surfaces, exterior concrete walks, and concrete paving slabs.

3.12 FINISHING TOLERANCES

Finishes with a Class C tolerance shall be true planes within 1/4" in 2'-0" as determined by a 2'-0" straight edge placed elsewhere on the slab in any direction. Variation from level for Class A. tolerance shall not exceed 1/4" in 10'-0" or 1/2" maximum in any one bay between columns. Variation from level for a Class B and Class C finish shall not exceed 1/4" in 10'-0" or 3/4" in any one bay between columns.

3.13 RELATED UNFORMED SURFACES

As tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike off smooth and finish with a texture matching the adjacent formed surfaces. Continue the final surface treatment of formed surfaces uniformly across the adjacent unformed surface unless otherwise shown.

3.14 MISCELLANEOUS CONCRETE ITEMS

A. Provide monolithic finish to interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to a hard, dense finish with corners, intersections and terminations slightly rounded.

B. Provide machine and equipment bases and foundations, as shown on the drawings. Set anchor bolts for machines and equipment to template at correct elevations prior to placement of the concrete, complying with certified diagrams or templates of the manufacturer finishing machines and equipment.

3.15 INSPECTION

Before placing concrete, the formwork installation, reinforcing steel, and items to be embedded or cast-in must be complete. Notify other crafts involved in ample time to permit the installation of their work; co-operate with other trades in setting such work, as required. Notify Engineer upon completion of installation of all reinforcing and other items in ample time to permit inspection of the work before concrete is poured. Soil bottoms at foundation systems are subject to testing laboratory as directed by the Engineer. Place concrete immediately after approval of foundation excavations.

3.16 TESTING AND QUALITY CONTROL

A. The Owner shall employ a concrete testing laboratory to provide all laboratory testing services on the project and a concrete technician to perform all quality control tests on concrete and materials used to batch concrete. The testing agency employed shall meet the requirement of "Recommended Practice for Inspection and Testing Agencies for Concrete and Steel as Used in Construction", (ASTM E-329).

B. The Contractor shall provide and maintain adequate facilities on the project for the testing laboratory to locate the required testing equipment and for safe storage area for test cylinders. The general contractor shall provide at his own expense all casual labor needed to assist the concrete technician in obtaining samples of concrete and concrete materials and moving and transporting cylinders and materials which are being tested.

C. The following services shall be performed by the designated testing agency:

1. Review and/or check-test the Contractor's proposed materials for compliance with the specifications.

2. Review and/or check-test the Contractor's proposed mix design as required by the Engineer.

3. Secure production samples of materials at plants or stock-piles during the course of the work and test for compliance with the specifications as required by the Engineer.

4. Conduct strength tests of the concrete during construction in accordance with the following procedures:

a. Secure composite samples in accordance with "Method of Sampling Fresh Concrete" (ASTM C-172). Each sample shall be obtained from a different batch of concrete on a random basis, avoiding any selection of the test batch other than by a number selected at random before commencement of concrete placement.

b. Mold and cure three specimens from each sample in accordance with "Method of Making and Curing Concrete Compression and

Flexural Specimens in the Field" (ASTM C-31). Any deviations from the requirements of this Standard shall be recorded in the test report.

c. Test specimens in accordance with "Method of Test for Compression Strength of Molded Concrete Cylinders" (ASTM C-39). Two specimens shall be tested at 28 days for acceptance and one shall be the average of the strengths of the two specimens tested at 28 days. If one specimen in a test manifests evidence of improper sampling, molding or testing, it shall be discarded and the strength of the remaining cylinder shall be considered the test result. Should both specimens in the test show any of the above defects, the entire test shall be discarded. When high early strength concrete is used, the specimens shall be tested at the ages indicated in the Contract Documents.

d. Make at least one strength test for each 50 cu. yd., or fraction thereof, of each mix design of concrete placed in any l day. When the total quantity of concrete with a given mix design is less than 50 cu. yd., the strength test may be waived by the Engineer if, in his judgment, adequate evidence of satisfactory strength is provided, such as strength test results for the same kind of concrete supplied on the same day and under comparable conditions to other work or other projects.

5. Determine slump of the concrete sample for each strength test and whenever consistency of concrete appears to vary, using "Method of Test for Slump of Portland Cement Concrete" (ASTM C-143). Slump is to be 4” with a +/- 1” tolerance. Anything not in this range is to be approved by the engineer prior to placement.

6. Determine air content of normal weight concrete sample for each strength test in accordance with either "Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method" (ASTM C-231), "Method of Test for Air Content of Freshly Mixed Concrete by the Volumetric Method" (ASTM C-173), or "Method of Test for Weight per Cubic Foot, Yield and Air Content (Gravimetric) of Concrete", (ASTM C-138). Concrete shall be air entrained with 5-7% air.

7. Determine unit weight of concrete sample for each strength test.

8. Determine temperature of concrete sample for each strength test. If temperature is 90° or above, concrete is not to be used.

9. Determine in-place strength of concrete by curing cylinders under the same field conditions that the concrete representing these field cylinders is

cured and additionally by determining the degree/hours of curing required for the concrete to develop the required strength for form removal.

10. Inspect concrete batching, mixing and delivery operations to the extent deemed necessary by the Engineer.

3.17 EVALUATION AND ACCEPTANCE OF CONCRETE STRUCTURES

A. The concrete quality control testing as specified will be evaluated by the following criteria:

1. Compressive strength tests for laboratory-cured cylinders will be considered satisfactory if the averages of all sets of three consecutive compressive strength test results equal or exceed the 28-day design compressive strength of the type of class of concrete; and, no individual strength test falls below the required compressive strength by more than 500 psi. If compressive strength tests fail to meet these requirements, the concrete represented by these tests will be considered deficient and subject to additional testing and/or removal.

2. Concrete work, which does not conform to the specified requirements, including strength, tolerance and finishes, shall be corrected as directed at the Contractors expense, without extension of time therefor. The Contractor shall also be responsible for the cost of corrections to any other work affected by or resulting from correction to the concrete work. Core tests, if required, shall be evaluated in accordance with the requirements of ACI 318-77.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Type of the Contract.
   2. Work schedule and sequence.
   3. Use of premises.
   4. Work restrictions.
   5. Specification formats and conventions.

1.2 CONTRACTS

A. Project will be constructed under a Design/Build GMP

1.3 WORK SCHEDULE AND SEQUENCE

A. The Work shall be conducted in a single phase, with the date of Substantial Completion to be as indicated in the Agreement**.**

1.4 USE OF PREMISES

A. General: Contractor shall have full use of premises for construction operations, including use of Project site, during construction period. Contractor's use of premises is limited only by Owner's right to perform work or to retain other contractors on portions of Project.
   1. Driveways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
      a. Schedule deliveries to minimize use of driveways and entrances.
      b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

B. Deliveries: Provide representative to receive all materials and offload at the job site. The Owner will refuse all deliveries to other locations.

C. Personnel Identification: All construction personnel in occupied portions of the facility must wear Contractor-furnished identification badges at all times. Personnel without proper identification are subject to removal from the site by the Owner.

D. Safety and Security: Comply with Owner's requirements related to security and fire drills and alerts.

E. Burning/Welding Operations: Comply with Owner's requirements related to Burning and Welding permits. Coordinate turning off of fire/smoke detection systems in affected areas. Contractor shall be responsible for Fire Department response fees related to construction operations.

F. Smoking: No smoking is allowed on the premises, except within 20 feet of the Contractor's job office trailer or as otherwise designated by Owner's representative.

G. Use of Site: Limit use of premises to indicated areas within the Contract limits. Do not disturb portions of Project site beyond areas in which the Work is indicated.
   a. Limits: Confine constructions operations to areas indicated on Civil Drawings.

1.5 WORK RESTRICTIONS

A. On-Site Work Hours: Work shall be generally performed during normal business working hours of 7:00 a.m. to 9:00 p.m., Monday through Friday, except otherwise indicated. The Owner has the right to revise approved work hours at any time throughout the Project
   1. Weekend Hours:
      a. Saturday Hours: 8:00 a.m. to 6:00 p.m.
      b. Sunday Hours: 1:00 p.m. to 6:00 p.m.
   2. Early Morning Hours: Restrict noisy work until after 7:00 a.m.

1.6 SPECIFICATION FORMATS AND CONVENTIONS

A. Specification Format: The Specifications are organized into Divisions and Sections using the 33-division format and CSI/CSC's "MasterFormat" numbering system.

B. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred, as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.
2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.
    a. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 10 00

SECTION 012020

PROGRESS MEETINGS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. To enable orderly review of progress during construction and to provide for systematic discussions of problems, the architect will conduct project meetings throughout the construction period.

B. In general, project meetings will be held at the job site in accordance with a mutually acceptable schedule.

C. The purpose of the project meetings is analysis of problems that might arise relative to execution of the work.

1.3 RELATED SECTIONS

A. The Contractor's relations with his subcontractors and materials suppliers, and discussions relative thereto, are the Contractor's responsibility as described in the general conditions and are not part of project meetings content.

1.4 QUALITY ASSURANCE

A. Persons designated by the Contractor to attend and participate in project meetings shall have all required authority to commit the contractor to solutions as agreed upon in the project meetings.

1.5 SUBMITTALS

A. Agenda Items: To the maximum extent possible, advise the architect at least twenty-four (24) hours in advance of the project meeting regarding all items to be added to the agenda.

B. Minimum Agenda

1. Review work progress since last meeting.

2. Note field observations, problems and decisions.

3. Identify problems which impede planned progress.

4. Review off-site fabrication problems.

5. Develop corrective measures and procedures to regain schedule.

6. Coordinate projected progress with other prime contractors.

7. Review submittal schedules, expedite as required to maintain schedule.

C. Minutes: The Contractor shall compile minutes of each project meeting and shall distribute copies to the Owner and the Architect. The Contractor shall make and distribute such other copies as he wishes. The Architect and/or Owner may issue amendments to the minutes as necessary. Contractor shall issue same to other interested parties.

PART 2 PRODUCTS

(Not Applicable)

PART 3 EXECUTION

3.1 MEETING SCHEDULE

A. Coordinate with the Architect as required to establish a mutually acceptable schedule for project meetings.

3.2 MEETING LOCATION

A. Project meetings shall be held at the job site. Provide adequate space and facility including table, chairs, and lighting for proper conduct of meeting.

3.3 ATTENDANCE

A. Assign the same person or persons to represent the contractor at project meetings throughout the construction period. Subcontractors, materials suppliers, and others may be invited to attend those project meetings in which their aspects of the work are involved.

END OF SECTION

SECTION 012600

MODIFICATION PROCEDURES

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Minor Changes in the Work: The Architect will issue instructions authorizing minor changes in the Work on AIA Form G710.

B. Owner-Initiated Change Order Proposal Requests: The Architect will issue a description of proposed changes in the Work that require adjustment to the Contract Sum or Time. The description may include supplemental or revised Drawings and Specifications.

1. Proposal requests are for information only. Do not consider them an instruction to stop work or to execute the proposed change.

2. Within 3 days of receipt, submit an estimate of cost necessary to execute the change for the Owner's review.

a. Include an itemized list of products required and unit costs, with the total amount of purchases.

b. Indicate taxes, delivery charges, equipment rental, and amounts of trade discounts.

c. Indicate the effect the change will have on the Contract Time.

3. Contractor shall endeavor to solicit reasonable prices from high quality Subcontractors for any additional work required.

C. Contractor-Initiated Proposals: When unforeseen conditions require modifications, the Contractor may submit a request for a change to the Architect.

1. Describe the proposed change. Indicate reasons for the change and the effect of the change on the Contract Sum and Time.

2. Include an itemized list of products required and unit costs, with the total amount of purchases.

3. Indicate taxes, delivery charges, equipment rental, and amounts of trade discounts.

D. Proposal Request Form: Use AIA Document G709.

E. Allowance Adjustment: Base Change Order Proposals on the difference between the purchase amount and the allowance, multiplied by the measurement of work-in-place. Allow for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.

1. Include installation costs only where indicated as part of the allowance.

2. Prepare explanations and documentation to substantiate margins claimed.

3. Submit substantiation of a change in work claimed in the Change Orders related to unit-cost allowances.

F. Submit claims for increased costs because of a change in the allowance, whether for purchase order amount or handling, labor, installation, overhead, and profit. Submit claims within 7 days of receipt of authorization to proceed. The Owner will reject claims submitted later than 14 days.

G. Construction Change Directive: When Owner and Contractor disagree on the terms of a Proposal Request, the Architect may issue a Construction Change Directive on AIA Form G714 instructing the Contractor to proceed with a change.

1. The Construction Change Directive contains a description of the change and designates the method to be followed to determine change in the Contract Sum or Time.

H. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

1. After completing the change, submit an itemized account and supporting data to substantiate Contract adjustments.

I. Change Order Procedures: Upon the Owner's approval of a Proposal Request, the Contractor will issue a Change Order on AIA Form G701.

END OF SECTION

SECTION 012900

APPLICATIONS FOR PAYMENT

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Schedule of Values: Coordinate preparation of the Schedule of Values with preparation of the Contractor's Construction Schedule.

1. Correlate line items in the Schedule of Values with other required administrative schedules and forms, including:

a. Contractor's Construction Schedule.

b. Application for Payment forms, including Continuation Sheets.

c. List of subcontractors.

2. Submit the Schedule of Values at the earliest possible date but not later than 7 days before the date scheduled for submittal of the initial Applications for Payment.

B. Format and Content: Use the Project Manual table of contents as a guide to establish the format for the Schedule of Values. Provide at least one line-item for each Specification Section.

1. Include the following Project identification:

a. Project name and location.

b. Name of Architect.

c. Project number.

d. Contractor's name and address.

e. Date of submittal.

2. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:

a. Related Specification Section or Division.

b. Description of Work.

c. Name of subcontractor.

d. Name of manufacturer or fabricator.

e. Name of supplier.

f. Change Orders (numbers) that affect value.

g. Dollar value.

h. Percentage of Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.

3. Provide a breakdown of the Contract Sum in sufficient detail to facilitate evaluation of Applications for Payment. Break subcontract amounts down into several line items. Round amounts to nearest whole dollar; the total shall equal the Contract Sum.

4. Provide a separate line item for each part of the Work where Applications for Payment may include materials or equipment, purchased or fabricated and stored, but not yet installed.

5. Provide separate line items of initial cost of the materials, for each subsequent stage of completion, and for total installed value.

6. Show line items for indirect costs and margins on costs only when such items are listed individually in Applications for Payment. Each item in the Schedule of Values and Applications for Payment shall be complete. Include the total cost and proportionate share of general overhead and profit margin for each item.

   a. Items that are not direct cost of work-in-place may be shown as separate line items or distributed as general overhead expense

7. Update and resubmit the Schedule of Values when Change Orders or Construction Change Directives change the Contract Sum.

C. Applications for Payment shall be consistent with previous applications and payments as certified by the Architect and paid for by the Owner.

D. Payment-Application Times: Payment dates are indicated in the Agreement. The period covered by each application is the period indicated in the Agreement.

E. Payment-Application Forms: Use AIA Document G702 and Continuation Sheets G703 as the form for Applications for Payment.

F. Application Preparation: Complete every entry, including notarization and execution by a person authorized to sign on behalf of the Contractor. The Architect will return incomplete applications without action.

1. Entries shall match data on the Schedule of Values and the Contractor's Construction Schedule. Use updated schedules if revisions were made.

2. Include amounts of Change Orders and Construction Change Directives issued prior to the last day of the construction period covered by the application.

G. Transmittal: Submit 3 executed original copies of each Application for Payment to the Architect. One copy shall be complete, including waivers of lien and similar attachments.

1. Transmit each copy with a transmittal listing attachments and recording appropriate information related to the application.

H. Waivers of Mechanics Lien: Submit final Applications for Payment with final waivers from every entity involved with performance of the Work covered by the application who may file a lien. Submit waivers of lien on forms, and executed in a manner, acceptable to the Owner.

I. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of the first Application for Payment include the following:

1. List of subcontractors.

2. List of principal suppliers and fabricators.

3. Schedule of Values.

4. Contractor's construction Schedule.

5. Copies of building permits.

6. Copies of licenses from governing authorities.

7. Certificates of insurance and insurance policies.

J. Application for Payment at Substantial Completion: Following issuance of the Certificate of Substantial Completion, submit an Application for Payment.

1. Administrative actions and submittals that shall precede or coincide with this application include the following:

    a. Final cleaning.

K. Final Payment Application: Administrative actions and submittals that must precede or coincide with submittal of the final Application for Payment include the following:

1. Completion or Project close-out requirements.

2. Completion of items specified for completion after Substantial Completion.

3. Transmittal of Project construction records to the Owner.

END OF SECTION

SECTION 013100

COORDINATION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment and services necessary to complete the project coordination as specified herein, including but not limited to, the following:

1. General project coordination procedures.
2. Conservation.
3. Coordination drawings.
4. Administrative and supervisory personnel.
5. Cleaning and protection.

1.3 RELATED SECTIONS

A. Project meetings - Section 012020.

B. Submittals - Section 013300.

C. Product requirements - Section 016000.

D. Closeout procedures - Section 017700.

1.4 COORDINATION

A. Coordinate construction operations included in various sections of these specifications to ensure efficient and orderly installation of each part of the work. Coordinate construction operations included under different sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in the sequence required to obtain the best results where installation of one part of the work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components to ensure maximum accessibility for required maintenance, service, and repair.
3. Make provisions to accommodate items scheduled for later installation.

B. Where necessary, prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and attendance at meetings.

1. Prepare similar memoranda for the owner and separate contractors where coordination of their work is required.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and ensure orderly progress of the work. Such administrative activities include, but are not limited to, the following:

1. Preparation of schedules.

2. Installation and removal of temporary facilities.

3. Delivery and processing of submittals.

4. Progress meetings.

5. Project closeout activities.

D. Conservation: Coordinate construction operations to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.

1. Salvage materials and equipment involved in performance of, but not actually incorporated in, the work.

1.5 SUBMITTALS

A. Coordination Drawings: Prepare coordination drawings where careful coordination is needed for installation of products and materials fabricated by separate entities. Prepare coordination drawings where limited space availability necessitates maximum utilization of space for efficient installation of different components.

1. Show the relationship of components shown on separate shop drawings.

2. Indicate required installation sequences.

3. Comply with requirements contained in Division 1 Section "Submittals".

B. Staff Names: Within 15 days of commencement of construction operations, submit a list of the contractor's principal staff assignments, including the superintendent and other personnel in attendance at the project site. Identify individuals and their duties and responsibilities. List their addresses and telephone numbers.

1. Post copies of the list in the project meeting room, the temporary field office, and each temporary telephone.

PART 2 PRODUCTS

(Not Applicable)

PART 3 EXECUTION

3.1 GENERAL COORDINATION PROVISIONS

A. Inspection of Conditions: Require the installer of each major component to inspect both the substrate and conditions under which work is to be performed. Do not proceed until unsatisfactory conditions have been corrected in a manner acceptable to the Architect.

B. Coordinate temporary enclosures with required inspections and tests to minimize the necessity of uncovering completed construction for that purpose.

3.2 CLEANING AND PROTECTION

A. Clean and protect construction in progress and adjoining materials in place, during handling and installation. Apply protective covering where required to assure protection from damage or deterioration at substantial completion.

B. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to assure operability without damaging effects.

C. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period. Where applicable, such exposures include, but are not limited to, the following:

1. Excessive static or dynamic loading.
2. Excessive internal or external pressures.
3. Excessively high or low temperatures.
4. Thermal shock.
5. Excessively high or low humidity.
6. Air contamination or pollution.
7. Water or ice.
8. Solvents.
9. Chemicals.
10. Light.
11. Radiation.
12. Puncture.

13. Abrasion.
14. Heavy traffic.
15. Soiling, staining, and corrosion.
16. Bacteria.
17. Rodent and insect infestation.
18. Combustion.
19. Electrical current.
20. High-speed operation.
21. Improper lubrication.
22. Unusual wear or other misuse.
23. Contact between incompatible materials.
24. Destructive testing.
25. Misalignment.
26. Excessive weathering.
27. Unprotected storage.
28. Improper shipping or handling.
29. Theft.
30. Vandalism.

END OF SECTION

SECTION 013200

CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes administrative and procedural requirements for documenting the progress of construction during performance of the work, including but not limited to, the following:

1. Preliminary Construction Schedule.
2. Contractor's Construction Schedule.
3. Submittals Schedule.
4. Daily construction reports.
5. Material location reports.
6. Field condition reports.
7. Special reports.
8. Construction photographs.

1.3 RELATED SECTIONS

A. Progress meetings – Section 012020.

B. Submittals – Section 013000.

C. Coordination – Section 013100.

D. Closeout procedures – Section 017700.

1.4 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.

1. Critical activities are activities on the critical path. They must start and finish on the planned early start and finish times.
2. Predecessor activity is an activity that must be completed before a given activity can be started.

B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.

C. Critical Path: The longest continuous chain of activities through the network schedule that establishes the minimum overall Project duration and contains no float.

D. Event: The starting or ending point of an activity.

E. Float: The measure of leeway in starting and completing an activity.

1. Float time belongs to Owner.

2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the following activity.

3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

F. Fragnet: A partial or fragmentary network that breaks down activities into smaller activities for greater detail.

G. Major Area: A story of construction, a separate building, or a similar significant construction element.

H. Milestone: A key or critical point in time for reference or measurement.

I. Network Diagram: A graphic diagram of a network schedule, showing activities and activity relationships.

1.5 SUBMITTALS

A. Qualification Data: For firms and persons specified in "Quality Assurance" Article and in-house scheduling personnel to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

B. Submittals Schedule: Submit PDF copy of schedule. Arrange the following information in a tabular format:

1. Scheduled date for first submittal.

2. Specification Section number and title.

3. Submittal category (action or informational).

4. Name of subcontractor.

5. Description of the Work covered.

6. Scheduled date for Architect's final release.

C. Preliminary Construction Schedule: Submit PDF

D. Preliminary Network Diagram: Submit PDF.

E. Contractor's Construction Schedule: Submit PDF of initial schedule.

F. CPM Reports: Concurrent with CPM schedule, submit three printed copies of each of the following computer-generated reports. Format for each activity in reports shall contain activity number, activity description, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float.

1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.

2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.

3. Total Float Report: List of all activities sorted in ascending order of total float.

4. Earnings Report: Compilation of Contractor's total earnings from commencement of the Work until most recent Application for Payment.

G. Daily Construction Reports: Submit PDF at weekly intervals.

H. Material Location Reports: Submit PDF at monthly intervals.

I. Field Condition Reports: Submit PDF at time of discovery of differing conditions.

J. Special Reports: Submit two copies at time of unusual event.

K. Construction Photographs: Submit digital of each photographic view within seven days of taking photographs.

1. Format: Digital.

2. Identification: :

a. Name of Project.
b. Name and address of photographer.
c. Name of Architect.
d. Name of Contractor.
e. Date photograph was taken.
f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.

3. Submit Flash Drive of photographs.

1.6 QUALITY ASSURANCE

A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting.

B. Photographer Qualifications: An individual of established reputation who has been regularly engaged as a professional photographer for not less than three years.

C. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to the Preliminary Construction Schedule and Contractor's Construction Schedule, including, but not limited to, the following:

1. Review software limitations and content and format for reports.

2. Verify availability of qualified personnel needed to develop and update schedule.

3. Discuss constraints, including work stages, area separations, interim milestones, and partial Owner occupancy.

4. Review delivery dates for Owner-furnished products.

5. Review schedule for work of Owner's separate contracts.

6. Review time required for review of submittals and resubmittals.

7. Review requirements for tests and inspections by independent testing and inspecting agencies.

8. Review time required for completion and startup procedures.

9. Review and finalize list of construction activities to be included in schedule.

10. Review submittal requirements and procedures.

11. Review procedures for updating schedule.

1.7 COORDINATION

A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.

B. Coordinate Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from parties involved.

2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

C. Auxiliary Services: Cooperate with photographer and provide auxiliary services requested, including access to Project site and use of temporary facilities including temporary lighting.

PART 2 PRODUCTS

2.1 SUBMITTALS SCHEDULE

A. Preparation: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, resubmittal, ordering, manufacturing, fabrication, and delivery when establishing dates.

1. Coordinate Submittals Schedule with list of subcontracts, the Schedule of Values, and Contractor's Construction Schedule.

2. Initial Submittal: Submit concurrently with preliminary network diagram. Include submittals required during the first 60 days of construction. List those required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.

3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's Construction Schedule.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Procedures: Comply with procedures contained in AGC's "Construction Planning & Scheduling."

B. Time Frame: Extend schedule from date established for commencement of the Work to date of Final Completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

C. Activities: Treat each story or separate area as a separate numbered activity for each principal element of the Work. Comply with the following:

1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.

2. Procurement Activities: Include procurement process activities for long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.

3. Submittal Review Time: Include review and resubmittal times indicated in Division 1 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with Submittals Schedule.

4. Startup and Testing Time: Include not less than 10 days for startup and testing.

5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect’s administrative procedures necessary for certification of Substantial Completion.

D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.

1. Phasing: Arrange list of activities on schedule by phase.

2. Work under More Than One Contract: Include a separate activity for each contract.

3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.

4. Products Ordered in Advance: Include a separate activity for each product. Include delivery date. Delivery dates indicated stipulate the earliest possible delivery date.

5. Work Restrictions: Show the effect of the following items on the schedule:

    a. Coordination with existing construction.
    b. Limitations of continued occupancies.
    c. Uninterruptible services.
    d. Partial occupancy before Substantial Completion.
    e. Use of premises restrictions.
    f. Provisions for future construction.
    g. Seasonal variations.
    h. Environmental control.

6. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:

    a. Subcontract awards.
    b. Submittals.
    c. Purchases.
    d. Mockups.
    e. Fabrication.
    f. Sample testing.
    g. Deliveries.
    h. Installation.
    i. Tests and inspections.
    j. Adjusting.
    k. Curing.
    l. Startup and placement into final use and operation.

7. Area Separations: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:

    a. Structural completion.
    b. Permanent space enclosure.
    c. Completion of mechanical installation.
    d. Completion of electrical installation.
    e. Substantial Completion.

E. Milestones: Include milestones indicated in the schedule.

F. Cost Correlation: At the head of schedule, provide a cost correlation line, indicating planned and actual costs. On the line, show dollar volume of the Work performed as of dates used for preparation of payment requests.

G. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using fragnets to demonstrate the effect of the proposed change on the overall project schedule.

H. Computer Software: Prepare schedules using a program that has been developed specifically to manage construction schedules.

2.3 PRELIMINARY CONSTRUCTION SCHEDULE

A. Bar-Chart Schedule: Submit preliminary horizontal bar-chart-type construction schedule within seven days of date established for commencement of the Work.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 60 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

2.4 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

A. General: Prepare network diagrams using AON (activity-on-node) format.

B. Preliminary Network Diagram: Submit diagram within 14 days of date established for commencement of the Work. Outline significant construction activities for the first 60 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

C. CPM Schedule: Prepare Contractor's Construction Schedule using a CPM network analysis diagram.

1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 30 days after date established for commencement of the Work.

2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.

3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.

4. Use "one workday" as the unit of time.

D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the preliminary network diagram, prepare a skeleton network to identify probable critical paths.

1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:

a. Preparation and processing of submittals.
b. Purchase of materials.
c. Delivery.
d. Fabrication.
e. Installation.

2. Processing: Process data to produce output data or a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.

3. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.

   a. Sub-networks on separate sheets are permissible for activities clearly off the critical path.

E. Initial Issue of Schedule: Prepare initial network diagram from a list of straight "early start-total float" sort. Identify critical activities. Prepare tabulated reports showing the following:

1. Contractor or subcontractor and the Work or activity.

2. Description of activity.

3. Principal events of activity.

4. Immediate preceding and succeeding activities.

5. Early and late start dates.

6. Early and late finish dates.

7. Activity duration in workdays.

8. Total float or slack time.

9. Average size of workforce.

10. Dollar value of activity (coordinated with the Schedule of Values).

F. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:

1. Identification of activities that have changed.

2. Changes in early and late start dates.

3. Changes in early and late finish dates.

4. Changes in activity duration’s in workdays.

5. Changes in the critical path.

6. Changes in total float or slack time.

7. Changes in the Contract Time.

G. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.

1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.

2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.

3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.

4. Prepare list for ease of comparison with payment requests; coordinate timing with progress meetings.

a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.
b. Submit value summary printouts one week before each regularly scheduled progress meeting.

2.5 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.

2. List of separate contractors at Project site.

3. Approximate count of personnel at Project site.

4. High and low temperatures and general weather conditions.

5. Accidents.

6. Meetings and significant decisions.

7. Unusual events (refer to special reports).

8. Stoppages, delays, shortages, and losses.

9. Meter readings and similar recordings.

10. Emergency procedures.

11. Orders and requests of authorities having jurisdiction.

12. Change Orders received and implemented.

13. Construction Change Directives received.

14. Services connected and disconnected.

15. Equipment or system tests and startups.

16. Partial Completions and occupancies.

17. Substantial Completions authorized.

B. Material Location Reports: At monthly intervals, prepare a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site.

C. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare a detailed report. Submit with a request for information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.6 SPECIAL REPORTS

A. General: Submit special reports directly to Owner within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.

B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

PART 3 EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

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

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.

2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, duration’s, actual starts and finishes, and activity duration’s.

3. As the Work progresses, indicate Actual Completion percentage for each activity.

B. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

1. Post copies in Project meeting rooms and temporary field offices.

2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have

completed their assigned portion of the Work and are no longer involved in performance of construction activities.

3.2 CONSTRUCTION PHOTOGRAPHS

A. Photographer: Engage a qualified commercial photographer to take construction photographs.

B. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the work. Photographs with blurry or out-of-focus areas will not be accepted.

1. Maintain key plan with each set of construction photographs that identifies each photographic location.

C. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.

1. Date and Time: Include date and time in the file name for each image.

D. Preconstruction Photographs: Before starting construction, take four color photographs of Project site and surrounding properties from different vantage points, as directed by Architect. Show existing conditions adjacent to property.

E. Periodic Construction Photographs: Take four color photographs monthly, coinciding with cutoff date associated with each Application for Payment. Photographer shall select vantage points to best show status of construction and progress since last photographs were taken.

F. Final Completion Construction Photographs: Take eight color photographs after date of Substantial Completion for submission as Project Record Documents. Architect may direct photographer for desired vantage points.

END OF SECTION

SECTION 013300

SUBMITTALS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment and services necessary to complete submittal requirements as specified herein, including, but not limited to, the following:

1. Shop drawings and samples.

2. Integrated drawings.

1.3 RELATED SECTIONS

A. Progress schedule – Section 013200.

PART 2 PRODUCTS

2.1 SHOP DRAWINGS AND SAMPLES

A. General

1. The Contractor shall be responsible for coordinating the schedule for submittal of shop drawings and samples with his progress schedule and the requirements of the Contract Schedule, and submit a coordinated schedule of submission of all shop drawings and samples to the Architect.

2. Failure of the Contractor to schedule and submit shop drawings and samples in ample time for checking, correction, and rechecking will not justify any delay in the Contract Schedule. Allow ample time for items to be tested, including time for retesting if the tests or mock-ups fail.

3. Samples, shop drawings, manufacturers' literature, and other required information shall be submitted in sufficient time to permit proper consideration and action on same before any materials and items are delivered on the work. Stagger submissions so that the Architect can review the documents in an orderly and timely manner. All samples of materials requiring laboratory tests shall be submitted to the laboratory for testing not less than 90 days before such materials are required to be used in the work. All other samples, manufacturers' literature, and other sample information shall be submitted for approval not less than 30 days before such materials are required to be used in the work.

4. Shop drawings for each Section of the work shall be numbered consecutively, and the numbering system shall be retained throughout all revisions. Each drawings shall have a clear space for the stamps of the Contractor, Architect, and one of the Architect's consultants.

5. All shop drawings shall be thoroughly checked by the Contractor for compliance with the Contract Documents before submitting them to the Architect and shall bear the Contractor's stamp of approval certifying that they have been so checked. Any shop drawings submitted without this stamp of approval and certification, and shop drawings which, in the Architect's opinion, are incomplete, contain errors or have not been checked, or only checked superficially, will be returned unchecked by the Architect for re-submission by the Contractor.

6. In checking shop drawings, the Contractor shall verify all dimensions and field conditions and shall check and coordinate the shop drawings of any Section or trade with the requirements of all other Sections or trades whose work is related thereto, as required for proper and complete installation of the work. The Architect will review shop drawings. The Architect's acceptance of shop drawings is for design only and not method of assembly or erection. Acceptance shall in no way be construed as (1) permitting any departure whatsoever from the Contract Documents; (2) relieving the Contractor of full responsibility for any error in details, dimensions, omissions, or otherwise that may exist; (3) relieving the Contractor of full responsibility for adequate field connections, erection techniques, bracing, or deficiencies in strength; (4) relieving the Contractor of full responsibility for satisfactory performance of all work and coordination with the work of all subcontractors and other contractors; or (5) permitting departure from additional details or instructions previously furnished by the Architect. Acceptance of such drawings shall not be construed as a complete check, nor shall it relieve the Contractor from responsibility for proper fitting of the work, nor from the necessity of furnishing any work which may not be indicated on shop drawings when approved. The Contractor shall be solely responsible for any quantities which may be shown on the shop drawings.

7. No work shall be fabricated, manufactured, or installed from shop drawings stamped "Revise and Resubmit" or "Rejected", and such shop drawings shall be corrected and resubmitted by the Contractor until accepted by the Architect. At least one complete set of "No Exceptions Taken and/or Make Corrections Noted" shop drawings shall be kept at the site in the Contractor's field office for reference at all times. "Revise and Resubmit" or "Rejected" shop drawings shall not be permitted at the site.

8. Submittals marked "No Exceptions Taken":

    a. Submittals which require no corrections by the Architect will be marked "No Exceptions Taken".

9. Submittals marked "Make Corrections Noted":

    a. Submittals which require only a minor amount of correcting shall be marked "Make Corrections Noted". This mark shall mean that checking is complete and all corrections are obvious without ambiguity. Fabrication will be allowed on work marked "Make Corrections Noted" provided such action will expedite construction and noted corrections are adhered to. If fabrication is not made strictly in accordance with corrections noted, the item shall be rejected in the field, and the Contractor will be required to replace such work in accordance with corrected submittals.

10. Submittals marked "Revise and Resubmit" or "Rejected":

    a. When submittals are contrary to contract requirements or too many corrections are required, they shall be marked "Revise and Resubmit" or "Rejected". No work shall be fabricated under this mark. The Architect shall list his reasons for rejection on the submittals or in the transmittal letter accompanying their return. The submittals must be corrected and resubmitted for approval.

11. All shop drawings and samples shall be identified as follows:

    a. Date of submittal.
    b. Title of project.
    c. Name of Contractor and date of his approval.
    d. Name of subcontractor or supplier and date of submittal to Contractor.
    e. Number of submission.
    f. Any qualification, departure, or deviation from the requirements of the Contract.
    g. Federal Specification or ASTM number where required.
    h. Such additional information as may be required by the Specifications for the particular material being furnished.

12. If the Contractor wishes to deviate from the materials or details as shown in Specifications or Drawings, he shall submit the proposed deviation with shop drawings and/or samples stating the extent and the materials or details being replaced. The Contractor shall also submit information on the allowed credit or extra cost required for the proposed deviation, and also all information relating to the work of other Sections revised by the proposed deviation.

13. The Architect will review and approve shop drawings and samples for approval within 15 calendar days, but only for conformance with the design concept of the work and with information contained in the Contract Documents. Resubmittals and additional 15 days shall be required.

14. Incomplete shop drawings will be returned without checking for proper submission, and this shall not be considered as cause for delay of the work or extra compensation to the Contractor.

15. The Contractor shall submit appropriate transmittal forms with every submittal of shop drawings, manufacturer's literature, and samples. All reproducibles shall be rolled on cardboard tubes for resubmittal. The Contractor shall submit all required

shop drawings, manufacturer's literature and samples in accordance with the procedures specified herein.

16. Unless otherwise specifically directed by the Architect, make all shop drawings accurately to a scale sufficiently large to show all pertinent features of the item and its method of connection to the work.

17. Submit newly prepared information drawn accurately to scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to the Project is not a Shop Drawing.

18. The Contractor shall submit one copy of each standard referred to in the Specifications (ASTM, Fed. Spec., etc.) with the submission of each respective shop drawing, sample, or literature.

B. Submission of Shop Drawings

1. Architectural Work: Submit pdf of each shop drawing to the Architect for approval. If approved, the Architect will return pdf stamped "No Exceptions Taken" or "Make Corrections Noted", and the Contractor shall print the required number of copies. In the event the Architect returns pdf stamped "Revise and Resubmit" or "Rejected", the Contractor shall make indicated changes and resubmit to the Architect.

2. Structural Work and Mechanical Work: Submit pdf of each shop drawing to the Engineer and Architect. If accepted, the Architect shall return pdf stamped "No Exceptions Taken" or "Make Corrections Noted", and the Contractor shall print the required number of copies. In the event the Architect returns pdf stamped "Revise and Resubmit" or "Rejected", the Contractor shall make indicated changes and resubmit pdf to the Engineer and the Architect.

3. Prints: The Contractor shall provide all prints or shop drawings as reasonably required by subcontractors, material suppliers, superintendents, inspectors, and others as required for the work, or as directed by the Architect. The Contractor shall pay all costs in connection with printing and distribution of shop drawings.

C. Submission of Manufacturer's Literature, Including Catalog, Catalog Cuts, Brochures, Charts, Test Data, and Similar Information

1. Manufacturer's literature will receive consideration only when accompanied by the transmittal form properly filled out, as indicated, and listing each item of literature, as well as the Specification Section and paragraph numbers describing such materials. Any deviations from contract requirements shall be stated on the above form or attached to it.

2. Architectural Work: Submit pdf of manufacturer's literature to the Architect for acceptance. If accepted, the Architect will return pdf stamped "No Exceptions Taken" or "Make Corrections Noted". In the event the Architect returns the literature stamped "Revise and Resubmit" or "Rejected", he will return pdf. The Contractor shall resubmit pdf of correct or corrected literature of all submissions stamped by the Architect "Revise and Resubmit" or "Rejected".

3. Structural Work and Mechanical Work: Submit pdf of manufacturer's literature to the Engineer and the Architect. If accepted, the Architect will return pdf stamped "No Exceptions Taken" or "Make Corrections Noted". In the event the Architect stamps the literature "Revise and Resubmit" or "Rejected", he will return pdf. The Contractor shall resubmit pdf of correct or corrected literature to the Engineer and Architect for all submissions stamped "Revise and Resubmit" or "Rejected" by the Engineer.

4. All copies of manufacturer's literature required to be resubmitted hereunder shall be original printed material. Reproductions of printed material will not receive consideration.

D. Submission of Samples

1. All samples shall be submitted in triplicate unless otherwise indicated in the Specifications.

2. Samples will receive consideration only when accompanied by the transmittal form properly filled out, as indicated, and listing each sample, as well as the listing of any ASTM, Federal or other standard references specified or applicable and such additional information as may be required by the Specifications for the materials being submitted. Any deviation from the contract requirements shall be so stated on the above form or attached to it.

3. The Architect shall have the right to require submission of samples of any materials, whether or not specifically indicated in the various Sections of the Specifications.

4. Unless otherwise specified, samples of sufficient size to indicate general visual effect shall be submitted. Where samples must show a range of color, texture, finish, graining, or other similar property, the Contractor shall submit sets of pairs illustrating the full scope of the range.

5. One (1) sample of each submission will be returned to the Contractor. Samples stamped "Revise and Resubmit" or "Rejected" by the Architect shall be resubmitted in triplicate by the Contractor.

6. All samples stamped "No Exceptions Taken" or "Make Corrections Noted" shall be kept at the site in the Contractor's field office facilities for reference at all times. "Revise and Resubmit" or "Rejected" samples shall not be kept at the site.

2.2 INTEGRATED DRAWINGS

A. The HVAC subcontractor shall prepare a Drawing or Drawings showing duct work, heating and sprinkler piping. This Drawing shall include location of grilles, registers, etc., and access doors in hung ceilings. Locations shall be fixed by elevations and dimensions from column center lines and/or walls.

B. The HVAC subcontractor shall prepare and distribute to the Plumbing and Electrical subcontractors, the General Contractor, and to the Architect electronic drawing of above.

C. The HVAC subcontractor shall lay out on their electronic drawing the reflected ceiling plan, beam soffit elevations, ceiling heights, roof openings, etc.

D. The Plumbing subcontractor shall lay out on their electronic drawing the piping, valves, clean-outs, etc., indicating locations and elevations and shall indicate the necessary access doors.

E. The Electrical subcontractor shall indicate on their electronic the fixtures, large conduit runs, clearances, pull boxes, junction boxes, sound system speakers, etc.

F. The General Contractor shall indicate on their electronic drawings any structural framing, ceiling hangers, etc.

G. The General Contractor shall call as many meetings with the subcontractors as are necessary to resolve any conflicts that become apparent. He will call on the services of the Consultant Engineer or Architect where necessary. The General Contractor is responsible for the coordination of the Drawing or Drawings.

H. On resolution of the conflicts, each subcontractor shall enter their own work on the HVAC subcontractor's electronic drawings, which shall become the master or integrated Drawings. The master reproducible shall be signed by each contributing subcontractor to indicate his acceptance of the arrangement of the work.

I. A electronic drawing of the master integrated Drawing will be prepared by the HVAC subcontractor. The General Contractor will make distribution.

J. Each subcontractor shall prepare his Shop Drawings in accordance with the integrated Drawings. No work will be permitted without approved Shop Drawings. It is therefore essential that this procedure be instituted as quickly as possible.

PART 3 EXECUTION

3.1 COORDINATION OF SUBMITTALS

A. Prior to submittal for Architect's review, use all means necessary to fully coordinate all material, including the following procedures:

1. Determine and verify all field dimensions and conditions, materials, catalog numbers and similar data.

2. Coordinate as required with all trades and with public agencies involved.

3. Secure all necessary approvals from public agencies and others and signify by stamp, or other means, that they have been secured.

4. Clearly indicate all deviations from the Contract Documents.

B. Unless otherwise specifically permitted by the Architect, make all submittals in groups containing all associated items; the Architect may reject partial submittals as not complying with the provisions of the Contract Documents.

END OF SECTION

SECTION 014000

QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. This Section includes administrative and procedural requirements for quality assurance and quality control.

1.3 RELATED SECTIONS

A. Coordination – Section 013100.

B. Testing and inspection – Section 014100.

C. Divisions 2 through 32 Sections for specific test and inspection requirements.

1.4 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and ensure that proposed construction complies with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that completed construction complies with requirements. Services do not include contract enforcement activities performed by Architect.

C. Mockups: Full-size, physical example assemblies to illustrate finishes and materials. Mockups are used to verify selections made under Sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples. Mockups establish the standard by which the Work will be judged.

D. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

1.5 DELEGATED DESIGN

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

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

1.6 SUBMITTALS

A. Qualification Data: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

B. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

C. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

1. Specification Section number and title.
2. Description of test and inspection.
3. Identification of applicable standards.
4. Identification of test and inspection methods.
5. Number of tests and inspections required.
6. Time schedule or time span for tests and inspections.
7. Entity responsible for performing tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

D. Reports: Prepare and submit certified written reports that include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Ambient conditions at time of sample taking and testing and inspecting.

11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.

12. Name and signature of laboratory inspector.

13. Recommendations on retesting and reinspecting.

E. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.7 CONFLICTING REQUIREMENTS

A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Architect regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Architect for clarification before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified is the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.8 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

B. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

C. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

D. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the State of South Caroloina and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.

F. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

1. Requirement for specialists shall not supersede building codes and similar regulations governing the Work, nor interfere with local trade-union jurisdictional settlements and similar conventions.

G. Testing Agency Qualifications: An agency with the experience and capability to conduct testing and inspecting indicated, as documented by ASTM E 548, and that specializes in types of tests and inspections to be performed.

H. Preconstruction Testing: Testing agency shall perform preconstruction testing for compliance with specified requirements for performance and test methods.

1. Contractor responsibilities include the following:

a. Provide test specimens and assemblies representative of proposed materials and construction. Provide sizes and configurations of assemblies to adequately demonstrate capability of product to comply with performance requirements.
b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
c. Fabricate and install test assemblies using installers who will perform the same tasks for Project.
d. When testing is complete, remove assemblies; do not reuse materials on Project.

2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

I. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.

2. Notify Architect seven days in advance of dates and times when mockups will be constructed.

3. Demonstrate the proposed range of aesthetic effects and workmanship.

4. Obtain Architect's approval of mockups before starting work, fabrication, or construction.

5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

6. Demolish and remove mockups, unless otherwise directed by the Architect.

PART 2 PRODUCTS

(Not Applicable)

PART 3 EXECUTION

3.1 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Sections of these Specifications. Restore patched areas and extend restoration into adjoining areas in a manner that eliminates evidence of patching.

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION

SECTION 014100

TESTING AND INSPECTION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment and services necessary to complete the testing and inspection requirements as specified herein.

1.3 RELATED SECTIONS

A. Requirements for testing and inspection shall be described in various Sections of these Specifications. Where no testing and inspection requirements are described but the Owner decides that it is required, the Owner may require additional testing and inspection to be performed at his own expense.

B. Work Not Included

1. Unless otherwise noted in this Section or other Section of work, the Owner will select a pre-qualified independent testing laboratory and inspection professional.

2. Unless otherwise noted in this Section or other Sections of work, the Owner will pay for all initial services of the testing laboratory and inspection professionals as further described in Article 2.1 of this Section of these Specifications.

1.4 QUALITY ASSURANCE

A. The testing laboratory will be qualified to the Owner's approval in accordance with ASTM E 329-13b "Standard Specification for Agencies Engaged in Construction Inspection, Testing or Special Inspection."

B. Testing, when required, will be in accordance with all pertinent codes and regulations and with selected standards of the American Society for Testing and Materials.

1.5 PRODUCT HANDLING

A. Promptly process and distribute all required copies of test reports and related instructions to ensure all necessary retesting and/or replacement of materials with the least possible delay in progress of the work.

PART 2 PRODUCTS

2.1 PAYMENTS FOR TESTING AND INSPECTION SERVICES

A. Initial Services: The Owner will pay for all initial testing and inspection services.

B. Retesting: When initial tests and inspections indicate non-compliance with local Codes and the Contract Documents, all subsequent retesting occasioned by the non-compliance shall be performed by the same testing laboratory and inspectors and the costs thereof will be deducted by the Owner from the Contract Sum.

2.2 CODE COMPLIANCE TESTING AND INSPECTION

A. Inspections and tests required by Codes or Ordinances, or by a plan approval authority, shall be paid by for by the Owner unless otherwise noted in this Section or other Sections of work. Retesting or inspection as required shall conform to the requirements of Article 2.1 B of this Section.

2.3 CONTRACTOR'S TESTING

A. Inspection or testing performed exclusively for the Contractor's convenience shall be the sole responsibility of the Contractor.

B. Where operating tests are specified, the Contractor shall test his work as it progresses, on his own account, and shall make satisfactory preliminary tests in all cases before applying for official tests.

C. Tests shall be made in the manner specified, for the different branches of the work. Each test shall be made on the entire system for which such test is required, wherever practical. In case it is necessary to test portions of the work independently, the Contractor shall do so without extra compensation. The Contractor shall furnish all labor, material and apparatus, make corrections and conduct the official test. The test will be conducted in the presence of a representative of the Architect.

D. All parts of the mechanical and electrical work and associated equipment shall be tested and adjusted to work properly and be left in perfect operating condition. All defects disclosed by these tests shall be corrected to the satisfaction of the Architect and Engineer without any additional cost to the Owner. Tests shall be repeated on this repaired or replaced work if deemed necessary by the Architect. The Architect shall be notified at least forty-eight (48) hours in advance of all tests, and shall be represented at tests that he deems necessary. The Contractor shall furnish all necessary instruments, other equipment, and personnel required for such tests.

E. Required certificates of inspection, testing or approval shall be secured by the Contractor and promptly delivered by him to the Architect.

F. If the Architect or Engineer is to observe the inspections, tests or approvals required by the Contract Documents, he will endeavor to do so promptly and, where practicable, at the source of supply.

PART 3 EXECUTION

3.1 COOPERATION WITH TESTING LABORATORY AND INSPECTORS

A. Representatives of the testing laboratory and inspectors shall have access to the work at all times. Provide facilities for such access in order that they may properly perform their functions.

3.2 SCHEDULES

A. Establishing Schedule

1. By advance discussions with the inspection service and testing laboratory selected by the Owner, determine the time required to perform inspections and tests and to issue each of its findings.

2. Provide all required time within the construction schedule.

B. Revising Schedule

1. When changes of construction schedule are necessary during construction, coordinate all such changes of schedule with the inspectors and testing laboratory as required.

C. Adherence to Schedule

1. When the testing laboratory is ready to test according to the determined schedule but is prevented from testing or taking specimens due to incompleteness of the work, all extra costs for testing attributable to the delay will be back-charged to the Contractor.

3.3 TAKING SPECIMENS

A. All specimens and samples for testing, unless otherwise provided in these Contract Documents, will be taken by the testing laboratory; all sampling equipment and personnel will be provided by the testing laboratory; and all deliveries of specimens and samples to the testing laboratory will be performed by the testing laboratory.

END OF SECTION

SECTION 015000

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment and services necessary to complete the construction facilities and temporary controls as shown on the drawings and specified herein, including but not limited to, the following:

1. Construction sign.
2. Stairs, and ladders.
3. Rodent control.
4. Construction fence.
5. Field office.
6. Fire protection.
7. Temporary utilities.
8. Temporary toilets.
9. Temporary roads and site access.
10. Security.
11. Water and snow control.
12. Environmental controls.

1.3 RELATED SECTIONS

A. Materials and equipment - Section 016000.

B. Cleaning - Section 017300.

PART 2 PRODUCTS

2.1 GENERAL

A. Arrange for and provide temporary facilities and controls as specified herein and as required for the proper and expeditious prosecution of the work. Pay all costs, except

as otherwise specified, until final acceptance of the work unless the Owner makes arrangements for the use of completed portions of the work after substantial completion.

B. Make all temporary connections to utilities and services in locations acceptable to the local authorities having jurisdiction thereof; furnish all necessary labor and materials, and make all installations in a manner subject to the acceptance of such authorities; maintain such connections; remove the temporary installation and connections when no longer required; restore the services and sources of supply to proper operating condition.

C. Unless otherwise noted, pay all costs for temporary electrical power, temporary water, and temporary heating; provide metering as necessary.

D. A Staging Plan shall be submitted by the Contractor for approval by the Owner. The Staging Plan shall locate all temporary facilities and services, including parking for the Contractor's employees, within the limits of the staging areas, and shall allot ground space to Subcontractors for storage of materials, and the erection of sheds and tool houses. Materials and equipment can only be stored in the staging area. No parking for Contractor's or Subcontractors' employees' vehicles will be allowed in undesignated parking areas. The staging area shall be maintained in good repair, free of mud and standing water, and passable at all times. All materials stored within the project site are the responsibility of the Contractor. At the completion of the work, the staging areas shall be restored to their original condition, gravel removed, topsoil replaced and graded and re-seeded.

2.2 PROJECT IDENTIFICATION

A. No signs or advertisements will be allowed to be displayed on the premises without the approval of the Architect.

B. One construction sign on the site shall be provided by the Contractor and shall be subject to the review of the Architect and the approval of the Owner.

C. Erect the construction sign on the site where directed by the Architect. Provide sign approximately 4 ft. x 8 ft. in size, of 3/4 in. plywood with structural supports. Use Douglas Fir Overlaid Plywood, Grade B-B high density, exterior, good two sides, complying with PS-1. The sign shall be primed and given two coats of alkyd white paint. Lettering shall be black of a type, size, and lay-out as directed by the Owner. Sign shall contain the name of the Building, Owner, Architect, Contractor, and such other reasonable information as the Architect or Owner may require.

2.3 RODENT CONTROL

A. Institute an effective program of rodent control for the entire site within the construction limits. Cooperate with local authorities and provide the regular services of an experienced exterminator who shall visit the site at least once a month for the entire construction period. Provide marked metal containers for all edible rubbish and enforce their use by all employees. Containers shall be emptied and the contents removed from the site as often as required to maintain an adequate rodent control program. If the program of rodent control used is not effective, take whatever steps are necessary to rid the project of rodents, and such action shall not be the basis of a claim for additional compensation or damages.

2.4 TEMPORARY CONSTRUCTION OPENINGS

A. Provide openings in slabs, walls, and partitions where required for moving in large pieces of equipment of all types. Close and/or restore all openings and finish them after the equipment is in place. Structural modification, if required, shall be subject to review by the Architect.

2.5 TEMPORARY FENCE

A. Provide and maintain an 8 foot high temporary fence to enclose the area at the job site and to guard and close effectively the designated area. Provide gates at locations where required for access to the enclosed area. Gates shall be cross-braced, hung on heavy strap hinges, and shall have hasps and padlocks. Submit shop drawings of fence and gates for review of Architect and Owner. Paint the fence with two coats of an approved paint.

B. Remove the fence upon completion of the work or at such time before final completion as directed by the Owner.

2.6 TEMPORARY FIELD OFFICES

A. Provide and maintain a field office with a telephone and fax at the job site with not less than 200 square feet of space. The office shall be complete with light, heat, air conditioning, toilet facilities, electric water cooler, plan racks, four-drawer metal file with lock, shelves for samples, tables, chairs, and janitor service. When it becomes possible to establish an office in the building, office accommodation of approximately the same size as those in the field offices, including the services above, shall be provided and maintained until the issuance of a certificate of substantial completion. Temporary offices shall be removed when no longer required. Provide a high speed wifi connection and pay all charges for installation.

2.7 FIRE PROTECTION

A. Provide and maintain adequate fire protection, ready for instant use, distributed around the project.

B. Make arrangements for periodical inspection by local fire protection authorities and insurance underwriters inspections. Cooperate with said authorities and promptly carry out their recommendations.

C. Open fire will not be permitted within the building enclosure or on the project site.

2.8 TEMPORARY HEAT AND VENTILATION

A. Provide temporary heat as required during construction to protect the work from freezing or frost damage, and as necessary to ensure suitable working conditions for the construction operations of all trades. In areas of the building where work is being conducted, the temperature shall be maintained as specified in the various sections of the Specifications, but not less than 45 degrees Fahrenheit. Under no circumstances shall the temperature be allowed to reach a level that will cause damage to any portion of the work which may be subject to damage by low temperatures.

B. Until the building, or any major portion thereof, is enclosed, temporary heating shall be by smokeless portable unit heaters of type listed by Underwriter's Laboratories, Factory

Mutual, and the Fire Marshall. Pay for fuel, maintenance, and attendants required in connection with the portable unit heaters. Interior or exterior surfaces damaged by the use of these space heaters shall be replaced by new materials or be refinished.

C. The building shall be considered enclosed when it has reached the stage when exterior walls have been erected, the roof substantially completed, exterior openings closed up either by the permanently glazed windows and doors, or by adequate temporary closing, and the building is ready for interior masonry and plastering operations.

D. After the building, or any major portion thereof, has been enclosed, the permanent heating system as specified below may be used for temporary heat.

E. When the permanent heating system, or a suitable portion thereof, is in operating condition, the system may be used for temporary heating, provided that the Contractor assumes full responsibility for the entire heating system, and pays all costs for fuel, operation, maintenance, and restoration of the system.

F. Provide adequate ventilation as required to keep the temperature of the building within 10 degrees Fahrenheit of the ambient outdoor temperature when such ambient temperature exceeds 70 degrees Fahrenheit, and to prevent accumulation of excess moisture or to prevent excess thermal movement in the building.

G. When the permanent air circulation system, or a suitable portion thereof, is in operating condition, it may be used without refrigeration or chilling, provided that the Contractor assumes full responsibility for the system which he is using, and pays costs for power, operation, maintenance, and restoration of the system. Provide temporary filters to adequately filter air being distributed through the duct work to the supply outlets; disposable filters shall be placed in front of all exhaust registers to keep construction dirt out of exhaust duct work. The Contractor shall thoroughly clean the interior of the air handling units and duct work prior to acceptance of the work.

H. Upon conclusion of the temporary heating period, remove all temporary piping, temporary heating units, or other equipment and pay all costs in connection with repairing any damage caused by the installation or removal of temporary heating equipment. Thoroughly clean and recondition those parts of permanent heating and air circulation systems used for temporary service.

2.9 TEMPORARY LIGHT AND POWER

A. Make all arrangements with the local electric company for temporary electrical service to the construction site; provide all equipment necessary for temporary power and lighting; and pay all charges for this equipment, the installation thereof, and for current used. The electrical service shall be of 120v and 240v for single phase loads up to 30 amps for all construction tools and equipment without overloading the temporary facilities and shall be made available for power, lighting, and construction operations of all trades.

B. In addition to the electrical service, provide power distribution as required throughout structure. The terminations of power distribution shall be at convenient locations in the building. Terminations shall be provided for each voltage supply complete with circuit breakers, disconnect switches, and other electrical devices as required to protect the power supply system.

1. Provide double duplex outlets at not more than 200' o.c. both directions throughout this building.

C. A temporary lighting system shall be furnished, installed, and maintained as required to satisfy minimum requirements of safety and security. The temporary lighting system shall afford general illumination in all building areas and shall supply not less than 150 watt lamps on 30' centers both directions of floor area for illumination in the areas of the building where work is being performed.

D. All temporary equipment and wiring for power and lighting shall be in accordance with the applicable provisions of the governing codes. All temporary wiring shall be maintained in a safe manner and used so as not to constitute a hazard to persons or property.

E. When the permanent electrical power and lighting systems are in operating condition, they may be used for temporary power and lighting for construction purposes, provided that the Contractor assumes full responsibility for the entire power and lighting system, and pays costs for power, operations, maintenance, and restoration of the system.

2.10 TEMPORARY ROADS AND ACCESS TO SITE

A. Construct and maintain in good usable condition all required temporary roads and access to site, and, when no longer required, remove all temporary construction and restore the site.

B. Where streets now in use are within or adjacent to the work, keep the passageways of such streets open to vehicular and pedestrian traffic to building fronting thereon. Maintain constant access for police, fire and ambulance service.

C. Mud carried off the site and into public roads shall be removed immediately by the Contractor.

D. Access to the site for delivery of construction material or equipment shall be made only from locations designated by the Architect.

2.11 TEMPORARY STAIRS, LADDERS, RAMPS, SIDEWALK BRIDGING AND RUNWAYS

A. Provide and maintain all equipment such as temporary stairs, ladders, ramps, runways, and chutes as required for the proper execution of the work.

B. All such apparatus, equipment, and construction shall meet all requirements of the Labor Law and other state or local laws applicable thereto.

C. As soon as permanent stairs are erected, provide temporary protective treads, handrails, and shaft protection.

D. Covered Walkway: Erect a structurally adequate, protective, covered walkway for passage of persons along adjacent public street. Coordinate with entrance gates, other facilities, and obstructions. Comply with regulations of authorities having jurisdiction.

1. Construct covered walkways using scaffold or shoring framing.

2. Provide wood plank overhead decking, protective plywood enclosure walls, handrails, barricades, warning signs, lights, safe and well drained walkways, and similar provisions for protection and safe passage.

3. Extend back wall beyond the structure to complete enclosure fence.

4. Paint and maintain in a manner approved by Owner and Architect.

5. For safety barriers, sidewalk bridges, and similar uses, provide minimum 5/8" thick exterior plywood.

2.12 TEMPORARY TOILETS

A. Provide and maintain in a sanitary condition enclosed weathertight toilets for the use of all construction personnel at a location within the contract limits. Upon completion of the work, toilets shall be removed. Installation shall be in accordance with all applicable codes and regulations of authorities having jurisdiction. The number of toilet rooms required shall be in accordance with the ANSI Standard Safety Code for Building Construction or other local authorities.

2.13 TEMPORARY WATER SERVICE

A. Provide at a point within 10 feet of the building (or buildings) all water necessary for construction purposes. Make all temporary connections to existing mains; provide temporary meter; and make arrangements to pay for the temporary water service including cost of installation, maintenance thereof, and water used.

B. Furnish drinking water with suitable containers and cups for use of employees. Drinking water dispensers shall be conveniently located in the building where work is in progress.

C. When the permanent water supply and distribution system has been installed, it may be used as a source of water for construction purposes, provided that the Contractor assumes full responsibility for the entire water distribution system, and pays costs for operation, maintenance, and restoration of the system including the cost of water used.

D. At the completion of the construction work or at such time after the Contractor makes use of the permanent water installation, all temporary water service equipment and piping shall be removed, and all worn or damaged parts of the permanent system shall be replaced and equipment placed in first class condition equal to new.

2.14 SECURITY

A. Provide sufficient watchman service to prevent illegal entry or damage during nights, holidays, or other periods when work is not being executed, and such other control watchmen as required during working hours.

B. Provide all temporary enclosures required for protecting the project from the exterior, for providing passageways, for the protection of openings both exterior and interior, and any other location where temporary enclosures and protection may be required.

C. Take adequate precautions against fire; keep flammable material at an absolute minimum; and ensure that such material is properly handled and stored. Except as

otherwise provided herein, do not permit fires to be built or open salamanders to be used in any part of the work.

2.15 WATER AND SNOW CONTROL

A. From the commencement of the construction to the completion of the work, keep all parts of the site and the project free from accumulation of water, and supply, maintain, and operate all necessary pumping and bailing equipment.

B. Remove snow and ice as necessary for the protection and prosecution of the work, and protect the work against weather damage.

C. The Contractor shall take over responsibility for site drainage upon entering the premises and shall maintain such drainage until completion of the work so as not to adversely affect the adjacent areas.

2.16 ENVIRONMENTAL CONTROLS

A. The Contractor shall comply with all applicable Federal, State and local laws, regulations, ordinances, codes and standards concerning environment control. Particular attention shall be given, without limitations, to:

1. Minimization of dust, containment of chemical vapors, control of engine exhaust gases, and control of smoke from temporary heaters.

2. Reduction of water pollution by control of sanitary facilities, proper storage of fuels and other potential contaminants, and prevention of siltation from land erosion.

3. Minimization of noise levels.

4. Proper and legal disposal, off site unless otherwise provided, of waste and spoil resulting from construction activities.

PART 3 EXECUTION

3.1 REMOVAL

A. Maintain all temporary facilities and controls as long as needed for the safe and proper completion of the work. Remove all such temporary facilities and controls as rapidly as progress of the work will permit or as directed by the Architect.

END OF SECTION

SECTION 015700

TRAFFIC REGULATION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment and services necessary to complete the traffic regulation as specified herein, as follows:

1. Flagmen.
2. Flares and Lights.
3. Haul Routes.
4. Traffic Signs and Signals.
5. Removal.

1.3 RELATED SECTIONS

A. Construction facilities and temporary controls - Section 015000.

1.4 SIGNS, SIGNALS, AND DEVICES

A. Post Mounted and Wall Mounted Traffic Control and Information Signs.

B. Traffic Control Signals: As approved by local jurisdictions.

C. Traffic Cones and Drums, Flares and Lights: As approved by local jurisdictions.

D. Flagmen Equipment: As approved by local jurisdictions.

1.5 FLAGMEN

A. Provide trained and equipped flagmen to regulate traffic when construction operations or traffic encroach on public traffic lanes.

1.6 FLARES AND LIGHTS

A. Use flares and lights during hours of low visibility to delineate traffic lanes and to guide traffic.

1.7 HAUL ROUTES

A. Consult with authority having jurisdiction in establishing public thoroughfares to be used for haul routes and site access.

B. Confine construction traffic to designated haul routes.

C. Provide traffic control at critical areas of haul routes to regulate traffic, to minimize interference with public traffic.

1.8 TRAFFIC SIGNS AND SIGNALS

A. At approaches to site and on site, install at crossroads, detours, parking areas, and elsewhere as needed to direct construction and affected public traffic.

B. Install and operate traffic control signals to direct and maintain orderly flow of traffic in areas under Contractor's control, and areas affected by Contractor's operations.

C. Relocate as Work progresses, to maintain effective traffic control.

1.9 REMOVAL

A. Remove equipment and devices when no longer required.

B. Repair damage caused by installation.

PART 2 PRODUCTS

(Not Applicable)

PART 3 EXECUTION

(Not Applicable)

END OF SECTION

SECTION 016000

PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment and services necessary to complete product requirements as specified herein, including but not limited to, the following:

1. Product delivery, storage and handling.
2. Storage and protection.
3. Identifying markings.
4. Substitution requirements.
5. Temporary use of equipment.
6. General standards.

1.3 RELATED SECTIONS

A. Execution requirements – Section 017300.

1.4 TRANSPORTATION AND HANDLING

A. Materials, products, and equipment shall be properly containerized, packaged, boxed, and protected to prevent damage during transportation and handling.

B. More detailed requirements for transportation and handling are specified under the technical Sections.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.

2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.

3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.

4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.

2. Store materials in a manner that will not endanger Project structure.

3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.

4. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.

5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.

6. Protect stored products from damage and liquids from freezing.

7. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.6 IDENTIFYING MARKINGS

A. Name plates and other identifying markings shall not be affixed on exposed surfaces of manufactured items installed in finished spaces.

1.7 PRODUCT APPROVAL STANDARDS

A. Where the words "or approved equal" or other synonymous terms are used, it is expressly understood that they shall mean that the approval of any such submission is vested in the Architect, whose decision shall be final and binding upon all concerned. All submissions are subject to such approval and shall conform to the requirements of Article 1.8 herein.

1.8 SUBSTITUTIONS (SEE FORMS AT END OF THIS SECTION)

A. After the contract has been executed, the Architect will consider a formal request for the substitution of products in place of those specified, under the following conditions:

1. The request is accompanied by complete data on the proposed substitution substantiating compliance with the Contract Documents including product

identification and description, performance and test date, references and samples where applicable, and an itemized comparison of the proposed substitution with the products specified or named by Addenda, with data relating to Contract time schedule, design and artistic effect where applicable, and its relationship to separate contracts.

2. The request is accompanied by accurate cost data on the proposed substitution in comparison with the product specified, whether or not modification of the Contract Sum is to be a consideration.

B. Requests for substitution based on Para (1) above, when forwarded by the Contractor to the Architect for review are understood to mean that the Contractor:

1. represents that the contractor has personally investigated the proposed substitute product and determined that it is equal or superior in all respects to that specified:

2. will provide the same guarantee for the substitution that the contractor would for that specified;

3. certifies that the cost data presented is complete and includes all related costs under this Contract, but excludes costs under separate contracts and the Architect's redesign costs, and that the contractor waives all claims for additional costs related to the substitution which subsequently become apparent; and

4. will coordinate the installation of the accepted substitute, making such changes as may be required for the Work to be complete in all respects, at no additional cost to the Owner and at no extension of the contract completion date.

C. Substitutions will not be considered if:

1. they are indicated or implied on shop drawings submissions without the formal request required in Para (1) above; or

2. for their implementation they require a substantial revision of the Contract Documents in order to accommodate their use.

3. The Architect will examine, with reasonable promptness, such substitution submittals, and return of submittals to the Contractor shall not relieve the Contractor from responsibility for deviations and alternatives from the contract plans and specifications, nor shall it relieve him from responsibility for errors in the submittals. A failure by the Contractor to identify in his letter of transmittal material deviations from the plans and specifications shall void the submittals and any action taken thereon by the Architect. When specifically requested by the Architect, the Contractor shall resubmit such shop drawings, descriptive data and samples as may be required to evaluate substitutions.

D. If any mechanical, electrical, structural, or other changes are required for the proper installation and fit of alternative materials, articles, or equipment, or because of deviations from the contract plans and specifications, such changes shall not be made without the consent of the Architect and shall be made without additional cost to the Owner.

1.9 TEMPORARY USE OF EQUIPMENT

A. No equipment intended for permanent installation shall be operated for temporary purposes without the written permission of the Architect.

B. The temporary or trial usage by the Owner of any mechanical device, machinery, apparatus, equipment or any work or materials supplied under this Contract before final completion and written acceptance by the Architect, shall not be construed as evidence of the acceptance of same by the Owner. The Owner shall have the privilege of such temporary and trial usage, for such reasonable length of time as and when the Architect shall deem to be proper for making a complete and thorough test of same and no claim for damage shall be made by the Contractor for the injury to or breaking of parts of such work which may be caused by weakness or inaccuracy of structural parts or by defective material or workmanship. If the Contractor so elects, he may at his own expense, place a competent person or persons to make such trial usage; such trial usage shall be under the supervision of the Contractor.

1.10 GENERAL REQUIREMENTS

A. In the event that it is necessary for the Contractor to store any materials offsite, he shall first obtain the approval of the Architect. The Contractor shall be responsible for insurance and warehousing charges of any materials stored offsite. The Contractor shall also be responsible for the cost of delivery to the job site of any materials that have been stored offsite.

B. Materials delivered to the job site shall be carefully stored and protected from damage. Damaged material shall not be used in the work. The Contractor shall provide, where directed temporary storage facilities as may be required for the storage of all materials which might be damaged by weather.

C. Manufactured articles, materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned as directed by the representative manufacturers, unless otherwise specified.

D. Equipment, plant, and appliances, such as hoists, centering, concrete lifts, construction elevators, cranes, rigging, towers, derricks, walks, ramps, chutes, scaffolding, implements, transportation, cartage and other things necessary and required for the adequate execution of the work and as required by law and applicable Union rules shall be provided and shall be maintained in good and safe mechanical working order, be responsible for their safe use, and remove them when no longer required. Applicable requirements of OSHA shall become and form a part of this document.

E. During handling and installation of work at project site clean and protect work in progress and adjoining work on a basis of perpetual maintenance. Apply suitable protective covering on newly installed work where reasonably required to ensure freedom from damage or deterioration at time of substantial completion; otherwise, clean and perform maintenance on newly installed work as frequently as necessary through remainder of construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

F. To extent possible through reasonable control and protection methods, supervise performance of work in a manner and by means which will ensure that none of the work whether completed or in progress, will be subjected to harmful, dangerous,

damaging, or otherwise deleterious exposures during construction period. Such exposures include (where applicable, but not by way of limitation) static loading, dynamic loading, internal pressures, external pressures, high or low temperatures, thermal shock, high or low humidity, air contamination or pollution, water, ice, solvents, chemicals, light, radiation, puncture, abrasion, heavy traffic, soiling, bacteria, insect infestation, combustion, electrical current, high speed operation, improper lubrication, unusual wear, misuse, incompatible interface, destructive testing, misalignment, excessive weathering, unprotected storage, improper shipping/handling, theft and vandalism.

G. Require installer of each major unit of work to inspect substrate to receive the work, and conditions under which the work will be performed, and to report (in writing to Contractor) unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

H. Where installations include manufactured products, comply with manufacturer's applicable instructions and recommendations for installation to whatever extent these are more explicit or more stringent than applicable requirements indicated in the Contract Documents.

I. Inspect each item of materials or equipment immediately prior to installation and reject damaged and defective items.

J. Provide attachment and connection devices and methods for securing work properly as it is installed; true to line and level, and within recognized industry tolerance if not otherwise indicated. Allow for expansions and building movements. Provide uniform joint widths in exposed work, organized for best possible visual effect. Refer questionable visual-effect choices to Architect for final decision.

K. Recheck measurements and dimensions of the work as an integral step of starting each installation.

L. Install work during conditions of temperature, humidity, exposure, forecasted weather, and status of project completion which will ensure best possible results for each unit of work in coordination with entire work. Isolate each unit of work from non-compatible work, as required to prevent deterioration.

M. Coordinate enclosure (closing-in) of work with required inspections and tests, so as to avoid necessity of uncovering work for that purpose.

N. Mounting Heights: Except as otherwise indicated, mount individual units of work at industry-recognized standard mounting heights, for applications indicated. In CMU walls mount units at height closest to manufacturer's recommendation so as to minimize cutting of block coursings. Refer questionable mounting height choices to Architect for final decision.

END OF SECTION

SUBSTITUTION REQUEST
(After the Bidding/Negotiating Phase)

Project: _____ Substitution Request Number: _____

_____ From: _____

To: _____ Date: _____

_____ A/E Project Number: _____

Re: _____ Contract For: _____

Specification Title: _____ Description: _____

Section: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____

Manufacturer: _____ Address: _____ Phone: _____

Trade Name: _____ Model No.: _____

Installer: _____ Address: _____ Phone: _____

History: ☐ New product ☐ 1-4 years old ☐ 5-10 years old ☐ More than 10 years old

Differences between proposed substitution and specified product: _____

_____

_____

☐ Point-by-point comparative data attached — REQUIRED BY A/E

Reason for not providing specified item: _____

_____

Similar Installation:

Project: _____ Architect: _____

Address: _____ Owner: _____

_____ Date Installed: _____

Proposed substitution affects other parts of Work: ☐ No ☐ Yes; explain _____

_____

Savings to Owner for accepting substitution: _____ ($ _____).

Proposed substitution changes Contract Time: ☐ No ☐ Yes [Add] [Deduct] _____ days.

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ _____

© Copyright 2013, CSI,
110 S. Union St., Suite 100, Alexandria, VA 22314

Form Version: September 2013
CSI Form 13.1A

SUBSTITUTION REQUEST
(After the Bidding/Negotiating Phase — Continued)

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitted by: _____

Signed by: _____

Firm: _____

Address: _____

_____

Telephone: _____

Attachments: ☐

A/E's REVIEW AND RECOMMENDATION

☐ Approve Substitution - Make submittals in accordance with Specification Section 01 33 00 Submittal Procedures.
☐ Approve Substitution as noted - Make submittals in accordance with Specification Section 01 33 00 Submittal Procedures.
☐ Reject Substitution - Use specified materials.
☐ Substitution Request received too late - Use specified materials.

Signed by: _____ Date: _____

OWNER'S REVIEW AND ACTION

☐ Substitution approved - Make submittals in accordance with Specification Section 01 33 00 Submittal Procedures. Prepare Change Order.
☐ Substitution approved as noted - Make submittals in accordance with Specification Section 01 33 00 Submittal Procedures. Prepare Change Order.
☐ Substitution rejected - Use specified materials.

Signed by: _____ Date: _____

Additional Comments: ☐ Contractor ☐ Subcontractor ☐ Supplier ☐ Manufacturer ☐ A/E

© Copyright 2013, CSI,
110 S. Union St., Suite 100, Alexandria, VA 22314

Form Version: September 2013
CSI Form 13.1A

SECTION 017300

EXECUTION REQUIREMENTS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. General installation of products.
4. Progress cleaning.
5. Starting and adjusting.
6. Protection of installed construction.
7. Correction of the Work.

1.3 RELATED SECTIONS

A. Cutting and patching – Section 017329.

B. Closeout procedures – Section 017700.

1.4 SUBMITTALS

A. Qualification Data: For land surveyor to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

B. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.

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

D. Certified Surveys: Submit two copies signed by land surveyor.

E. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.

1.5 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

PART 2 PRODUCTS

(Not Applicable)

PART 3 EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.

1. Before construction, verify the location and points of connection of utility services.

B. Existing Utilities: Before beginning site work, investigate and verify the existence and location of underground utilities and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; and underground electrical services.

2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

C. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

a. Description of the Work.
b. List of detrimental conditions, including substrates.
c. List of unacceptable installation tolerances.
d. Recommended corrections.

2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.

4. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.

5. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

3.3 CONSTRUCTION LAYOUT

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

B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.

2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.

3. Inform installers of lines and levels to which they must comply.

4. Check the location, level and plumb, of every major element as the Work progresses.

5. Notify Architect when deviations from required lines and levels exceed allowable tolerances.

6. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

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

3.4 FIELD ENGINEERING

A. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.

2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

B. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.

2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.

3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

C. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and site work.

D. Final Property Survey: Prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.

1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.

2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.5 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.

2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.

3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.

4. Maintain minimum headroom clearance of 8 feet in spaces without a suspended ceiling.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

F. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.

2. Allow for building movement, including thermal expansion and contraction.

G. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

H. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.

2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg. F.

3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.

2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Cutting and Patching: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

1. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.

H. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

I. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

J. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

K. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.7 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 1 Section "Quality Requirements."

3.8 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

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

3.9 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 1 Section "Cutting and Patching."

1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Restore permanent facilities used during construction to their specified condition.

C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION

SECTION 017329

CUTTING AND PATCHING

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. This Section includes procedural requirements for cutting and patching.

1.3 RELATED SECTIONS

A. Refer to Divisions 2 through 32 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

1. Requirements in this Section apply to mechanical and electrical installations. Refer to Divisions 22, 23 and 26 Sections for other requirements and limitations applicable to cutting and patching mechanical and electrical installations.

1.4 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of other Work.

B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.5 SUBMITTALS

A. Cutting and Patching: Submit a method describing procedures at least 10 days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:

1. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.

2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.

3. Products: List products to be used and firms or entities that will perform the Work.

4. Dates: Indicate when cutting and patching will be performed.

5. Utilities: List utilities that cutting and patching procedures will disturb or affect. List utilities that will be relocated and those that will be temporarily out of service. Indicate how long service will be disrupted.

6. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.

7. Architect's Approval: Obtain approval of cutting and patching before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

1.6 QUALITY ASSURANCE

A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.

1. Provide a list of additional elements that are structural elements and that require Architect's or Construction Manager's approval of a cutting and patching proposal.

B. Operational Elements: Do not cut and patch the following operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.

1. Primary operational systems and equipment.

2. Air or smoke barriers.

3. Fire-protection systems.

4. Control systems.

5. Communication systems.

6. Conveying systems.

7. Electrical wiring systems.

8. Operating systems of special construction in Division 13 Sections.

C. Miscellaneous Elements: Do not cut and patch the following elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.

1. Water, moisture, or vapor barriers.

2. Membranes and flashings.

3. Exterior curtain-wall construction.

4. Equipment supports.

5. Piping, ductwork, vessels, and equipment.

6. Noise- and vibration-control elements and systems.

D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

E. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.7 WARRANTY

A. Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void warranties.

PART 2 PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections of these Specifications.

B. In-Place Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of in-place materials.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.

1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PERFORMANCE

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.

2. In-Place Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.

3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.

4. Excavating and Backfilling: Comply with requirements in applicable Division 31 Sections where required by cutting and patching operations.

5. Proceed with patching after construction operations requiring cutting are complete.

C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.

2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

END OF SECTION

SECTION 017700

CLOSEOUT PROCEDURES

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Inspection procedures.
2. Warranties.
3. Instruction of Owner's personnel.
4. Final cleaning.

1.3 RELATED SECTIONS

A. Execution requirements – Section 017300.

B. Operating and maintenance data – Section 017823.

C. Project record documents – Section 017839.

1.4 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.

1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
2. Advise Owner of pending insurance changeover requirements.
3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
5. Prepare and submit Project Record Documents, operation and maintenance manuals, Final Completion construction photographs and photographic negatives,

damage or settlement surveys, property surveys, and similar final record information.

6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.

7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.

8. Complete startup testing of systems.

9. Submit test/adjust/balance records.

10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.

11. Advise Owner of changeover in heat and other utilities.

12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

13. Complete final cleaning requirements, including touchup painting.

14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

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

2. Results of completed inspection will form the basis of requirements for Final Completion.

1.5 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:

1. Submit a final Application for Payment.

2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.

3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.

4. Submit pest-control final inspection report and warranty.

5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training videotapes.

B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will notify Contractor of construction that must be completed or corrected before certificate will be issued.

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

1.6 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

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

1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.

2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.

3. Include the following information at the top of each page:

a. Project name.
b. Date.
c. Name of Architect.
d. Name of Contractor.
e. Page number.

1.7 WARRANTIES

A. Submittal Time: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.

B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.

C. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

1. Submit on digital media acceptable to Architect.

PART 2 PRODUCTS

2.1 MATERIALS

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

PART 3 EXECUTION

3.1 DEMONSTRATION AND TRAINING

A. Instruction: Instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

1. Provide instructors experienced in operation and maintenance procedures.

2. Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at the start of each season.

3. Schedule training with Owner with at least seven days' advance notice.

4. Coordinate instructors, including providing notification of dates, times, length of instruction, and course content.

B. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections. For each training module, develop a learning objective and teaching outline. Include instruction for the following:

1. System design and operational philosophy.

2. Review of documentation.

3. Operations.

4. Adjustments.

5. Troubleshooting.

6. Maintenance.

7. Repair.

3.2 FINAL CLEANING

A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:

    a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
    b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
    c. Rake grounds that are neither planted nor paved to a smooth, even textured surface.
    d. Remove tools, construction equipment, machinery, and surplus material from Project site.
    e. Remove snow and ice to provide safe access to building.
    f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
    g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
    h. Sweep concrete floors broom clean in unoccupied spaces.
    i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
    j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
    k. Remove labels that are not permanent.
    l. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
        1). Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
    m. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
    n. Replace parts subject to unusual operating conditions.
    o. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
    p. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
    q. Clean ducts, blowers, and coils if units were operated without filters during construction.
    r. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
    s. Leave Project clean and ready for occupancy.

C. Pest Control: Engage an experienced, licensed exterminator to make a final inspection and rid Project of rodents, insects, and other pests. Prepare a report.

D. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION

SECTION 017823

OPERATING AND MAINTENANCE DATA

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment and services necessary to complete the operating and maintenance data as specified herein.

1.3 RELATED SECTIONS

A. Submittals - Section 013300.

B. Contract closeout - Section 017300.

1.4 GENERAL

A. Compile product data and related information appropriate for Owner's maintenance and operation of products furnished under the Contract.

1. Sub-Contractors shall prepare operating and maintenance data as specified in this Section and as referenced in other pertinent sections of Specifications.

1.5 FORM OF SUBMITTALS

A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.

1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.

2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

1.6 MANUAL FOR MATERIALS AND FINISHES

A. Submit pdf of complete manual in final form.

B. Content, for architectural products, applied materials and finishes

1. Manufacturer's data, giving full information on products.

    a. Catalog number, size, composition.
    b. Color and texture designations.
    c. Information required for re-ordering special-manufactured products.

2. Instructions for care and maintenance.

    a. Manufacturer's recommendation for types of cleaning agents and methods.
    b. Cautions against cleaning agents and methods which are detrimental to the product.
    c. Recommended schedule for cleaning and maintenance.

C. Content, for moisture-protection and weather-exposed products

1. Manufacturer's data, giving full information on products.

    a. Applicable standards.
    b. Chemical composition.
    c. Details of installation.

2. Instructions for inspection, maintenance, and repair.

1.7 MANUAL FOR EQUIPMENT AND SYSTEMS

A. Submit pdf of complete manual in final form.

B. Content, for each unit of equipment and system, as appropriate.

1. Description of unit and component parts.

    a. Function, normal operating characteristics, and limiting conditions.
    b. Performance curves, engineering data and tests.
    c. Complete nomenclature and commercial number of all replaceable parts.

2. Operating procedures

    a. Start-up, break-in, routine and normal operating instructions.
    b. Regulation, control, stopping, shut-down and emergency instructions.
    c. Summer and winter operating instructions.
    d. Special operating instructions.

3. Maintenance procedures

    a. Routine operations.
    b. Guide to "trouble-shooting".
    c. Disassembly, repair and reassembly.
    d. Alignment, adjusting and checking.

4. Servicing and lubrication schedule.

    a. List of lubricants required.

5. Manufacturer's printed operating and maintenance instructions.

6. Description of sequence of operation by control manufacturer.

7. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.

    a. Predicted life of parts subject to wear.
    b. Items recommended to be stocked as spare parts.

8. As-installed control diagrams by controls manufacturer.

9. Each contractor's coordination drawings.

    a. As-installed color coded piping diagrams.

10. Charts of valve tag numbers, with the location and function of each valve.

11. List of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.

12. Other data as required under pertinent sections of specifications.

C. Content, for each electric and electronic system, as appropriate:

1. Description of system and component parts.

    a. Function, normal operating characteristics, and limiting condition.
    b. Performance curves, engineering data and tests.
    c. Complete nomenclature and commercial number of replaceable parts.

2. Circuit directories of panel boards.

    a. Electrical service.
    b. Controls.
    c. Communications.

3. As-installed color coded wiring diagrams.

4. Operating procedures

    a. Routine and normal operating instructions.
    b. Sequences required.
    c. Special operating instructions.

5. Maintenance procedures

    a. Routine operations.
    b. Guide to "trouble-shooting".
    c. Disassembly, repair and reassembly.
    d. Adjustment and checking.

6. Manufacturer's printed operating and maintenance instructions.

7. List of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.

8. Other data as required under pertinent sections of specifications.

D. Prepare and include additional data when the need for such data becomes apparent during instruction of Owner's personnel.

E. Additional requirements for operating and maintenance data: The respective sections of Specifications.

END OF SECTION

SECTION 017839

PROJECT RECORD DOCUMENTS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this section, as shown or specified, shall be in accordance with the requirements of the contract documents.

1.2 SECTION INCLUDES

A. This section includes administrative and procedural requirements for Project Record Documents, including the following:

1. Record Drawings.

2. Record Specifications.

B. Maintenance of Documents and Samples: Store record documents and samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition. Make documents and samples available at all times for the Architect or designated representative's inspections.

1.3 SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit one set(s) of marked-up Record Prints.

a. Final Submittal: Provide information and drawings needed so that the Construction Manager can submit to the Construction Manager one set(s) of marked-up Record Prints.

B. Record Specifications: Provide information needed so that the Construction Manager can submit PDF copy of Project's Specifications, including addenda and contract modifications.

C. Record Product Data: Submit one copy of each Product Data submittal in PDF format.

1. Where Record Product Data is required as part of operation and maintenance manuals, submit marked-up Product Data as an insert in manual instead of submittal as Record Product Data.

PART 2 PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings and Shop Drawings.

1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.

    a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    b. Accurately record information in an understandable drawing technique.
    c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.

2. Content: Types of items requiring marking include, but are not limited to, the following:

    a. Dimensional changes to Drawings.
    b. Revisions to details shown on Drawings.
    c. Depths of foundations below first floor.
    d. Locations and depths of underground utilities.
    e. Revisions to routing of piping and conduits.
    f. Revisions to electrical circuitry.
    g. Actual equipment locations.
    h. Duct size and routing.
    i. Locations of concealed internal utilities.
    j. Changes made by Change Order or Construction Change Directive.
    k. Changes made following Architect's written orders.
    l. Details not on the original Contract Drawings.
    m. Field records for variable and concealed conditions.
    n. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.

4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.

5. Mark important additional information that was either shown schematically or omitted from original Drawings.

6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize Record Prints and newly prepared Record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.

2. Identification: As follows:

    a. Project name.
    b. Date.

c. Designation "PROJECT RECORD DRAWINGS."
d. Name of Architect and Construction Manager.
e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.

2. Note related Change Orders and Record Drawings where applicable.

2.3 RECORD PRODUCT DATA

A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.

2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.

3. Note related Change Orders and Record Drawings where applicable.

PART 3 EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain PDF of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.

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

END OF SECTION

SECTION 024118

SELECTIVE DEMOLITION AND ALTERATION WORK

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. The Work of this Section includes all labor, materials, equipment and services necessary to complete the selective demolition and alteration work as shown on the drawings and/or specified herein, including but not limited to the following:

1. Alterations, selective demolition and removals as noted on drawings and as required to accommodate new construction.

2. Removal of debris.

3. Protection of existing building and spaces to remain, and shoring of the structure as required for structural integrity and personal safety.

4. Protection of existing curbs and sidewalks.

5. Temporary coverage passageways.

6. Alterations, selective demolition and removals of exterior facade where noted.

7. Patching and refinishing of existing surfaces damaged as a result of this work.

8. Protection.

1.3 QUALITY ASSURANCE

A. The Contractor shall comply with the requirements of all applicable Federal, State and local safety and health regulations regarding the demolition of structures including ANSI/NFPD 241-Building Construction and Demolition Operations.

B. The Contractor shall be responsible for any damage to any adjacent structures or buildings to remain.

C. Qualifications: Qualifications of Contractor for work of this Section shall not be less than ten (10) years of field experience in work of this nature.

D. Professional Engineering: The Contractor shall retain the services of a Professional Engineer licensed in the State of North Carolina, who shall design and supervise installation of all underpinning and shoring.

1.4 RELATED SECTIONS

A. Alteration and removal requirements for mechanical and electrical work - Mechanical and Electrical Sections.

1.5 SUBMITTALS

A. Schedule of Demolition Operations: Submit demolition procedures and operational sequence for Architect's review prior to start of work. Submit a written request to Architect well in advance of executing any cutting or alteration which affects:

1. The work of tying in or connecting to operational systems of the building, including electrical, mechanical and security systems.

2. The work of the Owner or any separate Contractor.

3. The structural value or integrity of any element of the project or of adjacent structures.

4. The integrity or effectiveness of weather-exposed and moisture-resistant elements or systems.

5. The efficiency, operational life, maintenance, or safety of operational elements or systems.

B. Notice of Differing Conditions: Submit a written notification if, during the work of demolition and cutting, conditions are discovered which significantly vary from those shown on the drawings. Do not commence work until approval of Architect.

C. Shop Drawings: Submit the following prior to starting work:

1. Submit for Architect's information shop drawings indicating location and typical construction details of temporary dustproof and weatherproof partitions.

2. Submit drawings of temporary structural shoring, bracing, framing or support, for the information of the Architect. Such drawings will be reviewed by the Structural Engineer for the effects of such temporary members on the structural elements to remain. These drawings shall include the reason for such temporary members, the location, the direction and magnitude of design reaction forces on existing structure, and details showing how these reaction forces will be applied to the existing structure.

a. Shop drawings shall be submitted with the Seal of the P.E. engaged by Contractor; P.E. must be licensed in the State of North Carolina.
b. The Architect will receive acknowledgment for concepts shown. Such acknowledgments shall be of the concept only and not of actual capacities or structural design and shall not in any way diminish or limit the Contractor's responsibility for the quality and performance of the work and for protecting existing structures and facilities.

1.6 SPECIAL PRECAUTION

A. Hazardous materials may be encountered during demolition operations including asbestos; comply with applicable regulations, laws, and ordinances concerning removal, handling, and protection against exposure or environmental pollution.

1.7 JOB CONDITIONS

A. Condition of Structure

1. The Contractor for the work of this Section shall be held to have visited the site, examined the premises, determined for himself the existing conditions, character of equipment and facilities needed for the performance of the work, and all matters which may in any way affect the work before submitting a bid.

a. Information regarding existing construction or conditions is based on available record drawings which may or may not truly reflect existing conditions. Such information is included on the assumption that it may be of interest to the Contractor, but the Architect, Owner and their consultants do not assume responsibility for its accuracy or completeness.
b. Notify the Architect if, during the course of demolition, conditions are discovered which significantly vary from those shown on the drawings. Do not proceed until authorized by Architect.

2. The Contractor shall accept the condition of the site and structures as found. The Architect and Owner assume no responsibility for condition of site or structures nor the continuation of the condition existing at time of bidding or thereafter.

B. Areas of building to be demolished or altered will be vacated and discontinued in use prior to the start of the work.

1. Surrounding areas of the building shall remain operational by the Owner.

C. Partial Removal

1. Items of savable value to the Contractor may be removed from the structure as the work progresses. Salvaged items must be transported from the site as they are removed.

2. Storage or sale of removed items on the site will not be permitted.

D. Explosives: The use of explosives will not be permitted.

E. Traffic

1. Conduct demolition operations and the removal of debris to ensure minimum interference with roads, streets, walks and other adjacent occupied or used facilities.

2. Do not close or obstruct streets, walks or other occupied or used facilities without permission from authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.

F. Utilities

1. Refer to Division 22 and 26 of the specifications for special requirements concerning utilities and services.

2. Maintain any existing utilities required to remain; keep in service and protect against damage during demolition operations.

3. Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to the governing authorities.

4. Disconnect and seal any abandoned utilities before starting demolition operations. Coordinate all work with local utility companies having jurisdiction.

1.8 SCHEDULING

A. Before commencing any alteration or demolition work, submit for review by the Architect, and approval of the Owner, a schedule showing the commencement, the order, and the completion dates for the various parts of this work.

B. Before starting any work relating to existing utilities (electrical, sewer, water, heat, gas, fire lines, etc.) that will temporarily discontinue or disrupt service to the structures to remain, notify the Architect and the Owner 7 days in advance and obtain the Owner's approval in writing before proceeding with this phase of the work.

PART 2 PRODUCTS

Refer to Part 3 - Execution, for Product Requirements

PART 3 EXECUTION

3.1 PROTECTION

A. Take full precautions to protect workmen, passersby or any other persons from falling debris and other hazards of demolition operations.

B. Execute demolition work to insure protection of existing portions of building to remain against damages which might occur from falling debris or other cause. Do not interfere with use of adjacent occupied buildings and areas. Maintain free, safe passage to and from occupied adjacent buildings.

C. Materials Placement: Do not load structure with weight that will endanger, overload or cause excessive deflection of the existing structure, or that will damage finished surfaces adjacent to and/or supported by the existing structure, except portions being removed.

D. Construction Operations: Do not employ any construction operation, equipment or vehicles that will endanger, overload or cause excessive deflection of the existing structure, or that will damage finished surfaces adjacent to and/or supported by the existing structure, except portions being removed.

E. Take precautions to guard against movement, settlement, damage, or collapse of any part of building, sidewalks, adjacent property or street passages; be liable for any such

movement, settlement or collapse. If such damage does accidentally occur, Contractor shall repair promptly at no cost to Owner.

F. Provide the necessary safeguards to prevent accidents, to avoid all necessary hazards and protect the public, the work and property at all times, including Saturdays, Sundays, and holidays.

G. Be responsible for any and all damages which may arise or occur to any party whatsoever by reason of the neglect in providing proper lights, guards, barriers, or any other safeguards to prevent damage to property, life and limb.

H. Make such explorations and probes as are necessary to ascertain any required protective measures before proceeding with demolition and removal. Give particular attention to shoring and bracing requirements so as to prevent any damage to existing construction.

1. Provide interior and exterior shoring, bracing, or support to prevent movement or settlement or collapse of structures to be demolished and adjacent facilities to remain. The Contractor's Professional Engineer shall advise on bracing, shoring, underpinning, or other structural requirements. The Contractor shall bear all responsibility for prevention of movement or other structural fault.

2. The Contractor shall restore, by repair or otherwise, the portions of structure or their contents altered by the Contractor in furtherance of his underpinning and support operations. Restoration shall be completed to the conditions which existed prior to the start of the work. Any damage caused by inadequate support shall also be restored by the Contractor at no cost to the Owner.

I. Provide, erect and maintain catch platforms, lights, barriers, weather protection, warning signs, and other items as required for proper protection of the workmen engaged in demolition and alteration operations, occupants of the building, public and adjacent property. Any damage caused by the Contractor's operations shall be promptly repaired by the Contractor at no cost to the Owner.

J. Provide and maintain temporary protection of the existing structure designated to remain where demolition, removal, and new work are being done, connections made, materials handled, or equipment moved.

K. Take necessary precautions to prevent dust and dirt from rising. Protect unaltered portions of the existing building affected by the operations under this Section by dustproof partitions and other adequate means.

L. Provide adequate fire protection in accordance with local Fire Department requirements.

M. Do not close or obstruct walkways, passageways, or stairways. Do not store or place materials in passageways, stairs, or other means of egress. Conduct operations with minimum traffic interference.

N. Be responsible for any damage to the existing structure or contents by reason of the insufficiency of protection provided.

O. Erect temporary covered passageways at street level as required by authorities having jurisdiction.

P. Promptly repair damages caused to adjacent facilities by demolition operations at no cost to the Owner.

Q. Provide and maintain weather protection at exterior openings so as to fully protect the interior premises against damage from the elements until such openings are closed by new construction.

3.2 INSPECTION

A. Verify that areas of demolition work are protected and temporary dustproof partitions have been installed.

B. Verify that construction to be removed is not load bearing or has been properly braced, framed or supported.

C. Inspect existing conditions of the project, including elements subject to damage or to movement during demolition and cutting.

D. After uncovering work, inspect the conditions affecting the installation or performance of the work.

1. Report differing or questionable conditions to the Architect in writing; do not proceed with the work until the Architect has provided further instructions.

3.3 PREPARATION

A. Provide adequate temporary support as necessary to assure the structural value or integrity of the affected portion of the work

B. Provide devices and methods to protect other portions of the project from damage.

C. Pollution Controls

1. Use water sprinkling, temporary enclosures, and other suitable methods to limit the amount of dust and dirt rising and scattering in the air to the lowest practical level. Comply with governing regulations pertaining to environmental protection.

a. Do not use water when it may create hazardous or objectionable conditions such as ice, flooding, and pollution.

2. Clean adjacent structures and improvements of dust, dirt and debris caused by demolition operations. Return adjacent areas to condition existing prior to the start of the work.

3. Provide drainage for temporary water use.

3.4 DEMOLITION AND CUTTING

A. Selectively demolish existing construction in conformance with the drawings and these specifications.

1. Execute cutting and demolition by methods which will prevent damage to other work and will provide proper surface to receive installation of work by others and patching of finish surfaces.

2. Do all cutting or removal so as to leave neat, true, plumb and square edges, at edges to remain. Use carborundum or diamond saw equipment for cutting masonry, concrete and stone work, where edges or surfaces are to remain.

3. Do not cut or remove construction which might weaken or impair the structural integrity or strength of the structural framing or support systems which are to remain.

4. Demolish and remove materials as shown on the drawings without damage to the remaining parts of the structure or mechanical/electrical/utility systems.

5. Remove materials so as to not impose excessive loads in supporting walls, floors or framing and so as not to damage remaining undemolished portions of the structure.

6. Where portions of structures are to be removed, remaining portions shall be protected from damage and prepared to fit new construction. Damage to portions of structures to remain shall be repaired.

7. Reinforcing steel in existing structures shall be left in place, cleaned and aligned to provide tie with new work.

B. Shoring

1. Design, provide, erect and maintain necessary temporary shoring, bracing, framing, or support where load bearing structural or supporting members are removed or weakened by cuts or openings or are subject to damage from demolition operations, and otherwise as required for safety or to protect finish surfaces from damage.

2. Construction and adequacy of the shoring shall be the entire responsibility of the Contractor. Any damage caused by the inadequacy of the shoring or other support shall be the responsibility of the Contractor to remedy at no additional expense to the Owner.

3. Shoring and bracing shall remain until new structural framing and/or supports are installed. Coordinate operations fully with other trades.

4. Be ready at any time to promptly provide, add to, or strengthen temporary shoring, bracing, or support for existing work, in case existing construction begins to show signs of structural stress.

3.5 WORKMANSHIP STANDARDS FOR ALTERATION AND REMOVAL WORK

A. Cut, remove, alter, temporarily remove and replace, or relocate existing work as required for performance of the work. Perform such work required with due care, including shoring and bracing.

B. Coordinate patching involving the various trades whether or not specifically mentioned in the respective specification Sections.

C. Materials or items demolished and not designated to become the property of the Owner or to be reinstalled shall become the property of the Contractor and shall be removed from the Owner's property.

D. Execute the work in a careful and orderly manner, with the least possible disturbance to the public and to the occupants of the adjacent buildings.

E. In general, demolish masonry in small sections. Where necessary to prevent collapse of any construction, install temporary shores, struts, or bracing.

F. Materials to be removed by existing elevators shall be put in enclosed containers.

G. Where existing equipment and/or fixtures are indicated to be reused, repair such equipment and/or fixtures and refinish to put in perfect working order. Refinish as directed.

H. Cut out embedded anchorage and attachment items as required to properly provide for patching and repair of the respective finishes.

I. Where utilities are removed, relocated or abandoned, cap, valve, plug, or by-pass to make complete and working installation.

J. Restore existing pipe and duct coverings damaged by work under this Contract to original undamaged condition.

K. Immediately restore to service and repair any damage caused by Contractor's workmen to existing pipe and conduits, wires, cables, etc., of utility services or of fire protection systems and communications systems which are not scheduled for discontinuance or abandonment.

L. Upon completion of contract, deliver work complete. Damage that may be caused by Contractor or Contractor's workmen to existing structures designated to remain, grounds, and utilities shall be repaired by Contractor and left in as good condition as existed prior to damaging.

M. Restore finish work of floors, walls, and ceilings remaining in place but damaged or defaced because of demolition or alteration work to condition equal that which existed at beginning of work under this Contract.

N. Where alteration or removals expose damaged or unfinished surfaces or materials, refinish such surfaces or materials, or remove them and provide new or salvaged materials to make continuous surfaces uniform.

O. Perform new work and restore and refinish existing work in conformance with applicable requirements of the specifications, except as follows:

1. Materials for use in repair of existing surfaces, but not otherwise specified, shall conform to the highest standards of the trade involved, and be in accordance with approved industry standards, and shall be as required to match existing surfaces.

2. Workmanship for repair of existing materials shall, unless otherwise specified, be equal to similar workmanship existing in or adjacent to the space where the work is being done.

3. Installation of salvaged items where no similar items exist shall be done in accordance with the highest standards of the trade involved and in accordance with approved shop drawings.

P. Materials or items designated to become the property of the Owner shall be as shown on the drawings. Remove such items with care and store them in a location at the site to be designated by the Owner.

Q. Materials or items designated to be reinstalled shall be as shown on the drawings. Remove such items with care under the supervision of the trade responsible for reinstallation; protect and store until required. Replace materials or items damaged in their removal with similar new material.

R. The existing building shall not be used as a work shop. Neither shall the furnishings or equipment in any room be used as work benches. Should any damage occur during the progress of the work to any furniture, fixtures, equipment, or appurtenances therein, such damage shall be repaired, replaced or made good by the Contractor without extra cost to the Owner.

S. Where removing existing floor finish and base, remove all adhesive and leave floors and walls smooth and flush, ready to receive new finish.

T. Finish new and adjacent existing surfaces as specified for new work. Clean existing surfaces of dirt, grease and loose paint before refinishing.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. General

1. Remove from the site debris, rubbish and other materials resulting from work of this Section.

2. Burning of removed materials from demolished structures will not be permitted on the site.

B. Removal: Transport materials removed from demolished structures and legally dispose of off site. Pay any and all fees associated with disposal work. Leave the site in an orderly condition to the approval of the Architect.

3.7 CLEANING UP

A. Remove debris as the work progresses. Maintain existing premises in a neat and clean condition.

END OF SECTION

SECTION 03 10 00

CONCRETE FORMING AND ACCESSORIES

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. Form-facing material for cast-in-place concrete.

2. Form liners.

3. Shoring, bracing, and anchoring.

B. Related Requirements:

1. Section 321313 "Concrete Paving" for formwork related to concrete pavement and walks.

1.3 DEFINITIONS

A. Form-Facing Material: Temporary structure or mold for the support of concrete while the concrete is setting and gaining sufficient strength to be self-supporting.

B. Formwork: The total system of support of freshly placed concrete, including the mold or sheathing that contacts the concrete, as well as supporting members, hardware, and necessary bracing.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review the following:

a. Special inspection and testing and inspecting agency procedures for field quality control.

b. Construction, movement, contraction, and isolation joints

c. Forms and form-removal limitations.

d. Shoring and reshoring procedures.

e. Anchor rod and anchorage device installation tolerances.

1.5 ACTION SUBMITTALS

A. Product Data: For each of the following:

1. Exposed surface form-facing material.
2. Concealed surface form-facing material.
3. Pan-type forms.
4. Void forms.
5. Form liners.
6. Form ties.
7. Waterstops.
8. Form-release agent.

B. Shop Drawings: Prepared by, and signed and sealed by, a qualified professional engineer responsible for their preparation, detailing fabrication, assembly, and support of forms.

1. For exposed vertical concrete walls, indicate dimensions and form tie locations.
2. Indicate dimension and locations of construction and movement joints required to construct the structure in accordance with ACI 301 (ACI 301M).
   a. Location of construction joints is subject to approval of the Architect.
3. Indicate location of waterstops.
4. Indicate form liner layout and form line termination details.
5. Indicate proposed schedule and sequence of stripping of forms, shoring removal, and reshoring installation and removal.
6. Indicate layout of insulating concrete forms, dimensions, course heights, form types, and details.

C. Samples:

1. For waterstops.
2. For Form Liners: 12-inch by 12-inch (305-mm by 305-mm) sample, indicating texture.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing and inspection agency.

B. Research Reports: For insulating concrete forms indicating compliance with International Code Council Acceptance Criteria AC353.

C. Field quality-control reports.

D. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

A. Testing and Inspection Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

1. Subject to compliance with requirements, approved mockups may become part of the completed Work.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Form Liners: Store form liners under cover to protect from sunlight.

B. Insulating Concrete Forms: Store forms off ground and under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

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

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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

1. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."

2. Design formwork to limit deflection of form-facing material to 1/240 of center-to-center spacing of supports.

a. For architectural concrete specified in Section 033300 "Architectural Concrete," limit deflection of form-facing material, studs, and walers to 0.0025 times their respective clear spans (L/400).

B. Design, engineer, erect, shore, brace, and maintain insulating concrete forms in accordance with ACI 301 (ACI 301M), to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.

1. Design cross ties to transfer the effects of the following loads to the cast-in-place concrete core:

a. Wind Loads: As indicated on Drawings.

1) Horizontal Deflection Limit: Not more than 1/360 of the wall height.

2.2 FORM-FACING MATERIALS

A. As-Cast Surface Form-Facing Material:

1. Provide continuous, true, and smooth concrete surfaces.

2. Furnish in largest practicable sizes to minimize number of joints.

3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete, and as follows:

   a. Plywood, metal, or other approved panel materials.

   b. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

      1) APA HDO (high-density overlay).

      2) APA MDO (medium-density overlay); mill-release agent treated and edge sealed.

      3) APA Structural 1 Plyform, B-B or better; mill oiled and edge sealed.

      4) APA Plyform Class I, B-B or better; mill oiled and edge sealed.

B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.

   1. Provide lumber dressed on at least two edges and one side for tight fit.

   2. Provide forms with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

C. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

D. Form Liners:

   1. <Double click here to find, evaluate, and insert list of manufacturers and products.>

   2. Size: <Insert dimensions>.

   3. Face Pattern: [Smooth] [Ribbed] [Stone] [Brick] [Wood] <Insert pattern>.

2.3 WATERSTOPS

A. Flexible Rubber Waterstops: U.S. Army Corps of Engineers CRD-C 513 for embedding in concrete to prevent passage of fluids through joints, with factory fabricated corners, intersections, and directional changes.

   1. Profile: Flat dumbbell with center bulb

   2. Dimensions: 4 inches by 3/16 inch thick; nontapered.

B. Flexible PVC Waterstops: U.S. Army Corps of Engineers CRD-C 572 for embedding in concrete to prevent passage of fluids through joints, with factory fabricate corners, intersections, and directional changes.

   1. Profile: Flat dumbbell with center bulb

2. Dimensions: 4 inches by 3/16 inch thick, nontapered.

C. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch (19 by 25 mm).

1. Manufacturers: subject to compliance with requirements, provide products by one of the following:

a. Carlisle Coatings & Waterproofing Inc.

b. CETCO, a Minerals Technologies company.

c. Concrete Sealants, Inc.

d. Sika Corporation

D. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer-modified chloroprene rubber, for adhesive bonding to concrete, 3/8 by 3/4 inch (10 by 19 mm).

1. Manufacturers: subject to compliance with requirements, provide products by one of the following:

a. Adeka Corporation

b. CETCO, a Minerals Technologies company.

c. Sika Corporation

2.4 RELATED MATERIALS

A. Reglets: Fabricate reglets of not less than 0.022-inch- (0.55-mm-) thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

B. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch (0.85 mm) thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.

D. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

E. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

2. Form release agent for form liners shall be acceptable to form liner manufacturer.

F. Form Ties: Factory-fabricated, removable or snap-off, glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to

prevent spalling of concrete on removal.

1. Furnish units that leave no corrodible metal closer than 1 inch (25 mm) to the plane of exposed concrete surface.

2. Furnish ties that, when removed, leave holes no larger than 1 inch (25 mm) in diameter in concrete surface.

3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

PART 3 EXECUTION

3.1 INSTALLATION OF FORMWORK

A. Comply with ACI 301 (ACI 301M).

B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 (ACI 117M) and to comply with the Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete" for as-cast finishes.

C. Limit concrete surface irregularities as follows:

1. Surface Finish-1.0: ACI 117 Class D, 1 inch (25 mm).

2. Surface Finish-2.0: ACI 117 Class B, 1/4 inch (6 mm).

3. Surface Finish-3.0: ACI 117 Class A, 1/8 inch (3.0 mm).

D. Construct forms tight enough to prevent loss of concrete mortar.

1. Minimize joints.

2. Exposed Concrete: Symmetrically align joints in forms.

E. Construct removable forms for easy removal without hammering or prying against concrete surfaces.

1. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces.

2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

3. Install keyways, reglets, recesses, and other accessories, for easy removal.

F. Do not use rust-stained, steel, form-facing material.

G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.

1. Provide and secure units to support screed strips

2. Use strike-off templates or compacting-type screeds.

H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.

1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.

2. Locate temporary openings in forms at inconspicuous locations.

I. Chamfer exterior corners and edges of permanently exposed concrete.

J. At construction joints, overlap forms onto previously placed concrete not less than 12 inches (305 mm).

K. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.

1. Determine sizes and locations from trades providing such items.

2. Obtain written approval of Architect prior to forming openings not indicated on Drawings.

L. Construction and Movement Joints:

1. Construct joints true to line with faces perpendicular to surface plane of concrete.

2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

3. Place joints perpendicular to main reinforcement.

4. Locate joints for beams, slabs, joists, and girders in the middle third of spans.

a. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.

5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.

6. Space vertical joints in walls as indicated on Drawings.

a. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.

M. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.

1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.

2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.

N. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

O. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

P. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 INSTALLATION OF EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete.

1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.

3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

4. Install dovetail anchor slots in concrete structures, as indicated on Drawings.

5. Clean embedded items immediately prior to concrete placement.

3.3 INSTALLATION OF WATERSTOPS

A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm.

1. Install in longest lengths practicable.

2. Locate waterstops in center of joint unless otherwise indicated on Drawings.

3. Allow clearance between waterstop and reinforcing steel of not less than 2 times the largest concrete aggregate size specified in Section 033000 "Cast-In-Place Concrete."

4. Secure waterstops in correct position at 12 inches (305 mm) on center.

5. Field fabricate joints in accordance with manufacturer's instructions using heat welding.

a. Miter corners, intersections, and directional changes in waterstops.

b. Align center bulbs.

6. Clean waterstops immediately prior to placement of concrete.

7. Support and protect exposed waterstops during progress of the Work.

B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated on Drawings, according to manufacturer's written instructions, by adhesive bonding, mechanically fastening, and firmly pressing into place.

1. Install in longest lengths practicable.

2. Locate waterstops in center of joint unless otherwise indicated on Drawings.

3. Protect exposed waterstops during progress of the Work.

3.4 REMOVING AND REUSING FORMS

A. Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 75 percent of its 28-day design compressive strength.

2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work.

1. Split, frayed, delaminated, or otherwise damaged form-facing material are unacceptable for exposed surfaces.

2. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.

1. Align and secure joints to avoid offsets.

2. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.5 SHORING AND RESHORING INSTALLATION

A. Comply with ACI 318 (ACI 318M) and ACI 301 (ACI 301M) for design, installation, and removal of shoring and reshoring.

1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.6 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

C. Inspections:

1. Inspect formwork for shape, location, and dimensions of the concrete member being formed.

2. Inspect insulating concrete forms for shape, location, and dimensions of the concrete member being formed.

END OF SECTION

SECTION 03 11 00

CONCRETE FORMWORK

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

Extent of formwork is indicated by the concrete structures shown on the drawings. Work shall include (except as specified elsewhere in the Contract Documents) providing formwork and shoring for all cast-in-place concrete; and installation into the formwork, items furnished by others, such as anchors, plates, inserts, frames, nosings, and any other items embedded in concrete.

1.2 STANDARDS

A. REFERENCES

Some products and execution are specified in this section by reference to published specifications or standards of the following with respective abbreviations used:

1. American Concrete Institute .....ACI

2. The American Society for Testing and Materials .....ASTM

3. U. S. Products Standards .....PS

B. STANDARD SPECIFICATIONS AND CODES

The following Publications of the American Concrete Institute form a part of this Specification:

1. ACI 347-78 "Recommended Practice for Concrete Formwork".

2. ACI 301-72 "Specifications for Structural Concrete".

PART 2 PRODUCTS

2.1 MATERIALS

Materials used for formwork shall be selected by the Contractor, subject to approval by the Engineer. All materials shall be high quality and standard for the industry.

PART 3: EXECUTION

3.1 FORMWORK DESIGN

A. The Contractor shall be responsible for the design of all concrete formwork. Formwork shall be designed in accordance with ACI 347 unless noted. Design, erect, support, brace and maintain formwork so that it will safely support vertical and lateral loads that might be applied until such loads can be supported by the concrete structure. Carry vertical and lateral loads to ground by formwork system and in-place construction that has attained adequate strength for that purpose. Construct formwork so that concrete members and structures are of correct size, shape, alignment, elevation and position.

B. Design forms and falsework to include assumed values of live load, dead load, weight of moving equipment operated on formwork, concrete mix, height of concrete drop, vibrator frequency, ambient temperature, foundation pressure, stresses, lateral stability, and other factors pertinent to safety of structure during construction. Provide shores and struts with positive means of adjustment capable of taking up formwork settlement during concrete placing operations, using wedges or jacks or a combination thereof. Support form facing materials by structural members spaced sufficiently close to prevent deflection. Fit forms placed in successive units for continuous surfaces to accurate alignment, free from irregularities and within allowable tolerances. Provide camber in formwork as required for anticipated deflections due to weight and pressures of fresh concrete. Provide formwork sufficiently tight to prevent leakage of cement paste during concrete placement. Solidly butt joints and provide back-up material at joints as required to prevent leakage and fins.

C. Formwork for foundation systems may be omitted when workmanship and soil conditions permit accurate excavation and the omission is approved by the Engineer. Provide temporary openings in wall forms, column forms, and other locations necessary to permit inspection and cleanout.

D. Form accessories to be partially or wholly embedded in the concrete, such as ties and hangers, shall be a commercially manufactured type. Non-fabricated wire shall be used. Form ties shall be constructed so that the end fasteners can be removed without causing appreciable spalling at the faces of the concrete. After the ends or end fasteners of form ties have been removed, the embedded portion of the ties shall terminate not less than two diameters or twice the minimum dimensions of the tie from the formed faces of concrete to be permanently exposed to view except that in no case shall this distance be less than 3/4”. When the formed face of the concrete is not to be permanently exposed to view, form ties may be cut off flush with the formed surfaces.

E. At construction joints, contact surface of the form for sheeting for flush surfaces exposed to view shall overlap the hardened concrete in the previous placement by more than one foot. The forms shall be held against the hardened concrete to prevent offsets or loss of mortar at the construction joint and to maintain a true surface. Wood forms for wall openings shall be constructed to facilitate loosening, if necessary, to counteract swelling of the forms. Wedges used for final adjustment of the forms prior to concrete placement shall be fastened in position after the final check. Formwork shall be so anchored to shores or other supporting surfaces or members that upward or lateral movement of any parts of the formwork system during concrete placement will be prevented. Runways for moving equipment or pump lines shall be provided with struts or legs and shall be supported directly on the formwork or structural member without resting on the

reinforcing steel. When mudsills are to be placed for supporting concrete forms, a reasonably level and sufficiently compacted surface will be required. Shores shall be plumb within acceptable tolerances.

3.2 TOLERANCES

A. Unless otherwise specified by the Engineer, formwork shall be constructed so that the concrete surfaces will conform to the tolerance limits listed in Table 4.3.1 of ACI 301-72.

B. The Contractor shall establish and maintain in an undisturbed condition and until final completion and acceptance of the project, sufficient control points and bench marks to be used for reference purposes to check tolerances.

3.3 PREPARATION OF FORM SURFACES AND FORM COATINGS

A. All surfaces of forms and embedded materials shall be cleaned of any accumulated mortar or grout from previous concreting and of all other foreign materials before concrete is placed in the forms. Coat form contact surfaces with form-coating compound before reinforcement is placed. Provide form-coating compounds that will not bond with, stain, or adversely affect concrete surfaces, and will not impair subsequent treatment of concrete surfaces requiring bond or adhesion or impede the wetting of surfaces to be cured with water or curing compounds. Do not allow excess form coating material to accumulate in the forms or to come into contact with surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.

3.4 REMOVAL OF FORMS

A. Formwork for columns, walls, sides of beams, and other parts not supporting the weight of the concrete may be removed as soon as the concrete has hardened sufficiently to resist damage from removal operations provided surfaces are cured and protected from cold weather as specified in other sections of this specification.

Forms and shoring in the formwork used to support the weight of concrete in beams, slabs and other structural members, shall remain in place until the concrete has reached the minimum strength specified of 75% of the specified 28-day design strength. Strength of concrete must be verified by concrete test cylinders molded and cured in the field under the same conditions that the concrete represented by these cylinders are cured and/or maturity meters connected to thermo-couples embedded in the concrete. It shall be the responsibility of the concrete technician, employed by the Owner, to inform the General Contractor when the strength of concrete cured in the field has attained the minimum specified strength required for removal of the forms.

Bottom forms of slabs shall not be removed in less time than is indicated below unless otherwise approved by the Engineer.

Above 60° F.	50° F.	40° to 50° F.
8 days	10 days	18 days

When temperature is below 40° F., the shores shall remain in place for an additional time equal to the lower temperature.

B. When shores and other vertical supports are so arranged that the non-load-carrying form-facing material may be removed without loosening or disturbing the shores and supports, the facing material may be removed at an earlier age as specified or permitted. Wood forms for wall openings shall be loosened as soon as this can be accomplished without damage to the concrete.

When repair of surface defects or finishing is required at an early age, forms shall be removed as soon as the concrete has hardened sufficiently to resist damage from removal operations.

3.5 RESHORING

A. When reshoring is permitted or required, the operations shall be planned in advance and shall be subject to approval. While reshoring is under way, no live load shall be permitted on the new construction.

In no case during reshoring shall concrete in beam, slabs, column or any other structural member be subjected to combined dead and construction loads in excess of the loads permitted by the Engineer for the developed concrete strength at the time of reshoring. Reshores shall be placed as soon as practicable after stripping operations are complete but in no case later than the end of the working day on which stripping occurs.

3.6 INSPECTION

The Engineer shall always be notified of the pouring schedule in advance and in ample time prior to placement of concrete to inspect the formwork. Inspection of formwork will be made only after each section to be poured is complete.

3.7 RECORDS

A. The Contractor shall maintain an accurate log showing the following information:

1. Date of pour
2. Area poured
3. Average ambient temperature during curing period
4. Date forms scheduled for removal
5. Date form removal completed
6. Method of reshoring (number of floor, etc.)
7. Test cylinder serial numbers
8. Strength of test cylinders at 7 and 28 days.

3.8 QUALITY CONTROL & TESTING

A. All sampling and testing services shall be performed, at the Owners expense, by a testing agency which operates in accordance to ASTM D 3740 and E 329 latest edition and accepted by the Engineer.

B. The Contractor shall submit for review a design mix for each class of concrete proposed for use. An approved testing laboratory shall prepare the mix. Compressive strength of at least four (4) specimens of the design mix shall indicate 15% higher than 28 days strengths specified. During the work, the Contractor shall make 3 test cylinders for each 50 cubic yards, or fraction thereof, of concrete placed each day. One cylinder shall be tested at 7 days and the other two at 28 days in accordance with ASTM C 39. Copies of all test reports shall be furnished to the Engineer.

END OF SECTION

SECTION 032000

CONCRETE REINFORCEMENT

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

A. The extent of concrete reinforcement is shown on the drawings. The work includes fabrication and placement of reinforcement for cast-in-place concrete, including bar, ties and supports.

1.2 REFERENCES

A. Some products and execution are specified in the Section by reference to publish specifications or standards of the following with respective abbreviations used:

1. American Concrete Institute .....ACI
2. The American Society for Testing and Materials .....ASTM
3. American Welding Society .....AWS

B. STANDARD REFERENCE

The current edition of the following standard references shall apply to the work of this Section. Suffixes indicating date of issue are omitted from reference numbers used in the text.

1. Publication of the American Concrete Institute:
   a. ACI 315-74 Manual of Standard Practice for Detailing Reinforced Concrete Structures.
   b. ACI 318-77 Building Code Requirements for Reinforced Concrete.
2. Publications of the American Welding Society:
   a. AWS D12.10-61 Recommended Practice for Welding Reinforcing Steel, Metal Inserts, and Connections in Reinforced Concrete Construction
3. Publications of the Concrete Reinforcing Steel Institute: "Manual of Standard Practice"
4. Publications of the American Society for Testing and Materials:
   a. ASTM A 82-76 Specification for Cold Drawn Steel Wire for Concrete Reinforcement.

b. ASTM A 185-73 Specification for Welded Steel Wire Fabric for Concrete Reinforcement.

c. ASTM A 615-78 Specification for Deformed Billet-Steel Bars for Concrete Reinforcement.

d. ASTM A 617-76 Specification for Axle-Steel Deformed and Plan Bars for Concrete Reinforcement.

1.3 DELIVERY, STORAGE AND HANDLING

A. Reinforcing Steel shall be delivered to the Project Site properly tagged, bundled, and ready to place. Reinforcing steel delivered to the Project Site, and not immediately placed in forms, shall be protected from mud, excessive rust producing conditions, oil, grease, or distortion. Reinforcing steel shall be stored off the ground.

PART 2 PRODUCTS

2.1 MATERIALS

A. All reinforcing steel shall conform to one of the following ASTM Standards, latest edition:

1. "Standard Specification for Deformed Billet-Steel Bars for Concrete Reinforcement", ASTM A-615, Grade 40.

2. "Standard Specification for Axle Steel Deformed Bars for Concrete Reinforcement, ASTM A-617, Grade 40.

B. Weld wire fabric shall be electrically welded wire fabric of cold drawn wire of gauge and mesh shown on the drawings or required and shall conform to "Specifications for Welded Steel Wire Fabric for Concrete Reinforcement" (ASTM A-185).

C. Tie wire shall be 16-gauge or heavier, black annealed wire. Reinforcing shall be free from scale, rust or coatings. Stainless steel or plastic coated bar chairs and spacers shall be furnished where concrete will be exposed.

PART 3 EXECUTION

3.1 FABRICATING AND WELDING TOLERANCE

A. Bars used for concrete reinforcement shall meet the following requirements for fabrication tolerance.

A. Sheared Length	+1″
B. Overall Dimension of Stirrups	+1/2″
C. All Other Bends	+1″

B. Bars shall be placed to the following tolerances:

A. Concrete Cover to Formed Surfaces	+1/4″
B. Top Bars in Slabs	+1/4″
C. Top Bars in Beams	+1/2″
D. Horizontal Tolerance from Vertical Surfaces	+1/4″
E. Vertical Bars in Columns	+1/4″
F. Vertical and Horizontal Bars in Walls	+1/2″
G. Lengthwise in Member	+2″
H. Wire Fabric	+1/2″ from center of slab or location called for on drawings

C. Bars may be moved one bar diameter as necessary to avoid interference with other reinforcing steel, conduits, or embedded items. If the bars are moved more than one bar diameter, the resulting arrangement of bars shall be subject to approval.

3.2 WELDING

A. When required or approved, welding of reinforcing steel shall conform to "Recommended Practice for Welding Reinforcing Steel Metal Inserts, and Connections in Reinforced Concrete Construction" (AWS D12.1). No welding shall be done at the bend in a bar. Welding of cross bars (tack welding) shall not be permitted except as authorized or directed by the Engineer.

3.3 PLACING

A. Minimum concrete protective covering for reinforcement except for extremely corrosive atmosphere or other severe exposures shall be as follows:

A. Concrete deposited Against the Ground	3"
B. Formed Surfaces Exposed to Weather or in Contact with the Ground	2"
C. Interior Surfaces:	1-1/2" for Beams and Column Ties; 3/4" for Slabs and Walls; Beam and Column Bars Shall be Anchored Against the Ties.

B. All reinforcement at the time concrete is placed shall be free of mud, oil, or other materials that may adversely affect or reduce the bond. Reinforcement with rust, mill scale or tooth will be accepted as being satisfactory without cleaning or brushing

provided the dimensions and weights, including heights of deformations, of a cleaned sample shall not be less than required by applicable ASTM Standards.

C. All reinforcing bars shall be supported and wired together to prevent displacement by construction loads or the placing of concrete beyond the tolerances as previously set forth.

D. Over formwork, metal, plastic or other approved bar chairs and spacers shall be furnished. When the concrete surface will be exposed to weather in the finished structure or where rust would impair architectural finishes, the portions of all accessories in contact with the formwork shall be stainless steel or plastic.

E. Welded wire fabric shall be lapped at least 1/2 mesh plus end extension of wires but not less than 6". Wire mesh shall be so placed as to positively secure its position 1/3 of the slab thickness below the top of the slab for slabs on grade.

F. Splices and offsets in reinforcements at points of maximum stress shall not be made. All splices shall be approved, and shall provide sufficient lap to transfer the stress between the bars by the required development length of the bars. The character and design of each splice shall conform to the requirements of the ACI 318-77. All reinforcing steel shall be stored off the ground at project site. All reinforcing steel shall be cut and shop fabricated and delivered to the project properly tagged, bundled and ready to place. Bars shall not be bent after being embedded in hardened concrete, unless otherwise noted on the drawings. Reinforcing shall be free from scale, loose rust or coatings which will reduce the bond to the concrete. Bars with kinks or bends not shown on the drawings shall not be placed. The heating of reinforcement for bending or straightening will be permitted only if the entire operation is approved by the Engineer.

G. The Contractor shall securely maintain the metal reinforcement accurately in place until the concrete is placed. Any and all disturbances of reinforcing from any cause whatsoever shall be fully corrected prior to placing of concrete, and all damaged bar supports and spaces shall be repaired or removed and replaced. All bars shall be extended beyond stress points the development length of the bar or be provided with an equivalent development length with a hook.

H. Unless otherwise shown on the plans and details, the following accessories shall be provided for supports for all reinforcement:

1. Reinforced slabs-on-grade shall have plain precast concrete blocks sufficient to support bars within prescribed tolerances, or individual high chairs with runners to rest on soil.

2. Slab bars shall have continuous slab bolsters for bottom bars spaced a maximum distance of 4'-0" o.c., and for individual high chairs spaced 4'-0" with a #6 continuous support bar for top bars. Top bar supports shall be spaced a maximum distance apart of 4'-0" and no greater than 18" from the overhanging ends of bars.

3. Beam bottom bars shall have beam bolsters spaced a maximum distance of 6’-0". Top beam bars may be supported from beam stirrups where permitted provided beam stirrups are fabricated sufficiently accurate to permit top bars to

be placed within the tolerances permitted. Individual high chairs are required where ties or other supports are not provided.

4. Box out all slots, chases, recesses or openings as shown on the drawings and specifications and as required by the work of other trades. Box out for all temporary openings such as slots, pipe spaces, etc., and build forms to seal up when and as required. Inserts, anchors, ties, hangers, etc. shall be built into concrete as required to secure the work of the various subcontractors. Collars, sleeves, thimbles, anchors, sockets, etc., shall be furnished to the General Contractor by the other subcontractors for installation in the formwork. Sleeves shall not displace the reinforcing steel from its designated location by more than one bar diameter unless approved by the Engineer. The Contractor shall be responsible for the design, engineering, construction and the coordination of the placement of items affecting each trade in the formwork.

3.4 INSPECTION

The Engineer shall always be notified of the pouring schedule in advance and in ample time prior to placement of concrete to inspect the reinforcement. Inspection of reinforcement will be made only after each section to be poured is complete.

END OF SECTION

SECTION 032000

CONCRETE REINFORCING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Steel reinforcement bars.

2. Welded-wire reinforcement.

B. Related Requirements:

1. Section 034500 "Precast Architectural Concrete" for reinforcing used in precast architectural concrete.

2. Section 321313 "Concrete Paving" for reinforcing related to concrete pavement and walks.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site

1. Review the following:

a. Special inspection and testing and inspecting agency procedures for field quality control.

b. Construction contraction and isolation joints.

c. Steel-reinforcement installation.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Each type of steel reinforcement.

2. Bar supports.

3. Mechanical splice couplers.

B. Shop Drawings: Comply with ACI SP-066:

1. Include placing drawings that detail fabrication, bending, and placement.

2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.

3. For structural thermal break insulated connection system, indicate general configuration, insulation dimensions, tension bars, compression pads, shear bars, and dimensions.

C. Construction Joint Layout: Indicate proposed construction joints required to build the structure.

1. Location of construction joints is subject to approval of the Architect.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1. Reinforcement To Be Welded: Welding procedure specification in accordance with AWS D1.4/D1.4M

B. Material Test Reports: For the following, from a qualified testing agency:

1. Steel Reinforcement:

a. For reinforcement to be welded, mill test analysis for chemical composition and carbon equivalent of the steel in accordance with ASTM A706/A706M.

2. Mechanical splice couplers.

C. Field quality-control reports.

D. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency acceptable to authorities having jurisdiction qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

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

1.7 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

1. Store reinforcement to avoid contact with earth.

2. Do not allow epoxy-coated reinforcement to be stored outdoors for more than 60 days without being stored under an opaque covering.

3. Do not allow dual-coated reinforcement to be stored outdoors for more than 60 days without being stored under an opaque covering.

4. Do not allow stainless steel reinforcement to come into contact with uncoated reinforcement.

PART 2 PRODUCTS

2.1 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.

B. Low-Alloy Steel Reinforcing Bars: ASTM A706/A706M, deformed.

C. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.

2.2 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A615/A615M, Grade 60 (Grade 420), plain-steel bars, cut true to length with ends square and free of burrs.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.

1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.

C. Mechanical Splice Couplers: ACI 318 (ACI 318M) Type 1, same material of reinforcing bar being spliced, tension-compression type.

D. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch (1.2908 mm) in diameter.

1. Finish: Plain.

2.3 FABRICATING REINFORCEMENT

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

PART 3 EXECUTION

3.1 PREPARATION

A. Protection of In-Place Conditions:

1. Do not cut or puncture vapor retarder.

2. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

3.2 INSTALLATION OF STEEL REINFORCEMENT

A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.

B. Accurately position, support, and secure reinforcement against displacement.

1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.

2. Do not tack weld crossing reinforcing bars.

C. Preserve clearance between bars of not less than 1 inch (25 mm), not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.

D. Provide concrete coverage in accordance with ACI 318 (ACI 318M).

E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

F. Splices: Lap splices as indicated on Drawings.

1. Bars indicated to be continuous, and all vertical bars shall be lapped not less than 36 bar diameters at splices, or 24 inches (610 mm), whichever is greater.

2. Stagger splices in accordance with ACI 318 (ACI 318M).

3. Mechanical Splice Couplers: Install in accordance with manufacturer's instructions.

G. Install structural thermal break insulated connection system in accordance with manufacturer's instructions.

H. Install welded-wire reinforcement in longest practicable lengths.

1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."

a. For reinforcement less than W4.0 or D4.0, continuous support spacing shall not exceed 12 inches (305 mm).

2. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches (50 mm) for plain wire and 8 inches (200 mm) for deformed wire.

3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.

I. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating in accordance with ASTM D3963/D3963M.

J. Dual-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating in accordance with ASTM D3963/D3963M.

K. Zinc-Coated Reinforcement: Repair cut and damaged zinc coatings with zinc repair material in accordance with ASTM A780/A780M.

3.3 JOINTS

A. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement.

2. Continue reinforcement across construction joints unless otherwise indicated.

3. Do not continue reinforcement through sides of strip placements of floors and slabs.

B. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length, to prevent concrete bonding to one side of joint.

3.4 INSTALLATION TOLERANCES

A. Comply with ACI 117 (ACI 117M).

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

C. Inspections:

1. Steel-reinforcement placement.

2. Steel-reinforcement mechanical splice couplers.

3. Steel-reinforcement welding.

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

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. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.

B. Related Requirements:

1. Section 031000 "Concrete Forming and Accessories" for form-facing materials, form liners, insulating concrete forms, and waterstops.

2. Section 032000 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.

3. Section 312000 "Earth Moving" for drainage fill under slabs-on-ground.

4. Section 321313 "Concrete Paving" for concrete pavement and walks.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

a. Contractor's superintendent.

b. Independent testing agency responsible for concrete design mixtures.

c. Ready-mix concrete manufacturer.

d. Concrete Subcontractor.

e. Special concrete finish Subcontractor.

2. Review the following:

a. Testing and inspecting agency procedures for field quality control.

b. Construction joints, control joints, isolation joints, and joint-filler strips.

c. Semirigid joint fillers.

d. Vapor-retarder installation.

e. Anchor rod and anchorage device installation tolerances.

f. Cold and hot weather concreting procedures.

g. Concrete finishes and finishing.

h. Curing procedures.

i. Forms and form-removal limitations.

j. Shoring and reshoring procedures.

k. Methods for achieving specified floor and slab flatness and levelness.

l. Floor and slab flatness and levelness measurements.

m. Concrete repair procedures.

n. Concrete protection.

o. Initial curing and field curing of field test cylinders (ASTM C31/C31M.)

p. Protection of field cured field test cylinders.

1.5 ACTION SUBMITTALS

A. Product Data: For each of the following.

1. Portland cement.

2. Fly ash.

3. Slag cement.

4. Blended hydraulic cement.

5. Silica fume.

6. Performance-based hydraulic cement

7. Aggregates.

8. Admixtures:

a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.

9. Color pigments.

10. Fiber reinforcement.

11. Vapor retarders.

12. Floor and slab treatments.

13. Liquid floor treatments.

14. Curing materials.

a. Include documentation from color pigment manufacturer, indicating that proposed methods of curing are recommended by color pigment manufacturer.

15. Joint fillers.

16. Repair materials.

B. Design Mixtures: For each concrete mixture, include the following:

1. Mixture identification.

2. Minimum 28-day compressive strength.

3. Durability exposure class.

4. Maximum w/cm.

5. Calculated equilibrium unit weight, for lightweight concrete.

6. Slump limit.

7. Air content.

8. Nominal maximum aggregate size.

9. Steel-fiber reinforcement content.

10. Synthetic micro-fiber content.

11. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.

12. Include manufacturer's certification that permeability-reducing admixture is compatible with mix design.

13. Include certification that dosage rate for permeability-reducing admixture matches dosage rate used in performance compliance test.

14. Intended placement method.

15. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

C. Shop Drawings:

1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.

a. Location of construction joints is subject to approval of the Architect.

D. Concrete Schedule: For each location of each Class of concrete indicated in "Concrete Mixtures" Article, including the following:

1. Concrete Class designation.

2. Location within Project.

3. Exposure Class designation.

4. Formed Surface Finish designation and final finish.

5. Final finish for floors.

6. Curing process.

7. Floor treatment if any.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For the following:

1. Installer: Include copies of applicable ACI certificates.

2. Ready-mixed concrete manufacturer.

3. Testing agency: Include copies of applicable ACI certificates.

B. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.

2. Admixtures.

3. Fiber reinforcement.

4. Curing compounds.

5. Floor and slab treatments.

6. Bonding agents.

7. Adhesives.

8. Vapor retarders.

9. Semirigid joint filler.

10. Joint-filler strips.

11. Repair materials.

C. Material Test Reports: For the following, from a qualified testing agency:

1. Portland cement.

2. Fly ash.

3. Slag cement.

4. Blended hydraulic cement.

5. Silica fume.

6. Performance-based hydraulic cement.

7. Aggregates.

8. Admixtures:

a. Permeability-Reducing Admixture: Include independent test reports, indicating compliance with specified requirements, including dosage rate used in test.

D. Floor surface flatness and levelness measurements report, indicating compliance with specified tolerances.

E. Research Reports:

1. For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.

2. For sheet vapor retarder/termite barrier, showing compliance with ICC AC380.

F. Preconstruction Test Reports: For each mix design.

G. Field quality-control reports.

H. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs Project personnel qualified as an ACI-certified Flatwork Technician and Finisher and a supervisor who is a certified ACI Flatwork Concrete Finisher/Technician or an ACI Concrete Flatwork Technician.

1. Post-Installed Concrete Anchors Installers: ACI-certified Adhesive Anchor Installer.

B. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Laboratory Testing Agency Qualifications: A testing agency qualified in accordance with

ASTM C1077 and ASTM E329 for testing indicated and employing an ACI-certified Concrete Quality Control Technical Manager.

1. Personnel performing laboratory tests shall be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

D. Field Quality Control Testing Agency Qualifications: An independent agency,[acceptable to authorities having jurisdiction,] qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

1. Personnel conducting field tests shall be qualified as an ACI Concrete Field Testing Technician, Grade 1, in accordance with ACI CPP 610.1 or an equivalent certification program.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with ASTM C94/C94M and ACI 301 (ACI 301M).

1.9 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 301 (ACI 301M) and ACI 306.1 and as follows.

1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

2. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301 (ACI 301M).

3. Do not use frozen materials or materials containing ice or snow.

4. Do not place concrete in contact with surfaces less than 35 deg F (1.7 deg C), other than reinforcing steel.

5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

B. Hot-Weather Placement: Comply with ACI 301 (ACI 301M) and ACI 305.1 (ACI 305.1M), and as follows:

1. Maintain concrete temperature at time of discharge to not exceed 95 deg F (35 deg C).

2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

1.10 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to furnish replacement sheet vapor retarder/termite barrier material and accessories for sheet vapor retarder/ termite barrier and accessories that do not comply with requirements or that fail to resist penetration by termites within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 (ACI 301M)unless modified by requirements in the Contract Documents.

2.2 CONCRETE MATERIALS

A. Source Limitations:

1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.

2. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.

3. Obtain aggregate from single source.

4. Obtain each type of admixture from single source from single manufacturer.

B. Cementitious Materials:

1. Portland Cement: ASTM C150/C150M, Type I/II, gray.

2. Fly Ash: ASTM C618, Class C or F.

C. Normal-Weight Aggregates: ASTM C33/C33M, Class 3M coarse aggregate or better, graded. Provide aggregates from a single source.

1. Alkali-Silica Reaction: Comply with one of the following:

a. Expansion Result of Aggregate: Not more than 0.04 percent at one-year when tested in accordance with ASTM C1293.

b. Expansion Results of Aggregate and Cementitious Materials in Combination: Not more than 0.10 percent at an age of 16 days when tested in accordance with ASTM C1567.

c. Alkali Content in Concrete: Not more than 4 lb./cu. yd. (2.37 kg/cu. m) for moderately reactive aggregate or 3 lb./cu. yd. (1.78 kg/cu. m) for highly reactive aggregate, when tested in accordance with ASTM C1293 and categorized in accordance with ASTM C1778, based on alkali content being calculated in accordance with ACI 301 (ACI 301M).

2. Maximum Coarse-Aggregate Size: 3/4 inch (19 mm) nominal.

3. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Lightweight Aggregate: ASTM C330/C330M 3/4-inch (19-mm) nominal maximum aggregate size.

E. Air-Entraining Admixture: ASTM C260/C260M.

F. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures

that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C494/C494M, Type A.

2. Retarding Admixture: ASTM C494/C494M, Type B.

3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.

4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.

5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.

6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.

G. Water and Water Used to Make Ice: ASTM C94/C94M, potable [or] [complying with ASTM C1602/C1602M, including all limits listed in Table 2 and the requirements of paragraph 5.4]

2.3 VAPOR RETARDERS

A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A, not less than 15 mils (0.25 mm) thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Poly-America, L.P.

b. Stego Industries, LLC.

c. Tex-Trude.

d. W.R. Meadows, Inc.

2.4 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. BASF Corporation.

b. Concrete Sealers USA.

c. Dayton Superior.

d. Euclid Chemical Company (The); an RPM company.

e. Kaufman Products, Inc.

f. Laticrete International, Inc.

g. Nox-Crete Products Group.

h. PROSOCO, Inc.

i. SpecChem, LLC.

j. US SPEC, Division of US MIX Company.

k. Vexcon Chemicals Inc.

l. V-Seal Concrete Sealers & Specialty Coatings.

m. W.R. Meadows, Inc.

2.5 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. BASF Corporation

b. Bon Tool Co.

c. ChemMasters, Inc.

d. Dayton Superior.

e. Euclid Chemical Company (The); an RPM company.

f. Kaufman Products, Inc.

g. Lambert Corporation.

h. Laticrete International, Inc.

i. Metalcrete Industries.

j. Nox-Crete Products Group.

k. Sika Corporation.

l. SpecChem, LLC.

m. TK Products.

n. Vexcon Chemicals Inc.

o. W.R. Meadows, Inc.

B. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.

1. Color:

a. Ambient Temperature Below 50 deg F (10 deg C): Black.

b. Ambient Temperature between 50 deg F (10 deg C) and 85 deg F (29 deg C): Any color.

c. Ambient Temperature Above 85 deg F (29 deg C): White.

C. Water: Potable or complying with ASTM C1602/C1602M.

D. Clear, Waterborne, Membrane-Forming, Nondissipating Curing Compound: ASTM C309, Type 1, Class B, certified by curing compound manufacturer to not interfere with bonding of floor covering.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Anti-Hydro International, Inc.

b. BASF Corporation.

c. ChemMasters, Inc.

d. Dayton Superior.

e. Euclid Chemical Company (The); an RPM company.

f. Kaufman Products, Inc.

g. Lambert Corporation.

h. Laticrete International, Inc.

i. Metalcrete Industries.

j. Nox-Crete Products Group.

k. SpecChem, LLC.

l. TK Products.

m. Vexcon Chemicals Inc.

n. W.R. Meadows, Inc.

E. Clear, Waterborne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ChemMasters, Inc.

b. Concrete Sealers USA.

c. Dayton Superior.

d. Euclid Chemical Company (The); an RPM company.

e. Kaufman Products, Inc.

f. Lambert Corporation.

g. Laticrete International, Inc.

h. Metalcrete Industries.

i. Nox-Crete Products Group.

j. Right Pointe.

k. SpecChem, LLC.

l. TK Products.

m. Vexcon Chemicals Inc.

n. W.R. Meadows, Inc.

2.6 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: [ASTM D1751, asphalt-saturated cellulosic fiber] [or] [ASTM D1752, cork or self-expanding cork].

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, [epoxy resin with a Type A shore durometer hardness of 80] [aromatic polyurea with a Type A shore durometer hardness range of 90 to 95] in accordance with ASTM D2240.

C. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

2.7 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3 mm) and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.

2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.

3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3 to 6 mm) or coarse sand, as recommended by underlayment manufacturer.

4. Compressive Strength: Not less than 4100 psi (29 MPa) at 28 days when tested in accordance with ASTM C109/C109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch (6 mm) and that can be filled in over a scarified surface to match adjacent floor elevations.

1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.

2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.

3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by topping manufacturer.

4. Compressive Strength: Not less than 5000 psi (34.5 MPa) at 28 days when tested in accordance with ASTM C109/C109M.

2.8 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301 (ACI 301M).

1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash or Other Pozzolans: 25 percent by mass.

C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.

1. Use water-reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.

2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

3. Use water-reducing admixture in pumped concrete, concrete for parking structure slabs, and concrete with a w/cm below 0.50.

2.9 CONCRETE MIXTURES

A. Reference structural drawings.

2.10 CONCRETE MIXING

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

PART 3 EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:

1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.

2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:

1. Daily access to the Work.

2. Incidental labor and facilities necessary to facilitate tests and inspections.

3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.

4. Security and protection for test samples and for testing and inspection equipment at Project site.

3.3 INSTALLATION OF EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.

1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.

3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

3.4 INSTALLATION OF VAPOR RETARDER

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.

1. Install vapor retarder with longest dimension parallel with direction of concrete pour.

2. Face laps away from exposed direction of concrete pour.

3. Lap vapor retarder over footings and grade beams not less than 6 inches (150 mm), sealing vapor retarder to concrete.

4. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.

5. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.

6. Seal penetrations in accordance with vapor retarder manufacturer's instructions.

7. Protect vapor retarder during placement of reinforcement and concrete.

a. Repair damaged areas by patching with vapor retarder material, overlapping

damages area by 6 inches (150 mm) on all sides, and sealing to vapor retarder.

3.5 JOINTS

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

B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.

1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.

2. Place joints perpendicular to main reinforcement.

a. Continue reinforcement across construction joints unless otherwise indicated.

b. Do not continue reinforcement through sides of strip placements of floors and slabs.

3. Form keyed joints as indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.

4. Locate joints for beams, slabs, joists, and girders at third points of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.

5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.

6. Space vertical joints in walls as indicated on Drawings. Unless otherwise indicated on Drawings, locate vertical joints beside piers integral with walls, near corners, and in concealed locations where possible.

7. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.

D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.

2. Terminate full-width joint-filler strips not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished concrete surface, where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.

3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints:

1. Install dowel bars and support assemblies at joints where indicated on Drawings.

2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.

F. Dowel Plates: Install dowel plates at joints where indicated on Drawings.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.

1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.

2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.

B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.

C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect in writing, but not to exceed the amount indicated on the concrete delivery ticket.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301 (ACI 301M), but not to exceed the amount indicated on the concrete delivery ticket.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

E. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.

1. If a section cannot be placed continuously, provide construction joints as indicated.

2. Deposit concrete to avoid segregation.

3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.

4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301 (ACI 301M).

a. Do not use vibrators to transport concrete inside forms.

b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer.

c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.

d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Do not place concrete floors and slabs in a checkerboard sequence.

2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.

3. Maintain reinforcement in position on chairs during concrete placement.

4. Screed slab surfaces with a straightedge and strike off to correct elevations.

5. Level concrete, cut high areas, and fill low areas.

6. Slope surfaces uniformly to drains where required.

7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.

8. Do not further disturb slab surfaces before starting finishing operations.

3.7 FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:

1. ACI 301 (ACI 301M) Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.

a. Patch voids larger than 1-1/2 inches (38 mm) wide or 1/2 inch (13 mm) deep.

b. Remove projections larger than 1 inch (25 mm).

c. Tie holes do not require patching.

d. Surface Tolerance: ACI 117 (ACI 117M) Class D.

e. Apply to concrete surfaces not exposed to public view.

2. ACI 301 (ACI 301M)Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.

a. Patch voids larger than 3/4 inch (19 mm) wide or 1/2 inch (13 mm) deep.

b. Remove projections larger than 1/4 inch (6 mm).

c. Patch tie holes.

d. Surface Tolerance: ACI 117 (ACI 117M) Class B.

e. Locations: Apply to concrete surfaces as indicated.

3. ACI 301 (ACI 301M) Surface Finish SF-3.0:

a. Patch voids larger than 3/4 inch (19 mm) wide or 1/2 inch (13 mm) deep.

b. Remove projections larger than 1/8 inch (3 mm).

c. Patch tie holes.

d. Surface Tolerance: ACI 117 (ACI 117M) Class A.

e. Locations: Apply to concrete surfaces as indicated.

B. Rubbed Finish: Apply the following to as cast surface finishes where indicated on Drawings:

1. Smooth-Rubbed Finish:

a. Perform no later than one day after form removal.

b. Moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture.

c. If sufficient cement paste cannot be drawn from the concrete by the rubbing process, use a grout made from the same cementitious materials used in the in-place concrete.

d. Maintain required patterns or variances as shown on Drawings or to match field sample panels.

2. Grout-Cleaned Rubbed Finish:

a. Clean concrete surfaces after contiguous surfaces are completed and accessible.

b. Do not clean concrete surfaces as Work progresses.

c. Mix 1 part portland cement to 1-1/2 parts fine sand, complying with ASTM C144 or ASTM C404, by volume, with sufficient water to produce a mixture with the consistency of thick paint. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces.

d. Wet concrete surfaces.

e. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap, and keep surface damp by fog spray for at least 36 hours.

f. Maintain required patterns or variances as shown on Drawings or to match field sample panels.

3. Cork-Floated Finish:

a. Mix 1 part portland cement to 1 part fine sand, complying with ASTM C144 or ASTM C404, by volume, with sufficient water to produce a mixture with the consistency of thick paint.

b. Mix 1 part portland cement and 1 part fine sand with sufficient water to produce a mixture of stiff grout. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces.

c. Wet concrete surfaces.

d. Compress grout into voids by grinding surface.

e. In a swirling motion, finish surface with a cork float.

f. Maintain required patterns or variances as shown on Drawings or to match field sample panels.

4. Scrubbed Finish: After concrete has achieved a compressive strength of from 1000 to 1500 psi (6.9 to 10.3 MPa), apply scrubbed finish.

a. Wet concrete surfaces thoroughly and scrub with stiff fiber or wire brushes, using water freely, until top mortar surface is removed and aggregate is uniformly exposed.

b. Rinse scrubbed surfaces with clean water.

c. Maintain continuity of finish on each surface or area of Work.

d. Remove only enough concrete mortar from surfaces to match field sample panels.

C. Related Unformed Surfaces:

1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a color and texture matching adjacent formed surfaces.

2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.8 FINISHING FLOORS AND SLABS

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

B. Scratch Finish:

1. While still plastic, texture concrete surface that has been screeded and bull-floated or darbied.

2. Use stiff brushes, brooms, or rakes to produce a profile depth of 1/4 inch (6 mm) in one direction.

3. Apply scratch finish to surfaces to receive concrete floor toppings and to receive mortar setting beds for bonded cementitious floor finishes.

C. Float Finish:

1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.

2. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 (ACI A117M) tolerances for conventional concrete.

3. Apply float finish to surfaces to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

D. Trowel Finish:

1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.

2. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.

3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

4. Do not add water to concrete surface.

5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.

6. Apply a trowel finish to surfaces [exposed to view] [or] [to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system] <Insert locations>.

7. Finish surfaces to the following tolerances, in accordance with ASTM E1155 (ASTM E1155M), for a randomly trafficked floor surface:

a. Slabs on Ground:

1) Specified overall values of flatness, F_F 35; and of levelness, F_L 25; with minimum local values of flatness, F_F 24; and of levelness, F_L 17.

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated on Drawings and where ceramic or quarry tile is to be installed by either thickset or thinset method. While concrete is still plastic, slightly scarify surface with a fine broom perpendicular to main traffic route.

1. Coordinate required final finish with Architect before application.

2. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and locations indicated on Drawings.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.

2. Coordinate required final finish with Architect before application.

3.9 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

A. Filling In:

1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.

2. Mix, place, and cure concrete, as specified, to blend with in-place construction.

3. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.

2. Construct concrete bases 4 inches (100 mm) high unless otherwise indicated on Drawings, and extend base not less than 6 inches (150 mm) in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.

3. Minimum Compressive Strength: as indicated on the drawings.

4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.

5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.

6. Prior to pouring concrete, place and secure anchorage devices.

a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

b. Cast anchor-bolt insert into bases.

c. Install anchor bolts to elevations required for proper attachment to supported equipment.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items.

1. Cast-in inserts and accessories, as shown on Drawings.

2. Reinforce interior concrete landings and treads with either microsynthetic monofilament fibers (at a minimum dosage rate of 1.0 lbs/cy) or 4x4-W1.4xW1.4 welded wire fabric.

3. Screed, tamp, and trowel finish concrete surfaces.

3.10 CONCRETE CURING

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

1. Comply with ACI 301 (ACI 301M) and ACI 306.1 for cold weather protection during curing.

2. Comply with ACI 301 (ACI 301M) and ACI 305.1 (ACI 305.1M) for hot-weather protection during curing.

3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h (1 kg/sq. m x h), calculated in accordance with ACI 305.1,) before and during finishing operations.

B. Curing Formed Surfaces: Comply with ACI 308.1 (ACI 308.1M) as follows:

1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.

2. If forms remain during curing period, moist cure after loosening forms.

3. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:

a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.

b. Continuous Sprinkling: Maintain concrete surface continuously wet.

c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.

d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.

e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.

1) Recoat areas subject to heavy rainfall within three hours after initial application.

2) Maintain continuity of coating and repair damage during curing period.

C. Curing Unformed Surfaces: Comply with ACI 308.1 (ACI 308.1M) as follows:

1. Begin curing immediately after finishing concrete.

2. Interior Concrete Floors:

   a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:

      1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.

         a) Lap edges and ends of absorptive cover not less than 12-inches (300-mm).

         b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.

      2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive.

         a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.

         b) Cure for not less than seven days.

      3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:

         a) Water.

         b) Continuous water-fog spray.

   b. Floors to Receive Penetrating Liquid Floor Treatments: Contractor has option of the following:

      1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.

         a) Lap edges and ends of absorptive cover not less than 12 inches (300 mm).

         b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.

      2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive.

         a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.

         b) Cure for not less than seven days.

3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:

a) Water.

b) Continuous water-fog spray.

c. Floors to Receive Polished Finish: Contractor has option of the following:

1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.

a) Lap edges and ends of absorptive cover not less than 12 inches (300 mm).

b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.

2) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:

a) Water.

b) Continuous water-fog spray.

d. Floors to Receive Curing Compound:

1) Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.

2) Recoat areas subjected to heavy rainfall within three hours after initial application.

3) Maintain continuity of coating, and repair damage during curing period.

4) Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer[unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project].

e. Floors to Receive Curing and Sealing Compound:

1) Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller in accordance with manufacturer's written instructions.

2) Recoat areas subjected to heavy rainfall within three hours after initial application.

3) Repeat process 24 hours later, and apply a second coat. Maintain continuity of coating, and repair damage during curing period.

3.11 TOLERANCES

A. Conform to ACI 117 (ACI 117M).

3.12 APPLICATION OF LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment in accordance with manufacturer's written instructions.

1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.

2. Do not apply to concrete that is less than [three] [seven] [14] [28] days' old.

3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing.

4. Rinse with water; remove excess material until surface is dry.

5. Apply a second coat in a similar manner if surface is rough or porous.

3.13 JOINT FILLING

A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least [one] [six] month(s).

2. Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches (50 mm) deep in formed joints.

D. Overfill joint, and trim joint filler flush with top of joint after hardening.

3.14 CONCRETE SURFACE REPAIRS

A. Defective Concrete:

1. Repair and patch defective areas when approved by Architect.

2. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks,

spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension to solid concrete.
    a. Limit cut depth to 3/4 inch (19 mm).
    b. Make edges of cuts perpendicular to concrete surface.
    c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
    d. Fill and compact with patching mortar before bonding agent has dried.
    e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.
    a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
    b. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces:

1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.
    a. Correct low and high areas.
    b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
3. After concrete has cured at least 14 days, correct high areas by grinding.
4. Correct localized low areas during, or immediately after, completing surface-finishing operations by cutting out low areas and replacing with patching mortar.
    a. Finish repaired areas to blend into adjacent concrete.
5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.
    a. Prepare, mix, and apply repair underlayment and primer in accordance with

manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

b. Feather edges to match adjacent floor elevations.

6. Correct other low areas scheduled to remain exposed with repair topping.

a. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations.

b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

7. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete.

a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch (19-mm) clearance all around.

b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.

c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.

d. Place, compact, and finish to blend with adjacent finished concrete.

e. Cure in same manner as adjacent concrete.

8. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar.

a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.

b. Dampen cleaned concrete surfaces and apply bonding agent.

c. Place patching mortar before bonding agent has dried.

d. Compact patching mortar and finish to match adjacent concrete.

e. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.15 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.

B. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

1. Testing agency shall be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.

2. Testing agency shall immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.

3. Testing agency shall report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.

a. Test reports shall include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:

1) Project name.

2) Name of testing agency.

3) Names and certification numbers of field and laboratory technicians performing inspections and testing.

4) Name of concrete manufacturer.

5) Date and time of inspection, sampling, and field testing.

6) Date and time of concrete placement.

7) Location in Work of concrete represented by samples.

8) Date and time sample was obtained.

9) Truck and batch ticket numbers.

10) Design compressive strength at 28 days.

11) Concrete mixture designation, proportions, and materials.

12) Field test results.

13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.

14) Type of fracture and compressive break strengths at seven days and 28 days.

C. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.

D. Inspections:

1. Headed bolts and studs.

2. Verification of use of required design mixture.

3. Concrete placement, including conveying and depositing.

4. Curing procedures and maintenance of curing temperature.

5. Verification of concrete strength before removal of shores and forms from beams and slabs.

E. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M shall be performed in accordance with the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.

   a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C143/C143M:

   a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.

   b. Perform additional tests when concrete consistency appears to change.

3. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete; ASTM C173/C173M volumetric method, for structural lightweight concrete.

   a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

4. Concrete Temperature: ASTM C1064/C1064M:

   a. One test hourly when air temperature is 40 deg F (4.4 deg C) and below or 80 deg F (27 deg C) and above, and one test for each composite sample.

5. Unit Weight: ASTM C567/C567M fresh unit weight of structural lightweight concrete.

   a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

6. Compression Test Specimens: ASTM C31/C31M:

   a. Cast and laboratory cure two sets of four 6-inch (150 mm) by 12-inch (300 mm) or 4-inch (100 mm) by 8-inch (200 mm) cylinder specimens for each composite sample.

7. Compressive-Strength Tests: ASTM C39/C39M.

a. Test one set of two laboratory-cured specimens at seven days and three sets of two specimens at 28 days.

b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.

9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa) if specified compressive strength is 5000 psi (34.5 MPa), or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi (34.5 MPa).

10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

11. Additional Tests:

a. Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.

b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.

1) Acceptance criteria for concrete strength shall be in accordance with ACI 301 (ACI 301M), section 1.6.6.3.

12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

F. Measure floor and slab flatness and levelness in accordance with ASTM E1155 (ASTM E1155M) within 24 hours of completion of floor finishing and promptly report test results to Architect.

3.16 PROTECTION

A. Protect concrete surfaces as follows:

1. Protect from petroleum stains.

2. Diaper hydraulic equipment used over concrete surfaces.

3. Prohibit vehicles from interior concrete slabs.

4. Prohibit use of pipe-cutting machinery over concrete surfaces.

5. Prohibit placement of steel items on concrete surfaces.

6. Prohibit use of acids or acidic detergents over concrete surfaces.

7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION

SECTION 03 30 00 CAST-IN-PLACE CONCRETE

PART 1: GENERAL

1.01 SCOPE OF WORK

This section includes cast-in-place concrete as shown on Drawings, and as specified herein. In general, this work includes providing cast-in-place concrete consisting of Portland Cement, fine and course aggregate, selected admixtures, mixing, transporting, placing, finishing, and curing as herein specified. This section further includes related items of quality control, testing, and evaluation of concrete strength.

1.02 STANDARDS

A. Some products and execution are specified in this section by reference to published specifications or standards of the following with respect abbreviations used.

1. American Concrete Institute .....ACI

2. The American Society for Testing and Materials .....ASTM

B. The current edition of the following standard references shall apply to the work of this Section as indicated. Suffixes indicating issue date are omitted from reference numerals elsewhere in the text. Concrete work shall comply with the following standards and codes except as indicated otherwise on the Drawings or herein.

1. ACI 301 "Specifications for Structural Concrete"

2. ACI 304 "Recommended Practice for Measuring, Mixing Transporting, and Placing Concrete"

3. ACI 305 "Recommended Practice for Hot Weather Concreting"

4. ACI 306 "Recommended Practice for Cold Weather Concreting"

5. ACI 308 "Recommended Practice for Curing Concrete"

6. ACI 309 "Recommended Practice for Consolidation of Concrete"

7. ACI 311 "Recommended Practice for Concrete Inspection"

8. ACI 214 "Recommended Practice for Evaluation of Compressive Test Results of Field Concrete"

9. ACI 211.1 "Recommended Practice for Selecting Proportions 70 for Normal Weight Concrete"

10. ACI 211.2 "Recommended Practice for Selecting Proportions for Structural light-weight Concrete"

11. ACI 212 "Guide for Use of Admixtures in Concrete"

12. ACI 214 "Recommended Practice for Evaluation of Compression Test Results of Field Concrete"

1.03 QUALITY ASSURANCE

A. If the average strength of the laboratory control cylinders shows the concrete to be below the specified design strength, the aggregate proportions and water content may be changed by the Engineer, who, in addition to such changes, may require core tests. Tests confirming concrete strengths on hardened concrete, which was poured without testing, shall be paid for by the Contractor.

B. Prepare design mixes for each class of concrete used in accordance with ACI 311.1. The Contractor shall pay for all design mix costs. Submit written reports to the Engineer for each proposed mix for each class of concrete prior to start of work. Do not begin concrete production until mixes have been reviewed by the Engineer.

C. Strength data for establishing standard deviation and required overstrength factor will be considered suitable if the concrete production facility has certified records consisting of at least 30 consecutive tests in one group or the statistical average for two groups totaling 30 or more tests representing similar materials and project conditions. Records of these tests shall be submitted with the proposed design mix.

D. If standard deviation exceeds 800 psi or if no suitable records are available, selected proportions to produce an average strength of at least 1200 psi greater than the required compressive strength of concrete. If standard deviations are less than 600 psi, the minimum overstrength factor required in the design mix shall be in accordance with ACI 318, Section 4.3.1.

E. Design mixes shall be proportioned using the maximum specified slump and temperature. Laboratory test date for revised mix designs and strength results must be submitted to and accepted by the Engineer before using in the work. Admixtures shall be used in strict accordance with the manufacturer's written instructions. Design mix shall be proportioned using the proposed admixtures at optimum recommended dosages. The manufacturer of the mixture shall prepare and submit test date used to determine the optimum dosage.

1.04 SUBMITTALS

The Contractor shall submit four copies of the proposed design mix for each class of concrete specified herein in accordance with the requirements herein. Design mixes shall be submitted two weeks prior to placement of concrete. The cost of the design mix shall be paid for by the contractor. Submit records of all concrete pours showing exact location of pour, date of pour, quantity of pour, and class of concrete poured to the Engineer each month. Temperature at time of pour should also be recorded. Submit to the Engineer chemical and physical analysis of all cement and fly ash delivered to the batch plant seven (7) days prior to use of the cement or fly ash.

PART 2: PRODUCTS

2.01 MATERIALS

A. PORTLAND CEMENT shall be fresh stock of an approved standard brand meeting the requirements of ASTM C-150, of Type II and shall be 4000 PSI unless otherwise specified. Only one brand of cement shall be used except when otherwise approved by the Engineer, and the Contractor shall inform the Engineer of the brand name of the cement proposed for use. The Contractor shall submit a copy of mill test reports on all cement delivered to the job 7 days prior to use of the cement. Cube strength from mill tests shall have a tolerance of ±600 psi. The fineness of cement used shall not have more than l0% retained on a #325 mesh screen when tested in accordance with ASTM C-430.

B. FLY ASH shall have a high fineness and low carbon content and shall exceed the requirements of ASTM C-618. Specifications for Fly Ash and Raw or Calcined Natural for use in Portland Cement Concretes for Class 7, except that the loss of ignition shall be less than 3%, and all fly ash shall be a classified processed material. Fly ash shall be obtained from one source for the concrete delivered to the project. Complete chemical and physical analysis of each carload of fly ash shall be submitted to the Engineer ten (10) days prior to use of each carload delivered. Concrete mixes proportioned with fly ash shall contain not less than 10% nor more than 20% by weight of cement of fly ash.

C. CONCRETE AGGREGATE for stone concrete shall consist of clean crushed stone or gravel having hard, strong, uncoated particles free from injurious amounts of soft, thin, elongated or laminated pieces, alkali, organic or other deleterious matter. Maximum aggregate size shall be 3/4" of slabs, columns, etc. The maximum permissible percentage of elongated particles shall not exceed 5% by weight. Elongated particles are those defined as having a length equal to or greater than 5 times the width. Samples of coarse aggregate shall be submitted to the testing laboratory for testing and approval prior to use. The fineness modulus of the coarse aggregate shall not vary for more than ±0.3%.

D. FINE AGGREGATE shall consist of sand, stone screening, or other inert materials with similar characteristics having clean, strong, durable, uncoated grains and free from lumps, soft or flaky particles, clay, shale, alkali, organic

matter or other deleterious substances. Fine aggregate shall be submitted for testing and approval to the testing laboratory. The laboratory shall verify that fine aggregate conforms to ASTM standards by making standard colormetric, sediment, and comparative tensile tests, and by sieve analysis. The fineness modules of the sand shall not vary by more than ±0.2%. Color shall be standard as determined from colormetric tests.

E. CONCRETE ADMIXTURES, when required or permitted shall conform to the appropriate specification listed. Do not use admixtures, which have not been incorporated and tested in the accepted mixes unless otherwise authorized in writing by the Engineer. Air-entraining admixtures shall exceed the requirements of ASTM C-260, "Specifications for Air-Entraining Admixtures for Concrete". Water reducing admixtures shall be hydroxolated polymer type exceeding the requirements of ASTM C-494, Type A.

F. PREMOLDED EXPANSION JOINT FILLERS shall conform to ASTM D1751.

G. LIQUID CURING MATERIAL for concrete shall exceed the requirements of ASTM C-309, Type I. Products acceptable shall provide water retention not exceeding a loss of 0.020 grams per sq. cm. when tested at a coverage of 200 sq. ft. per gallon and tested in accordance with ASTM C-156. Submit test data verifying these requirements for approval.

H. BURLAP shall be free of sizing or any substance that is injurious to cement or can cause discoloration. Burlap shall be rinsed in water prior to use. Burlap shall be sufficient thickness to retain water without requiring wetting.

I. STEEL FOR EMBEDDED ANGLES AND PLATE CAST IN CONCRETE shall conform to ASTM A-36. Plates and angles shall receive a commercial sand blast and be painted with an inorganic zinc base paint equal to Carbomastic #11, or an approved equal.

J. CRUSHED STONE FILL, 4" in depth, shall be placed under all concrete floors in contact with the ground. Stone shall be uniform 3/4" stone, no fines, compacted as thoroughly as possible by tamping and rolling. Stone fill shall conform to ASTM C-33.

K. VAPOR BARRIER shall be a minimum of a 6 mil polyethylene.

L. WATERSTOPS shall be Sealtight PVC waterstrips as manufactured by the W.R. Meadows Co., or an approved equal. All waterstops shall be Type 6316. Water bars shall be located in all expansive joints in the concrete and in all construction joints in concrete walls.

M. JOINT SEALING COMPOUND shall be a two-part mineral filled epoxy polyurethane, and shall be used for all exposed joints in exterior paving slabs,

sidewalks, where concrete slabs abut concrete walls, and in exposed joints in slabs on grade.

N. SURFACE COATING for all exposed concrete except where otherwise shown shall be a masonry water proofer or sealer.

O. AIR ENTRAINMENT: Air-entraining admixtures shall be used for all concrete exposed to freezing and thawing or subjected to hydraulic pressure. Entrained air shall conform to the air control limits of Table 3.4.1 of ACI 301. The water-cement ratio for all air-entrained concrete exposed to freezing and thawing shall not exceed 0.53.

P. SLUMPS: All concrete shall be proportioned and produced to have a maximum slump of 4" and a minimum slump of 2" as per ASTM C143. A tolerance of up to but not exceeding 1" above the indicated maximum shall be allowed for individual batches in any one day's pour provided the average of the most recent ten batches within the same pour does not exceed the maximum limits. No tolerance will be permitted for individual batches when less than ten (10) batches are delivered for one day's pour.

Q. CONCRETE MIXING

1. Concrete shall be mixed at batch plants or it may be transit mixed as specified herein. Concrete batch plants must comply with the requirements of ASTM C-94 for ready-mixed concrete, ASTM C33 for aggregates and ACI-304 with sufficient capacity of producing concrete of the quantity and quality as specified herein. All plant facilities are subject to inspection by the Engineer. Ready-mix concrete shall comply with requirements of ASTM C-94, and as specified herein, unless otherwise noted. During hot weather or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C-94 will be required as follows:

    a. When air temperatures are between 80°F. and 90°F., reduce the mixing and delivery time from 1-1/2 hours to 1 hour

    b. When outside air temperatures are above 90°F, reduce the mixing and delivery time from 1-1/2 hours to 45 minutes.

2. Addition of water at the site for concrete mix with insufficient slumps, slumps less than the maximum specified herein, will not be permitted. Concrete delivered to the project with slump less than the minimum or greater than the maximum specified shall be rejected and discarded off site.

3. Batch tickets for each load of concrete shall be submitted to the Engineer. The following information shall be provided on each batch ticket:

a. Design mix designation

b. Exact time cement, water and aggregate were discharged into the mix

c. Compressive strength of mix

d. Amount of water added to the mix

4. Maintain equipment in proper operating condition, with drums cleaned before charging of each batch. Schedule delivery of trucks in order to prevent delay of placing after mixing.

5. CONCRETE TYPE AND STRENGTHS

Location	Maximum Size Aggregate	*28 Day Compressive Strength
Slabs on Grade	3/4"	4000 psi
Walls	3/4"	4000 psi
Walks and Steps	3/4"	4000 psi

*Twenty-eight day strength shall be as determined from concrete sampled in accordance with ASTM C-172 and standard 6" x 12" molded cylinders tested in accordance with ASTM C-31 and C-39.

**See notes on plans for required concrete strengths.

PART 3: EXECUTION

3.01 PREPARATION

Before placing concrete, all equipment for mixing and transporting and placing concrete shall be cleaned, all debris and ice removed from spaces to be occupied by the concrete, forms thoroughly cleaned of soil, ice, or other coatings which will prevent proper bond, reinforcement shall be securely tied in place and expansion joint material, anchors, and other embedded items shall be securely positioned. Hardened concrete and foreign materials shall be removed from the conveying equipment.

3.02 CONCRETE PLACEMENT

A. Place concrete in compliance with the practices and recommendations of ACI 304 or as herein specified. Concrete shall be handled from the mixer to the place of final deposit as rapidly as practical by methods, which will prevent separation or loss of ingredients and in a manner, which will assure that the required quality concrete, is obtained. Conveying equipment shall be of size and design to insure a continuous flow of concrete at the delivery end.

B. Concrete shall be deposited continuous, or in layers of such thickness that no concrete will be deposited on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within the section. If a section cannot be placed continuously, construction joints shall be located at points as provided for in the drawings or as approved. Placing shall be carried on at such a rate that the concrete, which is being integrated, with fresh concrete is still plastic. Deposit concrete as nearly as possible to its final location to avoid segregation due to rehandling or flowing. Do not subject concrete to any procedure, which will cause segregation.

C. Concrete shall not be allowed to "freefall" a distance greater than 3'-0". All concrete placed in columns and walls shall be placed through a tremie with the bottom or outlet of the tremie being held at maximum of 3'-0" above the surface where concrete is being placed.

D. Screed concrete which is to receive other construction to the proper level to avoid excessive skimming or grouting.

E. Do not use concrete which has become non-plastic and unworkable or does not meet the required quality control limits, or which has become contaminated by foreign material. Remove rejected concrete from the project site and dispose of in an acceptable location. Consolidate concrete placed in forms by mechanical vibrating equipment supplemented by hand spading, rodding, and tamping. Vibration of forms and reinforcing steel will not be permitted.

F. Do not use vibrators to transport concrete inside forms. Insert and withdraw vertically at uniformly spaced locations not further than the visible effectiveness of the vibrator. Do not insert vibrators into lower levels of concrete that have begun to set. At each insertion, limit the duration of vibration to the time necessary to consolidate the concrete and complete embedment of reinforcing and other embedded items without causing segregation of the mix.

G. Deposit and consolidate concrete in slabs in a continuous operation, within the limits of construction joints until the placing of the entire section is complete.

H. Bring surface of slabs to the correct elevations with a straight edge and strike off. Use bull floats or darbies to smooth the surface, leaving it free of lumps and hollows. Do not sprinkle water on the plastic surface. Do not disturb the surface prior to beginning the finish operation.

I. Concrete placed by plumbing shall conform to the recommendations of ACI Publication, "Placing Concrete by Pumping Methods."

3.03 CONSTRUCTION JOINTS

Joints not shown on the drawings shall be made at locations that will least impair the strength of the structure and shall be approved by the Engineer. In general, they shall be located near the middle of the span of members. Joints in walls and columns shall be located at the underside of floors or slabs, and the tops of foundation walls. Roughen surfaces of hardened concrete at all vertical construction joints. Clean surface of laitance, coatings, loose particles, and foreign matter to expose aggregate. Prepare for bonding of fresh concrete to new concrete that has hardened; at joints between foundation systems and walls dampen, but do not saturate, the roughened and cleaned surface of set concrete immediately before placing fresh concrete. In lieu of neat cement grout, bonding grout may be a commercial bonding agent. Apply to cleaned concrete surfaces in accordance with the printed instruction of this bonding material manufacturer. Provide keyways at least 1-1/2" deep in all construction joints in walls, slabs, and between walls, and foundation systems. Provide PVC Waterstops in all construction joints in concrete walls and in concrete beams and slabs. PVC waterstops shall also be provided between concrete beams and slabs at all expansion joints.

3.04 COLD WEATHER PLACING AND CURING REQUIREMENTS

A. No concrete is to be placed when the air temperature is 40° F or below and the predicted low temperature for the succeeding 24-hour period is less than 32° F.

B. All Concrete when placed in the forms shall have a temperature of between 50° and 90° F and shall be maintained at a temperature of not less than 50° F for at least 72 hours for normal concrete and 24 hours for high early strength concrete, or for as much time as is necessary to secure proper rate of curing and designed compressive strength.

3.05 HOT WEATHER PLACING

An approved admixture designed to retard the rate of set shall be used for all concrete placed when temperatures exceed 75°F. Set retarding admixtures shall conform to ASTM C-494, Type D, water reducing and retarding. Wet forms thoroughly before placing. Cool reinforcing by wetting sufficiently so that steel temperatures will be nearly equal to the ambient air temperature. Provide windbreaks around the perimeter of the area where concrete is being placed. Fresh concrete with temperatures of 90°F. or above shall be discarded off site. The amount of cement used in the job is computed for the temperature indicated on the approved design mix. For higher concrete mix temperature, the weight of the cement shall be increased at the rate of 12 lbs. per cubic yard for each 10°F. above the concrete mix temperature.

3.06 CURING AND PROTECTION

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures, and maintain without drying at a relatively constant temperature for the period of time necessary for hydration of the cement and proper hardening of the concrete.

B. Curing for all horizontal slab surfaces, except those to receive a bonded finish material, during periods when the outside air temperature does not exceed 60ºF. shall be provided by applying a membrane-forming curing compound to concrete surfaces as soon as the final troweling or floating operation has been completed. Apply uniformly with a roller brush at a rate not to exceed 200 sq. ft. per gallon. Maintain the continuity of the coating and repair damage to the coat during the entire curing period. Curing for surfaces to receive a bonded finish material shall be as noted below. Curing for all horizontal surfaces during period when the outside air temperature will exceed 60ºF. shall be provided by covering the entire surface with burlap. The burlap shall be lapped 1/2 width in order to provide a double thickness of burlap. Immediately following the placement of the burlap, the entire surface shall be maintained continuously wet for a period of 7 days. Do not permit surfaces to dry at any period during the required curing period.

C. Cure formed surfaces by moist curing with the forms in place for the full curing period, or until forms are removed. If forms are removed before the curing period is complete, apply a membrane-forming curing compound to damp surfaces as soon as the water film has disappeared. Apply uniformly in continuous operation by roller brushes in accordance with the manufacturer's directions.

D. Do not use membrane curing compounds on surfaces which are to be covered with a coating material applied directly to the concrete or with any other cover or finish material which shall be bonded to the concrete. These surfaces must be watercured with a full coverage of burlap kept continuously moist for a period of 7 days.

E. During the curing period, protect concrete from damaging mechanical disturbances, including load stresses, shocks, excessive vibration and from change caused by subsequent construction operations.

3.07 SURFACE REPAIRS

A. Repair and patch defective areas immediately after removal of forms as directed by the Engineer. Cut out honeycombs, rock pockets, voids over 1/2" in diameter and holes left by tie rods and bolts down to solid concrete, but in no case to a depth of less than 1". Make edges of cuts perpendicular to the concrete surfaces. Exposed reinforcing steel with at least 3/4" clearance all around. Dampen all concrete surfaces in contact with patching concrete, and brush with a neat cement grout coating or concrete bonding agent. Place patching concrete before grout takes its initial set. Mix patching concrete of the same materials to provide concrete of the same type or class as the original adjacent concrete. Place, compact, and finish as required to blend with adjacent finished concrete. Cure in the same manner as adjacent concrete.

B. Fill holes extending through concrete by means of a plunger type gun or other suitable device from the least exposed face to insure complete filling. Remove stains and other discolorations that cannot be removed by cleaning for all exposed

surfaces. Repair isolated random cracks and single holes not over 1" in diameter by the dry-pack method. Groove the top of cracks and cut out holes to sound concrete and clean of dust, dirt, and loose particles. Dampen all cleaned concrete surfaces and brush with a neat cement grout coating. Place dry-pack, consisting of 1 part Portland cement to 2-1/2 parts fine aggregate passing a #16 mesh sieve using only enough water as required for handling and placing. Compact dry-pack mixture in place and finish to match the existing surface.

C. Fill in holes and openings left in concrete structures for the passage of work by other trades, unless otherwise shown or directed, after the work of other trades is in place. Mix, place, and cure concrete as herein specified, to blend with in-place construction. Provide all other miscellaneous concrete filling shown or required to complete work.

D. Correct high areas in unformed surfaces by grinding, after the concrete has cured at least 14 days. Correct low areas in unformed surfaces during, or immediately after, completion of surface finishing operations by cutting out the low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Proprietary patching compounds may be used when acceptable to the Engineer.

3.08 SLABS ON GRADE

A. PREPARATION OF SUBGRADE

The subgrade shall be well drained and of adequate and uniform loadbearing nature. The in-place density of the subgrade soils shall be at least the minimum required in the specifications. The bottom of an undrained granular base course shall not be lower than the adjacent finished grade. The subgrade shall be free of frost before concrete placing begins. If the temperature inside a building where concrete is to be placed is below freezing, it shall be raised and maintained above 50ºF. long enough to remove all frost from the subgrade. The subgrade shall be moist at the time of concreting. If necessary, it shall be dampened with water in advance of concreting, but there shall be no free water standing on the subgrade nor any muddy or soft spots when the concrete is placed.

B. JOINTS

Joints in slabs on grade shall be located as to divide the slab in areas not in excess of 800 sq. ft. The maximum distance between joints in slabs on grade at all points of contact between slabs on grade and vertical surfaces such as foundation walls and elsewhere as indicated. At exposed joints, recess the premolded fill on a minimum of 1/2”, and fill the remaining section with a joint seal and as specified herein. All exposed construction joints in the slabs on grade shall have the edges tooled and the crack and groove formed by the edging tool filled with a polyurethane joint sealant. No kold-key or metal form joints will be permitted.

3.09 SIDEWALKS

A. Brooming of the concrete surface shall be done transverse to the direction of traffic. Joint spacing shall not be less than 5'-0". Where existing sidewalks are being widened, transverse joints shall be located so as to line up with existing joints in the adjacent sidewalk. Joints shall not be sealed.

B. All sidewalks shall contain 6"x6" / 1.4x1.4 WWF. Chairs shall be installed or WWF lifted during placement to allow WWF to be within middle 1/3 of sidewalk cross section.

C. Backfill shall be compacted to a degree comparable to the adjacent undisturbed material.

3.10 CURB AND GUTTER

A. Concrete curb/curb and gutter shall meet the requirements of Section 846-3 of the NCDOT Standard Specifications for Roads and Structures (latest edition).

B. The concrete shall be given a light broom finish with the brush marks parallel to the curb line or gutter line.

C. No earth backfill or pavement shall be placed adjacent to the curb and gutter until at least three curing days have elapsed. Backfill shall be compacted to a degree satisfactory to the Engineer.

3.11 FINISHES

A. STANDARD ROUGH FORM FINISH

Provide a standard rough form finish to all concrete formed surfaces that are to be concealed in the finish work or other construction. (**NOTE:** Interior faces of walls of water retaining structures are not considered to be concealed.) Standard rough form finish shall consist of all defective areas repaired as specified and all holes or voids larger than 3/8" filled with cement grout.

B. STANDARD FINISH FOR EXPOSED SURFACES

Provide an applied surface finish of Masonry Water proofer or Sealer to all exposed interior and exterior concrete finishes unless otherwise noted. Interior faces of walls of water retaining structures, including areas which are normally submerged, are considered to be exposed surfaces and shall receive the specified standard finish for exposed surfaces. The surface finish shall consist of chopping and/or grinding down all high spots removing grinding of all burrs and/or other projections, filling all voids 3/8" and larger, and cutting out all unsound concrete and patching as specified herein. Before applying the finish, wet and clean the surface of all grease, oils, efflorescence, and other foreign material. Dampen surface immediately ahead of application. Apply the finish coat with a tampico

fiber brush by laying the finish coat on the wall in a thick coat of a minimum of 2 lbs. per sq. yard, and brush to a uniform level surface. Do not apply in temperatures 40°F or below, or when temperatures are likely to fall below 40°F within 24 hours after application. The finish coat shall be mixed in strict accordance with the manufacturer's written instructions. After the finish coat has cured, apply a finish coat of masonry water proofer or sealer at a minimum of 12 lb. per sq. yd. Trained technicians shall apply the masonry water proofer or sealer.

C. SMOOTH FORM FINISH

Provide a smooth form finish for all exposed interior concrete walls inside buildings, in pipe gallery areas, or as noted on the Drawings. Standard form finish shall produce a smooth, hard, uniform texture on the concrete. The arrangement of the forms and the number of seams and joints shall be kept to a minimum. Immediately after forms are removed, cut out all unsound concrete and patch as specified herein, and fill all pinholes and other voids larger than 1/4" with a cement grout. Compress mortar into voids with a firm rubber trowel or float. After mortar dries, wipe off surface with burlap.

D. SLAB FINISHES

1. Scratched Finish

After the concrete has been placed, consolidated, struck off, and leveled to a Class C tolerance, the surface shall be roughened with stiff brushes or rakes before a final set. A scratched finish shall be applied to all surfaces which are to receive a bonded surface finish.

2. Floated Finish

After the concrete has been placed, consolidated, struck off, and leveled, the concrete shall not be worked further until ready for floating. Floating shall begin when the water sheen has disappeared and when the surface has stiffened sufficiently to permit the operation. During or after the first floating, planeness of surface shall be checked with a 10’-0” straight edge applied at not less than two different angles. All high spots shall be cut down and all low spots filled during this procedure to produce a surface with Class B tolerance throughout. This slab shall then be floated immediately to a uniform sandy texture. A float finish shall be applied to all slab surfaces, which are to receive a waterproofing membrane.

3. Troweled Finish

The surface shall first be float-finished as specified. It shall next be power troweled, and finally hand troweled. The first troweling after power floating shall produce a smooth surface, which may still show some

trowel, marks. Additional troweling shall be done by hand after the surface has hardened sufficiently. The final troweling shall be done when a ringing sound is produced as the trowel is moved over the surface. The surface shall be thoroughly consolidated by the hand troweling operations. The finished surface shall be essentially free of trowel marks, uniform in texture, and appearance, and shall be planed to a Class tolerance. On surfaces intended to support floor coverings, any defects of sufficient magnitude to show through the floor covering shall be removed by grinding. A trowel finish shall be applied to all surfaces, which are exposed to view or are to receive a floor covering of carpet, vinyl, asbestos, tiles, etc.

4. Broom Finish

Immediately after the concrete has received a float finish as specified in Section B, it shall be given a coarse transverse scored texture by drawing a broom or burlap belt across the surface. A broom finish shall be applied to all parking surfaces, exterior concrete walks, and concrete paving slabs.

3.12 FINISHING TOLERANCES

Finishes with a Class C tolerance shall be true planes within 1/4" in 2'-0" as determined by a 2'-0" straight edge placed elsewhere on the slab in any direction. Variation from level for Class A. tolerance shall not exceed 1/4" in 10'-0" or 1/2" maximum in any one bay between columns. Variation from level for a Class B and Class C finish shall not exceed 1/4" in 10'-0" or 3/4" in any one bay between columns.

3.13 RELATED UNFORMED SURFACES

As tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike off smooth and finish with a texture matching the adjacent formed surfaces. Continue the final surface treatment of formed surfaces uniformly across the adjacent unformed surface unless otherwise shown.

3.14 MISCELLANEOUS CONCRETE ITEMS

A. Provide monolithic finish to interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to a hard, dense finish with corners, intersections and terminations slightly rounded.

B. Provide machine and equipment bases and foundations, as shown on the drawings. Set anchor bolts for machines and equipment to template at correct elevations prior to placement of the concrete, complying with certified diagrams or templates of the manufacturer finishing machines and equipment.

3.15 INSPECTION

Before placing concrete, the formwork installation, reinforcing steel, and items to be embedded or cast-in must be complete. Notify other crafts involved in ample time to permit the installation of their work; co-operate with other trades in setting such work, as required. Notify Engineer upon completion of installation of all reinforcing and other items in ample time to permit inspection of the work before concrete is poured. Soil bottoms at foundation systems are subject to testing laboratory as directed by the Engineer. Place concrete immediately after approval of foundation excavations.

3.16 TESTING AND QUALITY CONTROL

A. The Owner shall employ a concrete testing laboratory to provide all laboratory testing services on the project and a concrete technician to perform all quality control tests on concrete and materials used to batch concrete. The testing agency employed shall meet the requirement of "Recommended Practice for Inspection and Testing Agencies for Concrete and Steel as Used in Construction", (ASTM E-329).

B. The Contractor shall provide and maintain adequate facilities on the project for the testing laboratory to locate the required testing equipment and for safe storage area for test cylinders. The general contractor shall provide at his own expense all casual labor needed to assist the concrete technician in obtaining samples of concrete and concrete materials and moving and transporting cylinders and materials which are being tested.

C. The following services shall be performed by the designated testing agency:

1. Review and/or check-test the Contractor's proposed materials for compliance with the specifications.

2. Review and/or check-test the Contractor's proposed mix design as required by the Engineer.

3. Secure production samples of materials at plants or stock-piles during the course of the work and test for compliance with the specifications as required by the Engineer.

4. Conduct strength tests of the concrete during construction in accordance with the following procedures:

a. Secure composite samples in accordance with "Method of Sampling Fresh Concrete" (ASTM C-172). Each sample shall be obtained from a different batch of concrete on a random basis, avoiding any selection of the test batch other than by a number selected at random before commencement of concrete placement.

b. Mold and cure three specimens from each sample in accordance with "Method of Making and Curing Concrete Compression and

Flexural Specimens in the Field" (ASTM C-31). Any deviations from the requirements of this Standard shall be recorded in the test report.

c. Test specimens in accordance with "Method of Test for Compression Strength of Molded Concrete Cylinders" (ASTM C-39). Two specimens shall be tested at 28 days for acceptance and one shall be the average of the strengths of the two specimens tested at 28 days. If one specimen in a test manifests evidence of improper sampling, molding or testing, it shall be discarded and the strength of the remaining cylinder shall be considered the test result. Should both specimens in the test show any of the above defects, the entire test shall be discarded. When high early strength concrete is used, the specimens shall be tested at the ages indicated in the Contract Documents.

d. Make at least one strength test for each 50 cu. yd., or fraction thereof, of each mix design of concrete placed in any l day. When the total quantity of concrete with a given mix design is less than 50 cu. yd., the strength test may be waived by the Engineer if, in his judgment, adequate evidence of satisfactory strength is provided, such as strength test results for the same kind of concrete supplied on the same day and under comparable conditions to other work or other projects.

5. Determine slump of the concrete sample for each strength test and whenever consistency of concrete appears to vary, using "Method of Test for Slump of Portland Cement Concrete" (ASTM C-143). Slump is to be 4” with a +/- 1” tolerance. Anything not in this range is to be approved by the engineer prior to placement.

6. Determine air content of normal weight concrete sample for each strength test in accordance with either "Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method" (ASTM C-231), "Method of Test for Air Content of Freshly Mixed Concrete by the Volumetric Method" (ASTM C-173), or "Method of Test for Weight per Cubic Foot, Yield and Air Content (Gravimetric) of Concrete", (ASTM C-138). Concrete shall be air entrained with 5-7% air.

7. Determine unit weight of concrete sample for each strength test.

8. Determine temperature of concrete sample for each strength test. If temperature is 90° or above, concrete is not to be used.

9. Determine in-place strength of concrete by curing cylinders under the same field conditions that the concrete representing these field cylinders is

cured and additionally by determining the degree/hours of curing required for the concrete to develop the required strength for form removal.

10. Inspect concrete batching, mixing and delivery operations to the extent deemed necessary by the Engineer.

3.17 EVALUATION AND ACCEPTANCE OF CONCRETE STRUCTURES

A. The concrete quality control testing as specified will be evaluated by the following criteria:

1. Compressive strength tests for laboratory-cured cylinders will be considered satisfactory if the averages of all sets of three consecutive compressive strength test results equal or exceed the 28-day design compressive strength of the type of class of concrete; and, no individual strength test falls below the required compressive strength by more than 500 psi. If compressive strength tests fail to meet these requirements, the concrete represented by these tests will be considered deficient and subject to additional testing and/or removal.

2. Concrete work, which does not conform to the specified requirements, including strength, tolerance and finishes, shall be corrected as directed at the Contractors expense, without extension of time therefor. The Contractor shall also be responsible for the cost of corrections to any other work affected by or resulting from correction to the concrete work. Core tests, if required, shall be evaluated in accordance with the requirements of ACI 318-77.

END OF SECTION

SECTION 039000

PENETRATING CONCRETE SEALER

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SUMMARY

A. Section Includes:

1. Sealing of interior concrete slabs as indicated.

1.3 SUBMITTALS

A. Product Data: Submit the following information:

1. Sufficient technical data to prove compliance with the specified requirements.
2. Evidence that the proposed applicator is currently approved by the manufacturer of the specified product.

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency for concrete floor topping.

1.4 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. Mock-Up/Sample: Provide on-site mock-up for evaluation of surface preparation techniques and application workmanship. Reference schedules for additional sample requirements

1. Finish areas designated by Architect.
2. Sample requirements: minimum 3 samples in locations as approved.
3. Do not proceed with remaining work until workmanship color and finish are approved by Architect.
4. Refinish mock-up area as required to produce acceptable work.

C. Use an applicator currently approved in writing by the manufacturer of the specified product.

D. Pre-installation Conference: Conduct conference at Project site.

1.5 DELIVERY STORAGE AND HANDLING

A. Deliver materials in original packages and containers with seals unbroken bearing manufacturer's labels indicating brand name and directions for storage mixing with other components and applications.

B. Store materials to comply with manufacturer's written instructions to prevent deterioration from moisture or other detrimental effects.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature and moisture content ambient temperature and humidity ventilation and other conditions affecting concrete floor topping performance.

1. Place concrete floor topping only when ambient temperature and temperature of base slabs are between 50 and 86 deg F.

B. Close areas to traffic during topping application and after application for time period recommended in writing by manufacturer.

1.7 WARRANTY

A. Upon completion of the work of this Section and as a condition of its acceptance the Contractor together with the manufacturer of the penetrating concrete sealer shall provide a warranty against water penetration chloride salt damage or scaling of sealed areas. If the treated surfaces show water penetration of structurally sound areas or if spalling of the concrete occurs from chloride salt damage within the warranty period the manufacturer shall supply labor and materials to repair spalled surfaces and to re-treat such problem areas at no cost to the Owner.

1. Warranty Period: Ten (10) years from date of Substantial Completion.

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. Scofield
2. IPA Systems Inc.
3. Hilliard Chemical Corp.

B. Selected Product: Provide impregnating type as manufactured by Scofield or as scheduled.

C. Product requirements: Clear and matte finish to match samples.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates with Installer present for conditions affecting performance of concrete floor topping.

B. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 SURFACE CONDITIONS

A. Examine the areas and conditions under which the 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.

3.3 APPLICATION

A. Preparation: The concrete deck shall be clean and free of debris, oils or particles which would prevent proper penetration of the sealer.

B. Installation: The sealant shall be applied at the rate of 350 square feet per gallon of material. Water curing and vinyl protection of the concrete is required with this system. If results appear to be spotty apply additional coat at 50 sq. ft. per gallon to needed areas. Follow manufacturers recommended practices.

END OF SECTION

SECTION 042000

UNIT MASONRY

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. The Work of this Section includes all labor, materials, equipment and services necessary to complete the unit masonry work as shown on the drawings and/or specified herein, including but not necessarily limited to the following:

1. Concrete block walls and partitions.
2. Face brick.
3. Metal joint reinforcing, anchors, ties, weeps, closures and related accessories for masonry.
4. Control and expansion joints in masonry, filled with joint fillers.
5. Thru-wall flashing.
6. Mortar net.
7. Chases, recesses, pockets and openings in masonry as required for installation of work by others.
8. Building in of items furnished by others into masonry, including access doors, door frames, anchors, sleeves and inserts, and other similar items to be embedded in masonry.
9. Grouting in of metal items built into masonry work.
10. Protection, pointing and cleaning of masonry.

1.3 RELATED SECTIONS

A. Concrete - Section 033000.

B. Cast stone - Section 047200.

C. Cold formed metal framing - Section 054000.

D. Steel lintels - Section 055000.

E. Building insulation - Section 072100.

F. Metal flashing - Section 076200.

G. Firestops and smokeseals - Section 078413.

H. Sealant - Section 079200.

1.4 SUBMITTALS

A. Submit Shop Drawings for the following:

1. Anchoring details.

2. Control and expansion joint locations and details.

3. Special brick shapes, including large scale shop drawings showing configuration and dimensions.

4. Flashing at typical lintels indicating relationship of flashing to lintel hangers.

B. Submit Samples for the following:

1. Each type of face brick in sufficient number and color (not less than 5) to show full range of color, texture and shade. Submit certification that brick meets ASTM standards specified herein.

a. Submit samples of all special shapes required showing color range and sizes.

2. Joint reinforcing, each type, width and proposed location (labeled).

3. Anchors, wedges and ties, each type, width and proposed location (labeled).

4. Joint filler, each type.

5. Flashing, including splice sample, 12" long.

6. Mortar color, 12" long cured sample.

C. Submit technical and installation information for the following:

1. Mortar materials, each material and mortar type.

2. Certification of mortar mix.

3. Flashing material, descriptive literature.

4. Concrete block, joint reinforcing, anchors, ties and joint filler; submit manufacturer's technical and descriptive literature.

5. Block manufacturer shall submit certifications of compliance with ASTM C 90, C 331 and UL 618 prior to any job site delivery. Field sampling of concrete block may be tested by an Independent Testing Laboratory retained by the Owner according to the requirements of ASTM C 140.

D. Construction Procedures (Submit the following)

1. Procedures and materials for cleaning masonry work; including certification that cleaner will not adversely affect stone, gaskets, sealants, etc.

1.5 QUALITY ASSURANCE

A. Conform to the following non-cumulative tolerances (any masonry work not meeting these standards shall be re-built as directed by the Architect).

1. Variation from the plumb:

a.	In lines and surfaces of columns, walls and arrises:	
1).	In 10 feet	1/8"
2).	In any story of 25 feet maximum	1/4"
3).	In 40 feet or more	1/4"
b.	For external corners, expansion joints and other conspicuous lines:	
1).	In any story of 25 feet maximum	1/4"
2).	In 40 feet or more	3/8"

2. Variation from the level or the grades indicated on the drawings; for exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines:

a.	In any bay or 20 feet maximum	1/4"
b.	In 40 feet or more	1/4"

3. Variation of the linear building lines from established position in plan related portion of columns and partitions:

a.	In any bay or 20 feet maximum	1/4"
b.	In 40 feet or more	1/2"

4. Variation in cross-sectional dimensions of columns and in thickness of walls:

a.	Minus	1/8"
b.	Plus	1/8"

5. Variation in dimensions of masonry openings:

a.	Horizontal dimension	-0" + 1/16"
b.	Vertical dimension	+0" - 1/16"

B. Job Mock-Up

1. Prior to installation of masonry work, erect sample wall panel mock-up using materials, bonding patterns and joint tooling required for final work and including cavity wall, masonry sill, typical pier with returns and stone base, window unit and sill, projecting courses, anchors and reinforcement as detailed. Provide special features as directed by the Architect for caulking and contiguous work. Build mock-up at the site, 4' x 4' size as directed by the Architect, indicating the proposed range of colors, textures and workmanship to be expected in the completed work. Reconstruct mock-up if directed by the Architect until it meets with Architect's approval. Obtain Architect's acceptance of visual qualities of the mock-up before start of masonry work. Retain mock-up during construction as a standard for judging completed masonry work. Do not alter, move or destroy mock-up until work is completed and accepted by the Architect. Use sample panels to test proposed cleaning procedures after sample panel meets with Architect's approval.

2. Approved sample panel shall remain on view at the site until completion of face brick work and shall establish the technical and aesthetic standards for the Project.

3. Architect shall direct distribution of brick color and texture variation within mock-up.

C. Factory Control

1. The Architect reserves the right to visit the brick manufacturer's facility and review pre-sorting so that all brick falls within a color range acceptable to the Architect.

2. 4' x 4' mock-ups shall be constructed at the factory using the face brick specified. This mock-up, after approval of the Architect, shall become the quality control panel for the selected brick.

3. Prior to any shipment of the face brick from the factory, the Architect reserves the right to inspect the brick for the thoroughness of the pre-sorting and to reject any brick which in his opinion do not fall within acceptable color range.

D. Work of this Section shall conform to the requirements of the following (unless otherwise superseded by prevailing Building Code):

1. 2013 ACI 530/ASCE 5/TMS 402 Building Code Requirements for Masonry Structures.

2. 2013 ACI 530-1/ASCE 6/TMS 602 Specifications for Masonry Structures.

3. Brick Industry Association (BIA) "Technical Notes on Brick Construction."

E. Pre-Construction Conference: Prior to installation of masonry and associated work, Contractor shall arrange a meeting with Masonry Subcontractor, installers of related work, and other entities concerned with masonry wall performance, including the Architect and Owner. Contractor shall record discussions and agreements and furnish copy to each participant. Provide at least seventy-two (72) hours' advance notice to participants prior to convening conference. Review methods and procedures related to masonry work, including, but not limited to, the following:

1. Review masonry requirements (drawings, specifications and other Contract Documents).

2. Review required submittals, both completed and yet to be completed.

3. Review and finalize construction schedule related to masonry work and verify availability of materials, installer’s personnel, equipment and facilities needed to make progress and avoid delays.

4. Review required inspection, testing, certifying and material usage accounting procedures.

5. Review weather and forecasted weather conditions, and procedures for coping with unfavorable conditions.

6. Coordinate work with air/vapor barrier membrane and related flashing, review details to avoid conflicts.

1.6 PRODUCT HANDLING

A. General: Deliver, store, handle and protect all materials from damage, moisture, dirt and intrusion of foreign matter. Store all masonry units and mortar materials on raised platforms and under ventilated and waterproof cover. Store packaged materials in manufacturer's unopened containers, marked with manufacturer's name and product brand name. Immediately reseal containers after partial use. Remove and replace damaged materials.

B. Masonry Units: Pack, deliver and store to prevent breakage, cracking, chipping, spalling or other damage. Store, protect and ventilate units at project site.

C. Aggregate: Store with provisions for good drainage.

D. Reinforcement and Anchors: Store and protect so that when placed, joint reinforcement and anchors will be free of soil, dirt, ice, loose rust, scale, or other coatings which would destroy or reduce bond with mortar, and will not be disfigured or bent out of shape.

1.7 CODE REQUIREMENTS

A. Work of this Section shall conform to all applicable requirements of the State of South Carolina Building Code, including seismic requirements.

1.8 TESTING FOR EFFLORESCENCE

A. Test selected face brick for efflorescence in accordance with ASTM C 67.

B. If, at the end of the test period, the samples of brick or mortar show efflorescence, the materials represented shall be rejected and new materials shall be re-tested. This process shall be repeated until no efflorescence appears. Testing shall be done by an independent testing laboratory at the expense of the Contractor; submit test results in writing to the Architect.

1.9 JOB CONDITIONS

A. In cold weather, when the outside temperature is below forty (40) degrees F., conform to the requirements of "Cold Weather Masonry Construction and Protection Recommendations" publication by Brick Industry Association (BIA). No anti-freeze admixtures are permitted.

1. In addition, conform to the following:

a. Masonry materials must be warmed as required.
b. Brickwork must be protected a minimum of 24 hours after installation so as to maintain enough heat for hydration of the cement in the mortar.

B. Hot-Weather Requirements: Protect unit masonry work when temperature and humidity conditions produce excessive evaporation of water from mortar and grout. Provide artificial shade and wind breaks and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 deg. F. and above. In addition, conform to the following:

1. Masonry materials must be cool.

2. Mortar must be used within 2 hours of initial mixing.

C. Protection of Masonry: During erection, 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" down both sides and hold cover securely in place.

2. Where one wythe of multi-wythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24" down face next to unconstructed wythe and hold cover in place.

D. 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 mortar splatter by coverings spread 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 on completed masonry.

1.10 ATTIC STOCK

A. Provide additional 10% of dry mortar mix labeled, packaged and delivered to location determined by Owner for attic stock.

B. Provide additional 5% of brick labeled, packaged and delivered to location determined by Owner for attic stock.

PART 2 PRODUCTS

2.1 MATERIALS

A. Standard Concrete Block

1. Portland cement, ASTM C 150, Type 1, low alkali (less than 65) one source.

2. Aggregates, ASTM C 331, lightweight expanded shale, clay or slate aggregates, manufactured by the rotary kiln process equal to "Solite," "Norlite," or "Haydite."

a. Block scheduled to receive painted finish shall contain normal weight aggregate meeting ASTM C-33 in addition to light weight aggregate in order to receive a smooth, uniform finish.

3. Concrete Masonry Units: Load bearing lightweight aggregate concrete masonry units conforming to the requirements of ASTM C 90.

a. Block behind face brick and block for rated walls shall be 75% solid units.

b. All other block may be hollow units.

4. The producer of the concrete masonry units shall furnish certification from an independent testing laboratory confirming that all 8" or larger masonry units meet all of the UL 618 requirements for two (2) hours or better (as required), referencing full scale fire test reports (ASTM E 119). All 4" and 6" units shall conform to "National Bureau of Standards" and "National Research Council" full scale fire tests.

5. Sizes and Shapes: Nominal face size 8" x 16" by thickness as indicated on drawings, with stretcher units, jamb units, header units, square corner units (at ends and corners of exposed or painted work), sash units (at control joints within masonry wall), lintel units and other special shapes and sizes required to complete the work.

6. Finish: For exposed or painted block surfaces, in addition to ASTM requirements, block shall have uniformly dense, flat, fine grain texture, with no cracks, chips, spalls, or other defects which would impair appearance. For concealed CMU, surfaces shall be free from deleterious materials that would stain plaster or corrode metal.

7. Curing: All concrete block shall be steam cured, and air dried for not less than thirty (30) days before delivery.

8. Density of concrete block shall not exceed one hundred and five (105) lbs. per cubic foot.

9. Shrinkage: Shrinkage of concrete blocks shall not exceed 0.065% when tested in accordance with ASTM C 426-99.

10. Water Content

    a. At the time of delivery to the job site, concrete masonry units shall have a value, in weight of contained water, of not more than thirty (30) percent of the fully saturated content for the unit tested.
    b. Ship all units from the factory, and store at the job site, with all necessary protection to prevent increase of water content from rain and other sources.

B. Brick

1. Size: Match existing.

2. Facing Brick: ASTM C 216, Grade SW, Type FBX, match existing.

3. Where brick is fully concealed provide common brick conforming to ASTM C 62, Grade SW.

4. Provide all special molded shapes as indicated on the drawings.

5. For sills, caps and similar applications resulting in exposure of brick surfaces which otherwise would be concealed from view, provide uncored units with all exposed surfaces finished.

C. Joint Reinforcing for Masonry Walls

1. Seismic Construction: For anchoring face brick to CMU back-up, provide No. 280 "S.I.S. Dub'l Loop-Lock Ladder Seismiclip Interlock System" made by Hohmann & Barnard or equal by manufacturer noted below in Para. C.6. All wire used in assembly shall be 3/16" dia. Assembly shall contain ladder reinforcing, welded loops, box tie, seismiclip and continuous wire in face brick mortar joint. Provide special formed prefabricated pieces at corners and intersections of walls or partitions. Reinforcing wire in face brick mortar joint to extend at least 2" into face of brick. Show anchor locations on approved shop drawings.

    a. Reinforcing assembly shall be hot dip galvanized steel finish conforming to ASTM A 153 with zinc coating of 1.5 oz. of zinc per sq. ft., after fabrication.

2. For interior block walls and partitions, provide standard reinforcing fabricated of 9 ga. side and cross rods, truss or ladder design, no ties, spaced every other block course. Provide prefabricated pieces at corners and intersections of walls or partitions. Reinforcing shall be mill galvanized conforming to ASTM A 641, Class B-1, applied after fabrication.

3. Wire used in assemblies noted above shall be cold drawn steel wire conforming to ASTM A 82.

4. Approved Joint Reinforcing Manufacturers

    a. Hohmann & Barnard
    b. Wire-Bond
    c. Heckmann Building Products
    d. National Wire Products Industries, Inc.

D. Anchors and Ties

1. For anchoring brick to cold formed metal framing, provide one of the following or approved equal by other manufacturers noted above in Para. C.6:

    a. "Wing-Nut Pos-I-Tie®" with self-drilling screw for steel studs zinc barrel and thermal wing-nut as manufactured by Heckmann Building Products. Provide Seismic Wire Pintle Tie hot-dip galvanized steel.
    b. Hot-dip galvanized steel anchors equal to "X-Seal Veneer Anchor" with "X-Seal Tape" as manufactured by Hohman & Barnard or approved equal. Provide Model 187 "Seismiclip" with 9 ga. Wire.

2. Dovetail Anchor Slots: Hot-dip galvanized steel, 16 gauge equal to No. 100 Dovetail Anchor Slot made by Heckmann Building Products, No. 305 anchor slot made by Hohmann & Barnard, or approved equal by other manufacturers in Para. C.6.

3. Flexible Metal Ties for Dovetail Slots: Hot-dip galvanized, 16 gauge by 1" wide by Heckmann Building Products Inc., or approved equal manufacturer noted above in Para. C.6.

    a. No. 106 Dovetail Corrugated Anchor.
    b. No. 129 Dovetail Triangle Tie.

4. Wire Mesh: Hot-dip galvanized sixteen (16) gage steel wire, square mesh, width intended for size of block by length to suit condition;, or approved equal by manufacturer noted above in Para. C.6.

5. For anchoring face brick to concrete back-up where there are no dovetail slots provided, provide "CMU/Concrete Screw Wing-Nut Pos-I-Tie®" with five (5) gauge hot-dip galvanized (ASTM A 153, Class B-2) wire pintle tie made by Heckmann Building Products, or approved equal by manufacturer noted above in Para. C.6.

6. For anchoring CMU wall, at the exterior masonry cavity wall, to the underside of the concrete beam, provide dovetail slot as noted above and the following:

   a. No. 121 galvanized steel dowel anchor and No. 421 tube as manufactured by Heckmann Building Products or approved by manufacturer noted above in Para. C.6. Galvanized to conform to ASTM A 153, Class B-2.
   b. No. PTA-310 galvanized steel dowel anchor and No. NS-TA joint filler as manufactured by Hohmann & Barnard or approved equal by manufacturer noted above in Para. C.6. Galvanizing to conform to ASTM A 153, Class B-2.

7. For anchoring masonry to structural steel, provide hot-dip galvanized steel, as listed, or approved equal by manufacturer noted above in Para. C.6:

   a. Made by Heckmann Building Products. Galvanizing shall conform to ASTM A 153, with zinc coating of 1.5 oz. of zinc per sq. ft.
      1). No. 195 Column Anchors
      2). No. 197 Column Anchors
      3). No. 315 Weld-On Anchor Rods with No. 316 Triangle Ties
      4). No. 315-B Weld-On Anchor Straps with No. 316 Triangle Ties
   b. Made by Hohmann & Barnard or approved equal. Galvanizing shall conform to ASTM A 153, with zinc coating of 1.5 oz. of zinc per sq. ft.
      1). No. 355 Column Anchors
      2). No. 356 Column Anchors
      3). No. 357 Beam Anchors
      4). No. 359 F anchor straps with VWT tie.

8. For anchoring CMU interior partitions to underside of steel beams, provide hot dip galvanized steel tube anchors equal to No. 419 and No. 421 made by Heckmann Building Products, No. PTA-420 made by Hohmann & Barnard, or approved equal by manufacturer noted above in Para. C.6.

9. For anchoring CMU interior partitions to underside of structural deck, provide 4" x 4" x 1/4" galvanized steel angles (ASTM A 36), 3'-0" long spaced 3'-0" o.c. alternately on each side of partition. Anchor partition securely to structural deck.

E. Reinforcing Bars and Rods: ASTM A 615, Grade 60. See Drawings for size.

F. Control and Expansion Joint Fillers

1. Vertical Installation Within Concrete Masonry Wall: Extruded high grade neoprene rubber, cross shape, for use with concrete masonry sash units, which shall provide a force fit in the grooves of the sash block, and shall have 1/2" diameter tubular ends (compressed 25% when installed in 3/8" wide joint).

a. Provide the following sizes:
   1). 2-5/8" wide control joint fillers for 4" block walls.
   2). 4-5/8" wide for 6" block walls.
   3). 6-5/8" wide for 8", 10" and 12" block walls.
b. Provide backer rod and sealant joint over joint filler as per drawings and Section 079200 of these specifications.

2. Isolation Joint Filler at Abutting Construction and at Intersecting CMU Walls: Compressible and resilient closed cell neoprene gasket with pressure sensitive adhesive backing, thickness 30% greater than thickness of joint. Acceptable joint filler shall be "Everlastic, Type NN-1" by Williams Products, Inc., or approved equal. Recess joint filler and install backer rod and sealant as per drawings and Section 079200 of these specifications.

3. Within Face Brick: Provide filler rod and sealant installed by Section 079200. Filler depth shall be 2 times joint width.

   a. Compressible filler between top of brick and bottom of shelf angle or steel lintel shall be "Soft Joint Sealant" made by Polytite, or approved equal.

4. Within Expansion Joint at Face Brick: Manufacturer's standard preformed, pre-compressed, open-cell polyurethane foam sealant impregnated with a water based, non-drying polymer modified acrylic water repellent. Provide "Seismic Colorseal" installed to twenty-five 25 percent compression, as manufactured by Emseal or approved equal.

   a. Properties: Permanently elastic, mildew resistant, non-migratory, non-staining, and compatible with joint substrates and other joint sealants. Density: 8.4 to 9.1 lb./cu. ft..

2.2 MORTAR MATERIALS

A. Portland Cement: ASTM C 150, Type 1, standard color, one source.

B. Hydrated Lime: ASTM C 207, Type S, as manufactured by Corsons, or approved equal.

C. Aggregate: Clean, washed, buff colored sand, graded per ASTM C 144.

D. Aggregate for Grout: ASTM C 404.

E. Water: Clean, fresh and suitable for drinking.

2.3 MORTAR MIX

A. Exterior Face Brick Construction: Mortar mixes shall meet ASTM C 270, Type N, cement/lime mortar. Colors of mortars shall use coloring agent made by Davis Colors, Lehigh Cement or approved equal. Color of mortar to meet with Architect's approval. The Contractor may use pre-packaged colored mortar equal to "Color Mortar Blend" made by Glen-Gery.

   1. Color of mortar must meet with Architect's approved sample and mock-up panel.

B. Exterior Block Back-Up Construction: Provide Portland cement/lime mortar as noted above conforming to ASTM C 270, Type N.

C. Interior Masonry Construction: Provide Portland cement/lime mortar conforming to ASTM C 270, Type N, for load bearing conditions, mortar shall conform to ASTM C 270, Type M.

D. Reinforced Concrete Block: Provide Portland cement/lime mortar conforming to ASTM C 270, Type S.

E. Mortar for Cement Cants: One (1) part Portland cement and four (4) parts sand, by volume.

F. Grout for Unit Masonry: Comply with ASTM C 476 for grout for use in construction of unit masonry. Use grout of consistency (fine or coarse) at time of placement which will completely fill all spaces intended to receive grout. Grout shall have a minimum compressive strength of 3000 psi when tested in accordance with ASTM C 1019.

G. Mixing

1. General: Add cement just before mixing and mix dry. Use sufficient amount of water as necessary to produce workable mix. Mix in small batches to make plastic mass.

2. Mixing: Machine mix all mortars in approved type mixer with device to accurately and uniformly control water. Add hydrated lime dry. Mix dry materials not less than two (2) minutes. Add water, then mix not less than three (3) minutes, not to exceed five (5) minutes. Mix only amount of mortar that can be used before initial set. Do not use mortar which has reached its initial set or two (2) hours after initial mixing, whichever comes earlier. Mortar may not be re-tempered. Clean mixer for each batch, whenever mortar type is changed, and at end of each day's work.

3. Acceleration or other admixtures not permitted.

4. Mortar shall have a flow after suction of not less than seventy-five (75) percent of that immediately after mixing as determined by ASTM C 91.

H. Admixtures

1. No air-entraining admixtures or cementitious materials containing air-entraining admixtures shall be used in the mortar.

2. No antifreeze compounds or other substances shall be used in the mortar to lower the freezing point.

3. Calcium chloride or admixtures containing calcium chloride shall not be used in mortar.

2.4 WEEP HOLES

A. Provide clear plastic weep holes 3/8" wide and 1-1/2" high by four (4) inches long equal to No. 342 made by Hohmann & Barnard or approved equal manufacturer listed above.

2.5 THRU-WALL FLASHING

A. Provide sheet membrane flashing as part of exterior wall membrane system. Provide sealants and tapes as recommended by the manufacturer. Provide preformed corner sections "end dams" with system when flashing is discontinuous.

1. Provide flashing for surface adhered applications at sheathed areas with 26 ga. stainless steel termination bar.

2. Wall flashing shall have 26 ga. stainless steel drip edge adhered to edge of flashing, drip edge shall be set in sealant as specified in Section 079200.

2.6 MORTAR NET

A. Provide 10" high HDPE "Mortar Net" open mesh mortar net of width to fit masonry cavity shown on drawings, manufactured by Hohmann & Barnard, or equal "Mortar Break II," made by Advanced Building Products.

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

A. Inspection

1. Prior to all work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

2. Verify that masonry may be completed in accordance with all pertinent codes and regulations, the referenced standards, and the original design.

3. Do not start any work until mock-ups are approved by the Architect.

B. Discrepancies

1. In the event of discrepancy, immediately notify the Architect in writing.

2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3. Starting of work by the Contractor means acceptance by the Contractor of the substrate.

3.2 COORDINATION

A. Carefully coordinate with all other trades to ensure proper and adequate interface of the work of other trades with the work of this Section.

3.3 PREPARATION

A. Brick

1. Wet brick having an initial rate of absorption greater than 30 grams per 30 square inches when tested per ASTM C67. Wet bricks by allowing water to run on the cubes or pallets of brick, or placing them in a large tank of water.

2. Except for absorbent units specified to be wetted, lay masonry units dry.

B. Concrete Block: Do not wet concrete block units.

3.4 INSTALLATION

A. General

1. Build walls to the full thickness shown. Build single wythe walls to the actual thickness of the masonry units, using units of nominal thickness shown.

2. Build chases and recesses as shown or required for the work of other trades.

3. Leave openings for equipment to be installed before completion of masonry work. After installation of equipment, complete masonry work to match work immediately adjacent to the opening.

4. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint widths and to properly locate openings, movement type joints, returns and off-sets. Avoid the use of less than half size units at corners, jambs and wherever possible.

5. Lay up walls plumb and true with courses level, accurately spaced and coordinated with other work.

6. Provide templates made of steel studs for plumbing of two story masonry openings.

7. Pattern Bond: Lay exposed masonry patterns as noted on drawings. Lay concealed concrete block with all units in a wythe bonded by lapping not less than two (2) inches. Bond and interlock each course of each wythe at corners. Do not use units of less than four (4) inches horizontal face dimensions at corners or jambs.

8. Where possible, masonry walls and partitions shall be built after all overhead ducts, pipes and conduits are in place and tested. Masonry shall be neatly built around the items above. Walls and partitions shall be plumb, true to line and free from defects such as open cells, voids, dry joints and other similar defects. In rooms and spaces scheduled to have concrete block finish, all such surfaces including upper wall surfaces up to termination of structural ceiling in spaces without suspended ceilings, shall be made suitable for paint application. Cutting of openings in walls and partitions in place shall be done only with the approval of the Architect.

9. Do not use any brick that do not meet chippage and tolerances of the applicable ASTM standard noted herein for the grade, type or class of brick.

10. Mortar, ties and reinforcement must not extend into or bridge any expansion joints.

B. Mortar Bedding and Jointing

1. All joints between bricks shall be completely filled with mortar. Bed joints shall be beveled per BMI recommendations, with the brick then shoved in place. At cavity wall construction, care shall be taken that no excess mortar goes into masonry cavity. Head joints shall be completely filled with mortar and shall be formed by applying a full coat of mortar to the entire end or the entire side, as the case requires, and then shoving the mortar covered end and/or side of the brick tightly against the bricks previously laid; the practice of "slushing" by throwing mortar into the head joints will not be permitted. All brick shall be laid without disturbing the brick previously laid. Brick shall be laid within a minute or so after the mortar is placed. Dry or butt joints will not be permitted. Grouting shall be done only as necessary. Do not slush head joints.

2. After brick placement, mortar squeezed out of bed joints shall be cut off before tooling.

3. Lay concrete masonry units with full mortar coverage on horizontal and vertical face shells. Bed webs in mortar in starting course on exterior walls and in all courses of piers, columns and pilasters, where solid CMU is used and where adjacent to cells or cavities to be reinforced or filled with concrete or grout.

   a. To ensure alignment of brick and block coursing, adjust block back-up by cutting block to insure alignment of coursing or use adjustable anchorage.

4. Lay masonry walls with 3/8" joints unless otherwise shown on drawings.

5. Tool exposed joints slightly concave after the mortar joint is "thumbprint" hard. Concealed joints shall be struck flush, including at any CMU schedule to receive a waterproofing or air barrier membrane.

6. Remove masonry units disturbed after laying; clean and reset in fresh mortar. Do not pound corners at jambs to fit stretcher units which have been set in position. If adjustments are required, remove units, clean off mortar and reset in fresh mortar.

C. Stopping and Resuming Work: Rake back 1/2 brick length in each course; do not tooth. Clean exposed surfaces of set masonry, wet units lightly (if required) and remove loose masonry units and mortar prior to laying fresh masonry.

D. Built-In Work

1. As the work progresses, build in items specified under this and other Sections of these specifications. Fill in solidly with masonry around built-in items.

2. Mortar in door frames, access doors, louvers and other metal items embedded or built into masonry work solidly with mortar as the masonry units are laid up.

3. Grout under lintels, bearing plates, and steel bearing on masonry with solid bed grout.

4. Sleeves, pipes, ducts and all other items which pass through masonry walls shall be caulked with interior grade sealant meeting requirements of Section 079200, so

as to be air tight and prevent air leakage. Refer to Section 078413 for packing of voids in rated masonry walls.

5. Fill vertical cells of masonry units solid with grout which have anchoring, reinforcing rods, supporting or hanging devices embedded in the cell including stone anchors and window or curtain wall anchors.

6. Fill vertical cells of masonry units solid with mortar on each side of door frames to sixteen (16) inches beyond.

7. Unless otherwise noted, fill vertical cells of masonry units solid with grout which are below steel bearing plates, steel beams, and ends of lintels, to eight (8) inches beyond bearing and from floor to bearing.

8. Place wire mesh in horizontal joint below masonry unit cells to be filled with mortar, to prevent mortar from dropping into unfilled cells below.

9. Masonry indicated as being reinforced shall have all voids filled solid with grout. Grout shall be consolidated in place by vibration or other methods which insure complete filling of cells. When the least clear dimension of the grouted cell is less than two (2) inches, the maximum height of grout pour shall not exceed twelve (12) inches. When the least clear dimension is two (2) inches or more, maximum height of grout pour shall not exceed forty-eight (48) inches. When grouting is stopped for one (1) hour or longer, the grout pour shall be stopped 1-1/2" below the top of a masonry unit. Vertical bar reinforcing shall be accurately placed and held in position while being grouted, and shall be in place before grouting starts. All such reinforcing shall have a minimum clear cover of 5/8". Lap all bars a minimum of forty (40) bar diameters and provide steel spacer ties (not to exceed 192 bar diameter) to secure and position all vertical steel and prevent displacement during grouting. Provide continuous horizontal reinforcement embedded in mortar joints every second course.

E. Cutting and Patching

1. All exposed masonry which requires cutting or fitting shall be cut accurately to size with motorized carborundum or diamond saw, producing cut edges.

2. Do not saw cut any masonry openings in face brick construction without Architect's approval and after a procedure has been reviewed and approved.

3. Holes made in exposed masonry units for attachment of handrail brackets and similar items shall be neatly drilled to proper size.

4. All masonry which requires patching in exposed work, if approved by Architect, shall be patched neatly with mortar to match appearance of masonry as closely as possible and to the Architect's satisfaction. Rake back joints and use pointing mortar to match as required.

F. Solid Wall Construction

1. Fill the vertical longitudinal joint between wythes solidly with mortar by parging the in-place wythe and shoving units into the parging.

2. Tie wythes with continuous horizontal reinforcement embedded in mortar joints sixteen (16) inches o.c. vertically.

G. Cavity Walls

1. All exterior masonry walls, unless otherwise indicated, shall be cavity walls of thickness indicated.

2. Two wythes of masonry cavity walls shall be securely tied together by horizontal joint reinforcement and ties anchored to reinforcement, as herein specified, spaced every other block course.

   a. Where cavity back-up is concrete use ties specified herein spaced sixteen (16) inches o.c. both directions.

3. Cavity between facing and backing wythe shall be kept clean and clear of all mortar droppings, and no mortar ledges shall project into the cavity. Temporary wood strips, cut to width of cavity and fitted with lift-up wires, shall be laid on the joint reinforcement and carefully lifted out before placement of the next layer of reinforcement. Any projecting mortar shall be spread over the back of the outer wythe immediately following the setting of the masonry unit.

   a. Mortar net shall be installed at the bottom of each cavity over the flashing to protect weep holes.

4. At cavity and solid walls adjacent to window openings fill block solid with mortar where window anchors are to be located. Coordinate with window subcontractor.

5. Concrete block back-up at cavity wall construction shall be anchored to slab at top with dovetail anchors spaced sixteen (16) inches o.c.

6. Anchor CMU back-up with anchors as specified herein.

7. Where stone veneer is used (Section 044200) in cavity wall configuration, back-up block shall be reinforced every block course.

8. Refer to Section 072100, "Thermal Insulation," for material and installation of cavity wall insulation.

H. Interior Block Partitions

1. Build to full height unless otherwise shown on drawings. At non-rated partitions fill void between CMU and structural deck with continuous neoprene filler conforming to the requirements of Section 079100. At fire rated partitions, fill void with fire stop material meeting the requirements of Section 078413. Fasten to structure at top of partition using steel angles as specified herein.

2. Provide continuous horizontal joint reinforcing every other block course, except as otherwise noted. Fully embed longitudinal side rods in mortar for their entire length with a minimum cover of 5/8". Lap reinforcement a minimum of six (6) inches at ends of units.

3. Provide continuity at corners and wall intersections by use of prefabricated "L" and "T" sections. Cut and bend units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures and other special conditions.

4. Corners

    a. Provide interlocking masonry unit bond in each course at corners.
    b. Provide continuity at corners with prefabricated "L" reinforcement units, in addition to masonry bonding.

5. Intersecting and Abutting Walls

    a. Unless vertical control joints are shown as part of structural frame, provide interlocking masonry bond. Provide starters and special shapes as shown on the drawings to bond these walls.
    b. In addition to masonry bonding, provide horizontal reinforcement using prefabricated "T" units at interior partitions.

I. Ties and Anchors for Masonry Construction

1. Provide ties and anchors as shown or specified, but not less than one metal tie, spaced not to exceed sixteen (16) inches o.c. horizontally and/or vertically. Provide additional ties within 1'-0" of all openings and adjacent to expansion joints and spaced not more than 16" apart around perimeter of openings.

2. Anchor masonry to structure complying with the following:

    a. Provide an open space not less than 1/2" in width between masonry and structural member, unless otherwise shown. Keep open space free of mortar or other rigid materials.

3. Attach brick veneer to cold formed metal framing by anchoring brick to studs using specified anchors penetrating through sheathing and through flange of stud. Prior to application of anchors cover sheathing and vapor barrier with tape specified herein. Space anchors 8" o.c. at each stud; provide stainless steel screw anchors for attaching anchor to studs.

J. Control and Expansion Joints

1. Provide expansion, control and isolation joints in masonry as shown. Build in related items as the masonry work progresses.

2. CMU Control Joint Spacing: If location of control joints is not shown, place vertical joints spaced not to exceed 25'-0" o.c. In addition, locate joints at points of natural weakness in the masonry work, including the following:

    a. At structural column or joint between bay.
    b. Above control joints in the supporting structure.
    c. Above major openings at end of lintels upward and below at ends of sills downward. Place at one side of jamb for openings less than 6'-0" wide and at both sides for openings over 6'-0" wide.
    d. At reduction of wall thickness.
    e. Where masonry abuts supporting structure.

f. If additional joints are required, indicate same on approved shop drawings.

3. Brick Veneer Expansion Joint Spacing: Vertical expansion joints in brick veneer construction shall be located maximum 20'-0" o.c. unless otherwise noted in addition to expansion joints located within 2'-0" of each corner of the building.

K. Lintels

1. Install loose steel lintels furnished by Section 055000, allowing eight (8) inch bearing at ends.

2. For concrete block walls, use specially formed U-shaped concrete block lintel units with reinforcing bars in accordance with the Contract Drawings, filled with grout.

3. U-shaped concrete block lintels shall extend a minimum of 8” at each side of opening.

3.5 FLASHING/WEEP HOLES

A. General: Install embedded flashing and weep holes in masonry at relieving angles, shelf angles, lintels, ledges, other obstructions to the downward flow of water in the wall, and where indicated. Space weeps 16" o.c. unless otherwise shown on drawings. Weeps shall occur immediately above the flashing.

B. Prepare masonry surfaces so that they are smooth and free from projections that could puncture flashing.

C. Flashing shall be placed, generally, at bottoms of cavity wall construction, over all wall openings, window jambs, at sills of window, and in other locations where indicated on the drawings. Flashing shall overlap a minimum of 6". At bottoms of cavity walls, the flashing shall be built extending from the exterior face of the brick, up and into the mortar joint 2" at the inner wythe of the CMU back-up; at sheathed areas attached with pressure bar. At concrete spandrel beams and columns the flashing shall be installed with a termination bar. Extreme care shall be exercised in placing the masonry materials not to damage the flashing. Flashing damaged during the masonry erection shall be repaired or replaced by the Contractor at no additional cost to the Owner. Discontinuous flashing shall terminate with an end dam in a head joint, rising at least 1".

D. When spanning an air space, flashing shall be supported with a mortar wash, insulation or treated wood blocking.

E. Where flashing is penetrated by anchors, patch flashings at penetration using adhesive and mastic recommended by the manufacturer to insure watertight seal.

F. Install flashing in accordance with manufacturer's instructions, using adhesive, primer, thinner, cleaner and mastic as recommended by flashing manufacturer.

1. Flashing shall overlap adjacent piece of flashing a minimum of 6".

G. Provide drip edge when flashing extends beyond face of brick.

3.6 CANTS

A. Provide specified mortar for cement cants at beams and other projections in elevator shafts, where adjoining wall is of masonry construction. Cants shall slope twenty (20) degrees from the horizontal.

3.7 CLEANING, PROTECTION, ADJUSTMENT

A. Protection

1. The Contractor shall take adequate precautions for the protection of all surfaces against mortar spatter, and shall immediately remove any such spatter should it inadvertently occur, leaving no stain or discoloration.

2. Excess mortar shall be wiped off the masonry surfaces as the work progresses.

3. Wood coverings shall be placed over all such masonry surfaces as are likely to be damaged during the progress of the entire project.

4. Protective measures shall be performed in a manner satisfactory to the Architect.

5. Damaged masonry units shall be replaced to satisfaction of the Architect.

6. Exterior masonry walls shall be draped with waterproof covering until copings are in place, to prevent water penetration in cavity.

B. Clean-Up

1. Upon completion, all exposed masonry shall be thoroughly cleaned following recommendations of the BIA Technical Note No. 20. Before applying any cleaning agent to the entire wall, it shall be applied to a sample wall area of approximately 4' x 4' in a location approved by the Architect. No further cleaning work may proceed until the sample area has been approved by the Architect, after which time the same cleaning materials and method shall be used on the remaining wall area. If stiff brushes and water do not suffice, the surface shall be thoroughly saturated with clear water and then scrubbed with a solution of an approved detergent masonry cleaner, equal to "Vana Trol" made by ProSoCo Inc. or equal made by Diedrich or approved equal, mixed and applied as per manufacturer's directions, followed immediately by a thorough rinsing with clear water. All adjacent non-masonry surfaces shall be thoroughly protected during cleaning.

a. Unless otherwise required by cleaning agent manufacturer use only low pressure device (30 to 50 psi) for application of cleaning agent and water rinsing.

C. Pointing: Point any defective joint with mortar identical with that specified for that joint.

END OF SECTION

SECTION 047200

CAST STONE

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. The Work of this Section includes all labor, materials, equipment, and services necessary to complete the cast stone as shown on the drawings and/or specified herein, including, but not necessarily limited to, the following:

1. Cast stone, base course, copings, bands and niches on building façade.
2. Mortar.
3. Anchors and accessories.
4. Joint filler.

1.3 RELATED SECTIONS

A. Masonry work - Section 042000.

B. Sealant - Section 079200.

1.4 QUALITY ASSURANCE

A. Qualifications of Workmen

1. For the actual cutting and placing of cast stone units, use only skilled journeyman masons who are thoroughly experienced with the materials and methods specified and thoroughly familiar with the design requirements.
2. In acceptance or rejection of installed cast stone units, no allowance will be made for lack of skill on the part of workmen.

B. Manufacturer shall have a minimum of ten (10) years' experience in the manufacture of cast stone. Manufacturer's products must have previously been used on the exterior with satisfactory results. Manufacturer must have capability to produce cast stone on schedule and must be a member of the Cast Stone Institute.

C. Casting Tolerances: Maintain casting, bowing, warping and dimension tolerance within the following maximums:

1. Overall Dimension for Height and Width of Units: Plus zero of unit dimension to minus 3/32" for 10'-0" and over.

2. Twist, Bowing or Warping: Do not exceed length/360 or 1/8", whichever is greater.

3. Insert Locations: Place within plus or minus 1/8" in each direction.

4. Length of units shall not deviate by more than +/- 1/8" from approved dimensions.

D. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

1. ASTM C 1364 Standard Specification for Architectural Cast Stone, except where more stringent standards are specified herein.

2. ASTM C 150 Specification for Portland Cement.

3. ASTM C 33 Specification for Concrete Aggregates

4. ASTM C 979 Specification for Coloring Pigments for Integrally Pigmented Concrete.

5. ASTM C 494 Specification for Concrete Admixtures

6. ASTM A 615 Specification for Deformed and Plain Billet Steel Bars for Concrete Reinforcement.

7. ASTM C 1194 Test Method for Compressive Strength of Architectural Cast Stone.

8. ASTM C 1195 Test Method for Absorption of Architectural Cast Stone.

9. ASTM C 642 Test Method for Specific Gravity, Absorption, and Voids in Hardened Concrete.

10. ASTM C 39 Test Method for Compressive Strength of Concrete Cylinders.

11. ASTM D 2244 Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.

E. Testing: Test three specimens per 500 cubic feet at random from plant production in accordance with referenced standards.

F. Cold weather setting practices shall conform to the requirements specified in Section 042000.

1.5 SUBMITTALS

A. Submit samples of cast stone with documented independent testing laboratory reports to the Architect for approval.

B. Samples: Before any cast stone materials are delivered to the job site, submit twelve (12) inch long samples of each profile type cast stone unit required.

1. Submit 6" x 6" cast stone samples showing full range of colors and texture available.

C. Shop Drawings: Submit complete shop drawings of all cast stonework showing anchorage, type, location and spacing, joint fillers, mortar, and cast stone profiles, sizes, connections, location, type and size of reinforcing and adjacent construction.

1. The shop drawings shall show the setting mark of each stone and its location on the structure. The stone when delivered shall bear the same corresponding setting mark on an unexposed surface.

2. Shop drawings must show exact profiles for each piece.

D. Certification: Submit certification from an independent testing laboratory certifying to test results required under Article 1.4, Para. E. herein.

1.6 MOCK-UP

A. Provide full size unit(s) for use in construction of wall mock-up specified in Section 042000. The mock-up becomes the standard of workmanship for the project.

1.7 PRODUCT HANDLING

A. Protection: Use all means necessary to protect cast stone and related materials before, during, and after installation, and to protect the installed work and materials of all other trades.

1. Stone shall be stored on skids off the ground and covered with plastic sheeting; all material in contact with stone shall be non-staining.

B. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

PART 2 PRODUCTS

2.1 CAST STONE COLOR AND FINISH

A. The Cast Stone used in this work shall match color and texture of samples approved by the Architect.

B. Exposed surfaces, unless otherwise specified, shall exhibit a typically fine-grained texture similar to natural stone. No bug holes will be permitted and all facing material shall be mixed in a muller mixer.

C. The samples shall be approved by the Architect before the manufacturer shall be required to proceed with the work.

2.2 MANUFACTURER

A. All Cast Stone used in this work shall be manufactured by Dura Art Stone Co., Continental Cast Stone Mfg. Inc., or approved equal and conform to the following properties:

1. Compressive Strength, ASTM C 1194: 6500 psi min. for products at 28 days.

2. Absorption, ASTM C 1195 or ASTM C 642: 6% max. for products at 28 days.

3. Cumulative Percent Weight Loss (CPWL) shall be less than 5% after 300 freeze/thaw cycles when tested in accordance with ASTM C 1364.

4. Air Content: ASTM C 173 or C 231, for wet cast product only shall be 4-8%. Air entrainment is not required for dry cast products.

5. Linear Shrinkage - ASTM C 426: Shrinkage shall not exceed 0.065%.

6. Color Variation

   a. Must match color and finish of approved sample when viewed in direct daylight at a 5-foot distance.
   b. ASTM Color Variation Allowed: 2% hue; 6% lightness, chrome and hue combined.

2.3 MATERIALS

A. Cement shall be Portland Type I white, meeting ASTM C 150.

B. Fine aggregate shall be carefully graded and washed natural sands, or manufactured granite, marble, quartz or limestone sands meeting ASTM C 33, except that gradation may vary to achieve desired finish and texture.

C. Coarse aggregate shall be carefully graded and washed natural gravel, or crushed graded stone such as granite, marble quartz, limestone or other durable stone meeting ASTM C 33, except that gradation may vary to achieve desired finish and texture.

D. Coloring: All colors added shall be inorganic (natural or synthetic) iron oxide pigments meeting ASTM C 979 excluding the use of a cement grade of carbon black pigment, and shall be guaranteed by the manufacturer to be light fast and lime proof. The amount of pigment shall not exceed ten (10) percent by weight of the cement used. Colorant shall be manufactured by Davis Colors or approved equal.

E. Cast stone shall be reinforced with new billet steel reinforcing bars meeting ASTM A 615, grade 60, when necessary for safe handling, setting and structural stress, and the size of the reinforcing shall be as shown on approved shop drawings. If the surfaces are to be exposed to the weather, the reinforcement shall be galvanized or epoxy coated when covered with less than two (2) inches of material for bars larger than 5/8 inch and 1-1/2 inches for bars 5/8 inch or smaller. The material covering in all cases shall be at least twice the diameter of the bars. Stone shall be fully reinforced to take all stresses including handling, temperature changes and structural stress.

F. All anchors, dowels and other anchoring devices shall be furnished by the stone setter as shown on approved shop drawings using building stone anchors fabricated of Stainless Steel Type 304.

   1. Anchors shall allow for wracking of the structure (seismic) without stressing the cast stone units.

2.4 FABRICATION

A. Cast stone, after being made, shall be cured as noted below in Article 2.5.

B. Cast stone shall be "dry cast" or "wet cast" (depending upon selected finish) to produce sharp arrises to match profiles on approved shop drawings. Provide stone with sinkages to receive anchors.

C. Cast stone for copings shall be fabricated to largest practical length, as shown on approved shop drawings.

D. Acid etch exposed surfaces as required to remove cement film prior to packaging and shipment. Sandblasting or chemical retardation finishing is not permitted.

2.5 CURING

A. Cure units in a warm curing chamber approximately 100 deg. F. at 95% relative humidity for approximately 12 hours, or cure in a 95% moist environment at a minimum 70 deg. F. for 16 hours after casting. Additional yard curing at 95% relative humidity shall be 350 degree days (i.e. 7 days at 50 deg. F. or 5 days at 70 deg. F. prior to shipping. Form cured units shall be protected from moisture evaporation with curing blankets or curing compounds after casting.

2.6 ACCESSORIES

A. Mortar for setting of cast stone sections shall conform to ASTM C 270, Type N, with not more than 1/2 part lime per part of white non-staining Portland cement.

B. Joint Filler: Fill all joints with exposed tops with "Emseal Backerseal" Expanding Foam Sealant as manufactured by Emseal, Inc. or approved equal. Material shall be designed for compression in joint twenty-five (25) percent of its original width, depth of filler as per manufacturer's standard. Joint filler shall be recessed 3/4" from finished surface.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where cast stone is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. Carefully coordinate with all other trades to ensure proper and adequate interface of the work of other trades with the work of this Section.

3.3 JOINTING

A. Joint Size: 3/8", unless otherwise noted.

B. Joint Material

1. Use a full bed of mortar at all bed joints.

2. Flush vertical joints full with mortar.

3. Leave all joints with exposed tops open for sealant.

C. Location of Joints: As shown on approved shop drawings.

3.4 SETTING

A. All cast stone shall be set by experienced stone masons, accurately and in accordance with the shop and setting drawings. All anchors and dowels shall be firmly placed and all anchor holes and dowel holes and similar holes filled completely with mortar.

B. Setting Tolerances: Plus/minus 1/32" allowable out of plane with adjacent units.

C. When setting with mortar, all stones not thoroughly wet shall be drenched with clear water just prior to setting.

D. All stone shall be protected from splashing mortar or damage by other trades. Any foreign matter splashed on the stone shall be removed immediately.

E. All joints with exposed tops shall be filled with joint filler specified herein recessed 3/4" from stone surface; balance of joint shall be filled with back-up rod and sealant by Section 079200.

3.5 PATCHING

A. The repair of chipped or damaged cast stone shall be done only by mechanics skilled in this class of work, with materials furnished by the manufacturer and according to his direction.

B. Patching will not be permitted on copings and any other piece which can be removed and replaced without undue difficulty. Replace such pieces which are chipped or damaged with identical new pieces. Reseal and/or repoint to remove any evidence of replacement.

C. Cast stone shall show no obvious repairs or imperfections other than minimal color variations when viewed with the unaided eye under good typical lighting at a ten (10) foot distance.

3.6 CLEANING

A. Before pointing, the face of all cast stone shall be scrubbed with a fiber brush, using soap powder and water and shall then be rinsed thoroughly with clean running water. Any mortar on the face of the cast stone shall be removed. No acids or prepared cleaners shall be used without the approval of the cast stone manufacturer.

3.7 POINTING

A. When ready for tuck pointing, the mortar joints shall be dampened and raked back 3/4" for pointing. Pointing shall form a slight concave profile. No pointing shall be done in freezing weather nor in locations exposed to hot sun unless properly protected. Pointing mortar shall be composed of one (1) part non-staining cement (ASTM C 91), one (1) part hydrate lime (ASTM C 207, Type S) and four (4) parts of clean, washed sand (ASTM C 144). Coloring pigments shall be added as specified in Section 042000 for face brick construction. The Architect shall approve color of pointing mortar before proceeding with pointing.

3.8 PROTECTION

A. All projecting cast stone pieces shall be fully protected when installed against damage of any kind. Any piece damaged shall be replaced at no additional cost.

3.9 INSPECTION AND ADJUSTMENT

A. Upon completion of the work, make a thorough inspection of all installed cast stone and verify that all units and joints have been installed in accordance with the provisions of this Section; make all necessary adjustments.

END OF SECTION

SECTION 049000

MASONRY RESTORATION AND CLEANING

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment and services necessary to complete the masonry restoration and cleaning as shown on the drawings and/or specified herein, including but not limited to, the following:

1. Cleaning down existing face brick walls.
2. Re-pointing existing face brick walls.
3. Replacing existing damaged face brick.

1.3 RELATED SECTIONS

A. Unit masonry - Section 042000.

B. Sealant - Section 079200.

1.4 QUALITY ASSURANCE

A. Field-Constructed Mock-Ups: Prior to start of general masonry restoration, prepare the following sample panels on the building where directed by Architect. Obtain Architect's acceptance of visual qualities before proceeding with the work. Retain acceptable panels in undisturbed condition, suitably marked, during construction as a standard for judging completed work.

1. Cleaning: Demonstrate materials and methods to be used for cleaning each type of masonry surface and condition on sample panels of approximately 25 sq. ft. in area.

a. Test adjacent non-masonry materials for possible reaction with cleaning materials.

b. Allow waiting period not less than seven (7) calendar days, after completion of sample cleaning to permit study of sample panels for negative reactions.

2. Repointing: Prepare two (2) separate sample areas of approximately 3' high by 6' wide for each type of repointing required, one for demonstrating methods and quality of workmanship expected in removal of mortar from joints and the other for demonstrating quality of materials and workmanship expected in pointing mortar joints.

1.5 SUBMITTALS

A. Product Data: Submit manufacturers' technical data for each product indicated including recommendations for their application and use and VOC compliance. Include test reports and certifications substantiating that products comply with requirements.

B. Restoration Program: Submit written program for each phase of restoration process including protection of surrounding materials on building and site during operations. Describe in detail materials, methods and equipment to be used for each phase of restoration work.

1.6 DELIVERY, STORAGE AND HANDLING

A. Carefully pack, handle, and ship masonry units and accessories strapped together in suitable packs or pallets or in heavy cartons. Unload and handle to prevent chipping and breakage.

B. Deliver other materials to site in manufacturer's original and unopened containers and packaging, bearing labels as to type and names of products and manufacturers.

C. Protect masonry restoration materials during storage and construction from wetting by rain, snow or ground water, and from staining or intermixture with earth or other types of materials.

D. Protect grout, mortar and other materials from deterioration by moisture and temperature. Store in a dry location or in waterproof containers. Keep containers tightly closed and away from open flames. Protect liquid components from freezing. Comply with manufacturer's recommendations for minimum and maximum temperature requirements for storage.

1.7 PROJECT CONDITIONS

A. Clean masonry surfaces only when air temperatures are 40 deg. F. and above and will remain so until masonry has dried out, but for not less than seven (7) days after completion of cleaning.

B. Do not repoint mortar joints or repair masonry unless air temperatures are between 40 deg. F. and 80 deg. F. and will remain so for at least forty-eight (48) hours after completion of work.

C. Prevent grout or mortar used in repointing and repair work from staining face of surrounding masonry and other surfaces. Remove immediately grout and mortar in contact with exposed masonry and other surfaces.

D. Protect sills, ledges and projections from mortar droppings.

1.8 SEQUENCING/SCHEDULING

A. Perform masonry restoration work in the following sequence:

1. Repair existing masonry including replacing existing masonry with new masonry materials.

2. Rake-out existing mortar from joints indicated to be repointed.

3. Repoint existing mortar joints of masonry indicated to be restored.

4. Clean existing masonry surfaces.

PART 2 PRODUCTS

2.1 MASONRY MATERIALS

A. Provide face brick conforming to the requirements of Section 042000.

B. For mortar materials, conform to the requirements of Section 042000.

2.2 CLEANING MATERIALS AND EQUIPMENT

A. Water for Cleaning: Clean, potable, free of oils, acids, alkalis, salts, and organic matter.

B. Alkaline Prewash Cleaner: Manufacturer's standard alkaline cleaner for prewash applications only which are followed by acidic cleaner of type indicated for afterwash.

1. Product: Subject to compliance with requirements, provide "Sure Klean 766 Prewash", ProSoCo, Inc.

C. Acidic Cleaner: Manufacturer's standard strength acidic masonry restoration cleaner composed of hydrofluoric acid blended with other acids including trace of phosphoric acid and combined with special wetting systems and inhibitors.

1. Products: Subject to compliance with requirements, provide one of the following:

a. "Diedrich 101 Masonry Restorer", Diedrich Chemicals.

b. "Sure Klean Restoration Cleaner", ProSoCo, Inc.

D. Liquid Strippable Masking Agent: Manufacturer's standard liquid, film forming, strippable masking material for protecting glass, metal and polished stone surfaces from damaging effect of acidic and alkaline masonry cleaners.

1. Products: Subject to compliance with requirements provide one of the following:

a. "Diedrich Acid Guard", Diedrich Chemicals.

b. "Sure Klean Acid Stop", ProSoCo, Inc.

E. Spray Equipment: Provide equipment for controlled spray application of water and chemical cleaners, at rates required by the manufacturer, measured at spray tip, and for volume.

1. For spray application of chemical cleaners provide low-pressure tank or chemical pump suitable for chemical cleaner indicated, equipped with cone-shaped spray-tip.

2. For spray application of water provide fan-shaped spray-tip which disperses water at angle of not less than 15 degrees.

2.3 MORTAR MIXES

A. Measuring and Mixing: Measure cementitious and aggregate material in a dry condition by volume or equivalent weight. Do not measure by shovel, use known measure. Mix materials in a clean mechanical batch mixer.

1. Mixing Pointing Mortar: Thoroughly mix cementitious and aggregate materials together before adding any water. Then mix again adding only enough water to produce a damp, unworkable mix which will retain its form when pressed into a ball. Maintain mortar in this dampened condition for 1-to-2 hours. Add remaining water in small portions until mortar of desired consistency is reached. Use mortar within thirty (30) minutes of final mixing; do not retemper or use partially hardened material.

B. Colored Mortar: Produce mortar of color required by use of selected coloring agent.

C. Do not use admixtures of any kind in mortar, other than colorant.

D. Mortar Proportions

1. Pointing Mortar for Brick: One part white Portland cement, 2 parts lime and 6 parts colored mortar aggregate. Add colored mortar pigment to product mortar colors required to match.

2. Rebuilding Mortar: Comply with ASTM C 270, Proportion Specification, Type N, with cementitious material content limited to Portland cement-lime and coloring agent.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where masonry restoration and cleaning are to be performed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected by the Contractor in a manner acceptable to the Architect.

3.2 PROTECTION

A. General: Comply with recommendations of manufacturers of chemical cleaners for protecting building surfaces against damage from exposure to their products.

B. Protect persons, motor vehicles, surrounding surfaces of building whose masonry surfaces are being restored, building site, and surrounding buildings from injury resulting from masonry restoration work.

1. Prevent chemical cleaning solutions from coming into contact with pedestrians, motor vehicles, landscaping, buildings and other surfaces which could be injured by such contact.

2. Do not clean masonry during winds of sufficient force to spread cleaning solutions to unprotected surfaces.

3. Dispose of run-off from cleaning operations by legal means and in manner which prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.

4. Erect temporary protection covers over pedestrian walkways and at points of entrance and exit for persons and vehicles which must remain in operation during course of masonry restoration work.

C. Protect glass, unpainted metal trim and polished stone from contact with acidic chemical cleaners by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape. Apply masking agent to comply with manufacturer's recommendations. Do not apply liquid masking agent to painted or porous surfaces.

3.3 CLEANING EXISTING MASONRY, GENERAL

A. Proceed with cleaning in an orderly manner; work from top to bottom of each scaffold width and from one end of each elevation to the other.

B. Use only those cleaning methods indicated for each masonry material and location.

C. Perform each cleaning method indicated in a manner which results in uniform coverage of all surfaces, including corners, moldings, interstices and which produces an even effect without streaking or damage to masonry surfaces.

D. Rinse off chemical residue and soil by working upwards from bottom to top of each treated area at each stage or scaffold setting.

E. Water Application Methods: Prior to chemical cleaning, apply water application to mock-ups by spray at various pressures to determine if masonry surfaces can be cleaned adequately and to the Architect's satisfaction in this manner. If water applications prove ineffective, proceed with chemical cleaners.

F. Chemical Cleaner Application Methods: Apply chemical cleaners to masonry surfaces to comply with chemical manufacturer's recommendations. Do not allow chemicals to remain on surface for periods longer than that indicated or recommended by manufacturer.

1. For hard to remove dirt or grime, apply pre-wash cleaner prior to application of chemical cleaner; follow manufacturer's instructions.

3.4 BRICK REMOVAL AND REBUILDING

A. Brick Removal

1. Carefully remove by hand any brick which are damaged, spalled or deteriorated. Cut out full units from joint to joint and in manner to permit replacement with full size units.

2. Support and protect masonry indicated to remain which surrounds removal area.

3. Salvage as many whole, undamaged bricks as possible.

4. Remove mortar, loose particles and soil from salvaged brick by cleaning with brushes and water. Store brick for reuse.

5. Clean remaining brick at edges of removal areas by removing mortar, dust, and loose debris in preparation for rebuilding.

B. Brick Rebuilding

1. Install new or salvaged brick to replace removed brick. Fit replacement units into bonding and coursing pattern of existing brick. If cutting is required use motor driven saw designed to cut masonry with clean, sharp unchipped edges.

2. Lay replacement brick with completely filled bed, head and collar joints. Butter ends with sufficient mortar to fill head joints and shove into place. Wet clay brick which have ASTM C 67 initial rates of absorption (suction) of more than 30 grams

per 30 sq. in. per minute. Use wetting methods which ensure that units are nearly saturated but surface dry when laid. Maintain joint width for replacement units to match existing.

3. Tool exposed mortar joints in repaired areas to match joints of surrounding existing brickwork.

3.5 REPOINTING EXISTING MASONRY

A. Joint Raking

1. Rake out mortar from joints to depths equal to 2-1/2 times their widths but not less than 1/2" nor less than that required to expose sound, unweathered mortar.

2. Remove mortar from masonry surfaces within raked-out joints to provide reveals with square backs and to expose masonry for contact with pointing mortar. Brush, vacuum or flush joints to remove dirt and loose debris.

3. Do not spall edges of masonry units or widen joints. Replace any masonry units which become damaged.

a. Cut out old mortar by hand with chisel and mallet.

b. Power operated rotary hand saws and grinders will be permitted but only on specific written approval of Architect based on submission by Contractor of a satisfactory quality control program and demonstrated ability of operators to use tools without damage to masonry. Quality control program shall include provisions for supervising performance and preventing damage due to worker fatigue.

B. Joint Pointing

1. Rinse masonry joint surfaces with water to remove any dust and mortar particles. Time application of rinsing so that, at time of pointing, excess water has evaporated or run off, and joint surfaces are damp but free of standing water.

2. Apply first layer of pointing mortar to areas where existing mortar was removed to depths greater than surrounding areas. Apply in layers not greater than 3/8" until a uniform depth is formed. Compact each layer thoroughly and allow to become thumbprint-hard before applying next layer.

3. After joints have been filled to a uniform depth, place remaining pointing mortar in three (3) layers with each of first and second layers filling approximately 2/5 of joint depth and third layer the remaining 1/5. Fully compact each layer and allow to become thumbprint hard before applying next layer. Where existing bricks have rounded edges recess final layer slightly from face. Take care not to spread mortar over edges onto exposed masonry surfaces, or to featheredge mortar.

4. When mortar is thumbprint hard, tool joints to match original appearance of joints, unless otherwise indicated. Remove excess mortar from edge of joint by brushing.

5. Cure mortar by maintaining in a damp condition for not less than seventy-two (72) hours.

6. Where repointing work precedes cleaning of existing masonry allow mortar to harden not less than thirty (30) days before beginning cleaning work.

END OF SECTION

SECTION 05 12 00

STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Structural steel.

2. Shear stud connectors.

3. Shrinkage-resistant grout.

B. Related Requirements:

1. Section 053100 "Steel Decking" for field installation of shear stud connectors through deck.

2. Section 055000 "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame miscellaneous steel fabrications and other steel items not defined as structural steel.

3. Section 099600 "High-Performance Coatings" for painting requirements.

1.3 DEFINITIONS

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

1.4 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

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

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at [Project site] <Insert location>.

1.6 ACTION SUBMITTALS

A. Product Data:

1. Structural-steel materials.
2. High-strength, bolt-nut-washer assemblies.
3. Shear stud connectors.
4. Anchor rods.
5. Threaded rods.
6. Shop primer.
7. Galvanized-steel primer.
8. Galvanized repair paint.
9. Shrinkage-resistant grout.

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

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment Drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
5. Identify members not to be shop primed.

C. Delegated-Design Submittal: For structural-steel connections indicated on Drawings to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Fabricator and Erector.

B. Welding certificates as applicable from Fabricator and Erector.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Mill test reports for structural-steel materials, including chemical and physical properties.

E. Product Test Reports: For the following:

1. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
2. Direct-tension indicators.
3. Tension-control, high-strength, bolt-nut-washer assemblies.

4. Shear stud connectors.

F. Survey of existing conditions.

G. Source quality-control reports.

H. Field quality-control reports.

1.8 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).

B. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.

C. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8/D1.8M. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.

2. Clean and relubricate bolts and nuts that become dry or rusty before use.

3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125/F3125M, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with applicable provisions of the following specifications and documents:

1. ANSI/AISC 303.

2. ANSI/AISC 360.

3. RCSC's "Specification for Structural Joints Using High-Strength Bolts."

B. Connection Design Information:

1. Design connections and final configuration of member reinforcement at connections in accordance with ANSI/AISC 303 by fabricator's qualified professional engineer.

a. Use Load and Resistance Factor Design; data are given at factored-load level.

C. Moment Connections: Type PR, partially restrained.

D. Construction: as indicated in the drawings.

2.2 STRUCTURAL-STEEL MATERIALS

A. <Double click to insert sustainable design text for recycled content.>

B. W-Shapes: ASTM A992/A992M

C. Channels, Angles: ASTM A36/A36M.

D. Plate and Bar: ASTM A36/A36M and ASTM A572/A572M, Grade 50 as indicated.

E. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade B structural tubing.

F. Steel Pipe: ASTM A53/A53M, Grade B.

1. Weight Class: as indicated.

2. Finish: Black except where indicated to be galvanized.

G. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS AND CONNECTORS

A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325 (Grade A325M), Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH (ASTM A563M, Class 10S), heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.

B. High-Strength A490 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A490 (Grade A490M), Type 1, heavy-hex steel structural bolts[or Grade F2280 tension-control, bolt-nut-washer assemblies with splined ends]; ASTM A563, Grade DH (ASTM A563M, Class 10S), heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.

C. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

2.4 RODS

A. Unheaded Anchor Rods: ASTM F1554, Grade 36, or Grades 55 and 105 as indicated on the Drawings.

1. Configuration: Straight.

2. Nuts: ASTM A563 (ASTM A563M) heavy-hex carbon steel.

3. Plate Washers: ASTM A36/A36M carbon steel.

4. Washers: ASTM F436 (ASTM F436M), Type 1, hardened carbon steel.

5. Finish: Hot-dip zinc coating, ASTM A153/A153M, Class C

B. Headed Anchor Rods: ASTM F1554, Grade 36 or Grades 55 and 105 as indicated on the Drawings.

1. Nuts: ASTM A563 (ASTM A563M) heavy-hex carbon steel.

2. Plate Washers: ASTM A36/A36M carbon steel.

3. Washers: ASTM F436 (ASTM F436M), Type 1, hardened carbon steel.

4. Finish: Hot-dip zinc coating, ASTM A153/A153M, Class C

C. Threaded Rods: ASTM A36/A36M

1. Nuts: ASTM A63 (ASTM A563M) hex carbon steel.

2. Washers: ASTM F436 (ASTM F436M), Type 1, hardened carbon steel.

3. Finish: Hot-dip zinc coating, ASTM A153/A153M, Class C

2.5 PRIMER

A. Steel Primer:

1. Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

B. Galvanized-Steel Primer: MPI#134.

1. Etching Cleaner: MPI#25, for galvanized steel.

2. Galvanizing Repair Paint: ASTM A780/A780M.

2.6 SHRINKAGE-RESISTANT GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.7 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.

1. Camber structural-steel members where indicated.

2. Fabricate beams with rolling camber up.

3. Identify high-strength structural steel in accordance with ASTM A6/A6M and maintain markings until structural-steel framing has been erected.

4. Mark and match-mark materials for field assembly.

5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted in accordance with SSPC-SP 1.

F. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using automatic end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

G. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural-steel frame. Straighten as required to provide uniform, square, and true members in completed wall framing. Build up welded framing, weld exposed joints continuously, and grind smooth.

H. Welded-Steel Door Frames: Build up welded-steel door frames attached to structural-steel frame. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk machine screws, uniformly spaced not more than 10 inches (250 mm) o.c. unless otherwise indicated on Drawings.

I. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.

1. Cut, drill, or punch holes perpendicular to steel surfaces.Do not thermally cut bolt holes or enlarge holes by burning.

2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.

3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.8 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

2.9 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123/A123M.

1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.

2. Galvanize items as indicated in the Drawings.

2.10 SHOP PRIMING

A. Shop prime steel surfaces, except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).

2. Surfaces to be field welded.

3. Surfaces of high-strength bolted, slip-critical connections.

4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).

5. Galvanized surfaces [unless indicated to be painted].

B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards:

1. SSPC-SP 2.

2. SSPC-SP 3.

C. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.11 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.

1. Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

2. Bolted Connections: Inspect shop-bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."

3. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

   a. Liquid Penetrant Inspection: ASTM E165/E165M.

   b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.

   c. Ultrasonic Inspection: ASTM E164.

   d. Radiographic Inspection: ASTM E94/E94M.

4. In addition to visual inspection, test and inspect shop-welded shear stud connectors in accordance with requirements in AWS D1.1/D1.1M for stud welding and as follows:

   a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear stud connector.

   b. Conduct tests in accordance with requirements in AWS D1.1/D1.1M on additional shear stud connectors if weld fracture occurs on shear stud connectors already tested.

5. Prepare test and inspection reports.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

   1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

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

   1. Do not remove temporary shoring supporting composite deck construction and structural-steel framing until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.

B. Baseplates Bearing Plates and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.

2. Weld plate washers to top of baseplate.

3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.

4. Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates, so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for grouting.

C. Maintain erection tolerances of structural steel within ANSI/AISC 303.

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure. Slope roof framing members to slopes indicated on Drawings.

2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.

1. Joint Type: [Snug tightened] [Pretensioned] [Slip critical].

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.

2. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

3.5 REPAIR

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair

galvanizing to comply with ASTM A780/A780M.

B. Touchup Painting:

1. Immediately after erection, clean exposed areas where primer is damaged or missing, and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

C. Touchup Priming: Cleaning and touchup priming are specified in Section 099600 "High-Performance Coatings."

3.6 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector to perform the following special inspections:

1. Verify structural-steel materials and inspect steel frame joint details.

2. Verify weld materials and inspect welds.

3. Verify connection materials and inspect high-strength bolted connections.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

1. Bolted Connections: Inspect bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."

2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.

a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

1) Liquid Penetrant Inspection: ASTM E165/E165M.

2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.

3) Ultrasonic Inspection: ASTM E164.

4) Radiographic Inspection: ASTM E94/E94M.

END OF SECTION

SECTION 05 31 00

STEEL DECKING

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. Roof deck.

2. Composite floor deck.

3. Noncomposite form deck.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for normal-weight and lightweight structural concrete fill over steel deck.

2. Section 051200 "Structural Steel Framing" for shop- and field-welded shear connectors.

3. Section 055000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Roof deck.

2. Composite floor deck.

3. Noncomposite form deck.

B. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.

C. Product Test Reports: For tests performed by a qualified testing agency, indicating that each of the following complies with requirements:

1. Power-actuated mechanical fasteners.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

Welding Qualifications: Qualify procedures and personnel according to AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

B. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 ROOF DECK

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Canam Steel Corporation; Canam Group, Inc.

2. Cordeck.

3. DACS, Inc.

4. Epic Metals Corporation.

5. Marlyn Steel Decks, Inc.

6. New Millennium Building Systems, LLC.

7. Nucor Corp.

8. Roof Deck, Inc.

9. Valley Joist.

B. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:

1. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 33 zinc coating.

2. Deck Profile: As indicated.

3. Profile Depth: As indicated.

4. Design Uncoated-Steel Thickness: As indicated.

5. Span Condition: As indicated, two span minimum.

6. Side Laps: Overlapped or interlocking seam at Contractor's option.

2.3 COMPOSITE FLOOR DECK

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Canam Steel Corporation; Canam Group, Inc.

2. Cordeck.

3. DACS, Inc.

4. Marlyn Steel Decks, Inc.

5. New Millennium Building Systems, LLC.

6. Nucor Corp.

7. Roof Deck, Inc.

8. Valley Joist.

B. Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:

1. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 50 G60 zinc coating.

2. Profile Depth: As indicated.

3. Design Uncoated-Steel Thickness: As indicated.

4. Span Condition: As indicated, two span minimum..

2.4 ACCESSORIES

A. Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 (4.8-mm) minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), not less than 0.0359-inch (0.91-mm) design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), of same material and finish as deck, and of thickness and profile recommended by SDI Publication No. 31 for overhang and slab depth.

G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.

H. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.

I. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0747 inch (1.90 mm) thick, with factory-punched hole of 3/8-inch (9.5-mm) minimum diameter.

J. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch (1.90 mm) thick, of same material and finish as deck. For drains, cut holes in the field.

K. Galvanizing Repair Paint: [ASTM A780/A780M] [SSPC-Paint 20 or MIL-P-21035B, with dry film containing a minimum of 94 percent zinc dust by weight].

L. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.

B. Install temporary shoring before placing deck panels if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not

stretch or contract side-lap interlocks.

1. Align cellular deck panels over full length of cell runs and align cells at ends of abutting panels.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 INSTALLATION OF ROOF DECK

A. Fasten roof-deck panels to steel supporting members as indicated.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports as indicated.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm), with end joints as follows:

1. End Joints: Lapped 2 inches (51 mm) minimum or butted at Contractor's option.

D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and mechanically fasten flanges to top of deck. Space mechanical fasteners not more than 12 inches (305 mm) apart with at least one fastener at each corner.

1. Install reinforcing channels or zees in ribs to span between supports and mechanically fasten.

E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Mechanically fasten to substrate to provide a complete deck installation.

1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.

F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

3.4 INSTALLATION OF FLOOR DECK

A. Fasten floor-deck panels to steel supporting members as indicated.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels

between supports as indicated.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm), with end joints as follows:

1. End Joints: Lapped or butted at Contractor's option.

D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated.

E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

3.5 REPAIR

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Field welds will be subject to inspection.

C. Prepare test and inspection reports.

END OF SECTION

SECTION 055000

MISCELLANEOUS METALS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the miscellaneous metal work as indicated on the drawings and/or specified herein, including, but not limited to, the following:

1. Rough hardware.
2. Vertical steel ladders.
3. Steel pipe handrails and railings not part of steel pan stair assemblies.
4. Loose steel lintels.
5. Light steel framing and supports not included as part of work of other trades.
6. Elevator divider beams, guide rail beams and elevator pit hold down beams.
7. Miscellaneous steel trim, corner guards, angle guards and channels.
8. Countertop supports.
9. Masonry support steel.
10. Sleeves in concrete walls and slabs.
11. Steel framing, bracing, supports, anchors, bolts, shims, fastenings, and all other supplementary parts indicated on drawings or as required to complete each item of work of this Section.
12. Prime painting, touch-up painting, galvanizing and separation of dissimilar metals for work of this Section.
13. Cutting, fitting, drilling and tapping work of this Section to accommodate work of other Sections and of concrete, masonry or other materials as required for attaching and installing work of this Section.

1.3 RELATED SECTIONS

A. Structural steel - Section 051200.

B. Steel pan stairs - Section 055100.

C. Painting - Section 099000.

1.4 QUALITY ASSURANCE

A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication, where possible. Do not delay job progress; allow for trimming and fitting where taking field measurements before fabrication might delay work.

B. Shop Assembly: Pre-assemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for re-assembly and coordinated installation.

C. Reference Standards: The work is subject to requirements of applicable portions of the following standards:

1. "Manual of Steel Construction," American Institute of Steel Construction.

2. AWS D1-1 "Structural Welding Code," American Welding Society.

3. SSPC SP-3 "Surface Preparation Specification No. 3, Power Tool Cleaning," Steel Structures Painting Council.

4. SSPC PA-1 "Painting Application Specification," Steel Structures Painting Council.

5. "Handbook on Bolt, Nut and Rivet Standards," Industrial Fasteners Institute.

D. Steel Materials: For steel to be hot dip-galvanized, provide steel chemically suitable for metal coatings complying with the following requirements: carbon below 0.25 percent, silicon below 0.24 percent, phosphorous below 0.05 percent, and manganese below 1.35 percent. Notify galvanizer if steel does not comply with these requirements to determine suitability for processing.

E. Engage the services of a galvanizer who has demonstrated a minimum of five (5) years' experience in the successful performance of the processes outlined in this specification in the facility where the work is to be done and who will apply the galvanizing and coatings within the same facility as outlined herein. The Architect has the right to inspect and approve or reject the galvanizer/galvanizing facility.

F. The galvanizer/galvanizing facility must have an ongoing Quality Control/Quality Assurance program which has been in effect for a minimum of five years and shall provide the Architect with process and final inspection documentation. The galvanizer/galvanizing facility must have an on-premise testing facility capable of measuring the chemical and metallurgical composition of the galvanizing bath and pickling tanks.

G. Inspection and testing of hot-dip galvanized coating shall be done under the guidelines provided in the American Hot-Dip Galvanizers Association (AGA) publication "Inspection of Products Hot-Dip Galvanized After Fabrication."

1.5 PERFORMANCE STANDARDS

A. Railings shall be constructed to conform to the following performance standards:

1. Railings shall be designed to resist loads per State of South Carolina Building Code.

1.6 SUBMITTALS

A. Manufacturer's Literature: Submit manufacturer's specifications, load tables, dimension diagrams, anchor details and installation instructions for products to be used in the fabrication of miscellaneous metal work, including paint products.

B. Shop Drawings: Shop drawings for the fabrication and erection of all assemblies of miscellaneous iron work which are not completely shown by manufacturer's data sheets. Include plans and elevations at not less than 1" to 1'-0" scale, and include details of sections and connections at not less than 3" to 1'-0" scale. Show anchorage and accessory items.

C. Engineering Data

1. Before any ladders or railings are fabricated, submit engineering data drawings to the Architect for review indicating how performance standards specified here shall be met. The Contractor is responsible for the structural design and supports for these systems and must show his proposed systems on these drawings.

2. These drawings must show all load conditions and design calculations relative to connections, fastening devices and anchorage, as well as size and gauge of members. Calculations and drawings must be prepared by a Structural Engineer licensed in the State of South Carolina and shall be signed and sealed by this Engineer.

D. Welding shall be indicated on shop drawings using AWS symbols and showing length, size and spacing (if not continuous). Auxiliary views shall be shown to clarify all welding. Notes such as 1/4" weld, weld and tack weld are not acceptable.

E. Certification: For items to be hot-dip galvanized, identify each item galvanized and to show compliance of application. The Certificate shall be signed by the galvanizer and shall contain a detailed description of the material processed and the ASTM standard used for the coating and, the weight of the coating. In addition, and as attachment to Certification, submit reports of testing and inspections indicating compliance with the provisions of this Section.

PART 2 PRODUCTS

2.1 MATERIALS

A. Metals

1. Metal Surfaces, General: For fabrication of miscellaneous metal work which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trade names and roughness.

2. Steel Plates, Shapes and Bars: ASTM A 36.

3. Steel Bar Grating: ASTM A 1011 or ASTM A 36.

4. Steel Tubing: Cold formed, ASTM A 500; or hot rolled, ASTM A 501.

5. Structural Steel Sheet: Hot rolled, ASTM A 1011; or cold rolled, ASTM A 1008, Class 1; of grade required for design loading.

6. Galvanized Structural Steel Sheet: ASTM A 924, of grade required for design loading. Coating designation G90.

7. Steel Pipe: ASTM A 53, type and grade as selected by fabricator and as required for design loading; black finish unless galvanizing is indicated; standard weight (Schedule 40), unless otherwise indicated.

8. Gray Iron Castings: ASTM A 48, Class 30, unless another class is indicated or required by structural loads.

9. Malleable Iron Castings: ASTM A 47, grade as selected by fabricator.

10. Brackets, Flanges and Anchors: Cast or formed metal of the same type material and finish as supported rails, unless otherwise indicated.

11. Concrete Inserts: Threaded or wedge type; galvanized ferrous castings, either malleable iron, ASTM A 47, or cast steel, ASTM A 27. Provide bolts, washers and shims as required, hot-dip galvanized, ASTM A 153.

B. Grout: Non-shrink, non-metallic grout conforming to the requirements of Section 033000.

C. Fasteners

1. General: Provide zinc-coated fasteners for exterior use or where built into exterior walls. Select fasteners for the type, grade and class required.

2. Bolts and Nuts: Regular hexagon head type, ASTM A 307, Grade A.

3. Anchor Bolts: ASTM F 1554, Grade 36.

4. Lag Bolts: ASME B18.2.1.

5. Machine Screws: ASME B18.6.3.

6. Plain Washers: Round, carbon steel, ASME B18.22.1.

7. Masonry Anchorage Devices: Expansion shields, FS FF-S-325.

8. Toggle Bolts: Tumble-wing type, FS FF-B-588, type, class and style as required.

9. Lock Washers: Helical spring type carbon steel, ASME B18.21.1.

D. Shop Paint: Shop prime all non-galvanized miscellaneous metal items using Series 88 Azeron Primer made by Tnemec, ICI Devoe "Rust Guard" quick dry alkyd shop coat No. 41403, or "Interlac 393" by International Protection Coatings.

1. If steel is to receive high performance coating as noted in Section 099000, shop prime using primer noted in Section 099000.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

F. Galvanizing Repair Coating: For touching up galvanized surfaces after erection, provide repair coating that is V.O.C. compliant, equal to "Silver Galv" made by Z.R.C. Worldwide or approved equal. Apply to a dry film thickness of 1.5 to 3.0 mils.

2.2 PRIME PAINTING

A. Scope: All ferrous metal (except galvanized steel) shall be cleaned and shop painted with one coat of specified ferrous metal primer. No shop prime paint required on galvanized steel or aluminum work.

B. Cleaning: Conform to Steel Structures Painting Council Surface Preparation Specification SP 3 (latest edition) "Power Tool Cleaning" for cleaning of ferrous metals which are to receive shop prime coat.

1. Steel to get high performance coating as noted in Section 099000 shall be cleaned as per SSPC SP.6 "Commercial Blast Cleaning."

C. Application

1. Apply shop prime coat immediately after cleaning metal. Apply paint in dry weather or under cover. Metal surfaces shall be free from frost or moisture when painted. Paint all metal surfaces including edges, joints, holes, corners, etc.

2. Paint surfaces which will be concealed after shop assembly prior to such assembly. Apply paint in accordance with approved paint manufacturer's printed instructions, and the use of any thinners, adulterants or admixtures shall be only as stated in said instructions.

3. Paint shall uniformly and completely cover the metal surfaces, 2.0 mils minimum dry film thickness. No work shall be shipped until the shop prime coat thereon has dried.

D. Touch-Up: In the shop, after assembly and in the field, after installation of work of this Section, touch-up damaged or abraded portions of shop prime paint with specified ferrous metal primer.

E. Apply one shop coat to fabricated metal items, except apply two (2) coats of paint to surfaces inaccessible after assembly or erection. Change color of second coat to distinguish it from the first.

2.3 GALVANIZING

A. Scope: All ferrous metal exposed to the weather, and all ferrous metals indicated on drawings or in specifications to be galvanized, shall be cleaned and then hot-dipped galvanized after fabrication as provided by Duncan Galvanizing or approved equal.

B. Avoid fabrication techniques that could cause distortion or embrittlement of steel items to be hot-dip galvanized. Fabricator shall consult with hot-dip galvanizer regarding potential warpage problems or handling problems during the galvanizing process that may require adjustment of fabrication techniques or design before finalizing shop drawings and beginning of fabrication.

C. Cleaning: Thoroughly clean metal surfaces of all mill scale, rust, dirt, grease, oil, moisture and other contaminants prior to galvanizing.

D. Application: Hot-dip galvanizing shall conform to the following:

1. ASTM A 143: Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel.

2. ASTM A 123: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

3. ASTM A 153: Galvanized Coating on Iron and Steel Hardware - Table 1.

4. ASTM A 384: Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.

5. ASTM A 385: Practice for Providing High Quality Zinc Coatings.

6. ASTM A 924: Galvanized Coating on Steel Sheets.

7. Minimum weight of galvanized coating shall be two (2) oz. per square foot of surface.

E. Fabricate joints which will be exposed to weather in a manner to exclude water or provide weep holes where water may accumulate.

F. All galvanized materials must be inspected for compliance with these specifications and marked with a stamp indicating the name of the galvanizer, the weight of the coating, and the appropriate ASTM number.

G. To minimize surface imperfection (e.g.: flux inclusions), material to be galvanized shall be dipped into a solution of Zinc Ammonium Chloride (pre-flux) immediately prior to galvanizing. The type of galvanizing process utilizing a flux blanket overlaying the molten zinc will not be permitted.

H. After galvanizing all materials not exposed to view must be chromated by dipping material in a 0.2% chromic acid solution.

I. Galvanized surfaces, where exposed to view, must have a smooth, level surface finish. Where this does not occur, piece shall be rejected and replaced to the acceptance of the Architect.

2.4 PROTECTIVE COATINGS

A. Whenever dissimilar metals will be in contact, separate contact surfaces by coating each contact surface prior to assembly or installation with one coat of specified bituminous paint, which shall be in addition to the specified shop prime paint. Mask off those surfaces not required to receive protective coating.

2.5 WORKMANSHIP

A. General

1. Miscellaneous metal work shall be fabricated by an experienced fabricator or manufacturer and installed by an experienced tradesman.

2. Materials, methods of fabrication, fitting, assembly, bracing, supporting, fastening, operating devices, and erection shall be in accordance with drawings and

specifications, approved shop drawings, and best practices of the industry, using new and clean materials as specified, having structural properties sufficient to safely sustain or withstand stresses and strains to which materials and assembled work will be subjected.

3. All work shall be accurately and neatly fabricated, assembled and erected.

B. Shop Assembly: Insofar as practicable, fitting and assembly of work shall be done in shop. Shop assemble work in largest practical sizes to minimize field work. It is the responsibility of the miscellaneous metal subcontractor to assure himself that the shop-fabricated miscellaneous metal items will properly fit the field condition. In the event that shop-fabricated miscellaneous metal items do not fit the field condition, the item shall be returned to the shop for correction.

C. Cutting: Cut metal by sawing, shearing, or blanking. Flame cutting will be permitted only if cut edges are ground back to clean, smooth edges. Make cuts accurate, clean, sharp and free of burrs, without deforming adjacent surfaces or metals.

D. Holes: Drill or cleanly punch holes; do not burn.

E. Connections: Make connections with tight joints, capable of developing full strength of member, flush unless indicated otherwise, formed to exclude water where exposed to weather. Locate joints where least conspicuous. Unless indicated otherwise, weld or bolt shop connections; bolt or screw field connections. Provide expansion and contraction joints to allow for thermal movement of metal at locations and by methods approved by Architect.

1. Welding

    a. Shall be in accordance with AWS D1.1 Structural Welding Code of the American Welding Society and shall be done with electrodes and/or methods recommended by the manufacturer of the metals being welded.
    b. Welds shall be continuous, except where spot welding is specifically permitted. Welds exposed to view shall be ground flush and dressed smooth with and to match finish of adjoining surfaces; undercut metal edges where welds are required to be flush.
    c. All welds on or behind surfaces which will be exposed to view shall be done so as to prevent distortion of finished surface. Remove weld spatter and welding oxides from all welded surfaces.

2. Bolts and Screws: Make threaded connections tight with threads entirely concealed. Use lock nuts. Bolts and screw heads exposed to view shall be flat and countersunk. Cut off projecting ends of exposed bolts and screws flush with nuts or adjacent metal.

F. Operating Mechanism: Operating devices (i.e. pivots, hinges, etc.) mechanism and hardware used in connection with this work shall be fabricated, assembled, installed and adjusted after installation so that they will operate smoothly, freely, noiselessly and without excessive friction.

G. Built-In Work: Furnish anchor bolts, inserts, plates and any other anchorage devices, and all other items specified under this Section of the Specifications to be built into

concrete, masonry or work of other trades, with necessary templates and instructions, and in ample time to facilitate proper placing and installation.

H. Supplementary Parts: Provide as necessary to complete each item of work, even though such supplementary parts are not shown or specified.

I. Coordination: Accurately cut, fit, drill and tap work of this Section to accommodate and fit work of other trades. Furnish or obtain, as applicable, templates and drawings to or from applicable trades for proper coordination of this work.

J. Exposed Work

1. In addition to requirements specified herein and shown on drawings, all surfaces exposed to view shall be clean and free from dirt, stains, grease, scratches, distortions, waves, dents, buckles, tool marks, burrs, and other defects which mar appearance of finished work.

2. Metal work exposed to view shall be straight and true to line or curve, smooth arrises and angles as sharp as practicable, miters formed in true alignment, profiles accurately intersecting, and with joints carefully matched to produce continuity of line and design.

3. Exposed fastenings, where permitted, shall be of the same material, color and finish as the metal to which applied, unless otherwise indicated, and shall be of the smallest practicable size.

K. Preparation for Hot-Dip Galvanizing: Fabricator shall correctly prepare assemblies for galvanizing in consultation with galvanizer and in accordance with applicable Reference Standards and applicable AGA publications for the "Design of Products to be Hot-Dip galvanized After Fabrication." Preparation shall include but not be limited to the following:

1. Remove welding flux.

2. Drill appropriate vent holes and provide for drainage in inconspicuous locations of hollow sections and semi-enclosed elements. After galvanizing, plug vent holes with shaped lead and grind smooth.

2.6 MISCELLANEOUS METALS ITEMS

A. Rough Hardware

1. Furnish bent or otherwise custom fabricated bolts, plates, anchors, hangers, dowels and other miscellaneous steel and iron shapes as required for framing and supporting woodwork, and for anchoring or securing woodwork to concrete or other structures. Straight bolts and other stock rough hardware items are specified in Division 6 Sections.

2. Fabricate items to sizes, shapes and dimensions required. Furnish malleable iron washers for heads and nuts which bear on wood connections; elsewhere, furnish steel washers.

B. Ladders

1. Vertical steel ladders shall be eighteen (18) inches wide with 3/4" diameter non-slip steel rungs spaced twelve (12) inches o.c. Stringers shall be 3/8" thick by 2-1/2" wide steel bars; rungs welded to bars. Attach ladders to walls six (6) inches from top and bottom and maximum thirty-six (36) inches o.c. from these points.

2. Ladders shall be fabricated to support a live load of one hundred (100) lbs. per square foot and a concentrated load of three hundred (300) lbs. per rung; loads not to act simultaneously.

C. Steel Pipe Handrails

1. Steel pipe of size shown on Drawings, Schedule 40. Fittings shall be flush type, malleable of cast iron. Brackets shall be malleable iron, design as selected by the Architect.

2. Construction: Form direction changes in rails using solid bar stock or elbows. Connections shall be shop welded and ground smooth and flush, except where field connections and expansion joints are required. Field connections may be welded, internal sleeve and plug weld, or internal sleeve and set screw.

3. Secure handrails to walls with wall brackets. Provide brackets of malleable iron castings, with not more than three (3) inches clearance from inside face of handrail to wall surface. Neatly drill wall plate portion of the bracket into concrete or masonry to receive bolts for concealed anchorage. For installation at drywall, Drywall trades shall provide plate to receive wall plate portion of bracket and anchor or bolt wall plate through drywall to supporting steel plate. Locate brackets at not more than 5'-0" o.c. unless otherwise shown.

4. Provide wall return fittings of cast iron, flush type, with the same projection as that specified for wall brackets.

5. Longitudinal members shall be parallel with each other and with floor surface or shape of stair to a tolerance of 1/8" in 10'-0" linear feet. Center line of members within each run of railing shall be in the plane.

6. For steel pipe posts where indicated, anchor posts in concrete by means of pipe sleeves set and anchored into concrete. Provide sleeves of galvanized steel pipe, not less than six (6) inches long and having an inside diameter not less than 1/2" greater than outside diameter of the inserted pipe. Provide steel plate closure secure to bottom of sleeve and of width and length not less than one (1) inch greater than outside diameter of sleeve. After posts have been inserted into sleeves, fill annular space between post and sleeve solid with non-shrink, non-ferrous grout. Cover anchorage joint with a round steel flange welded to post. Posts shall be set plumb within 1/8" vertical tolerance.

7. Steel pipe handrails shall be capable of resisting a two hundred (200) lb. force applied to rail from any direction and a uniformly distributed load of fifty (50) lbs. per linear foot applied downward or horizontally, loads not to act simultaneously.

D. Loose Steel Lintels

1. Provide loose structural steel lintels for openings and recesses in masonry walls and partitions as shown. Weld adjoining members together to form a single unit where indicated. Provide not less than eight (8) inches bearing at each side of openings, unless otherwise indicated.

2. Loose lintels shall conform to the following Schedule:

W A L L T H I C K N E S S	
CLEAR OPENING	Loose Lintel Angle
Up to 5′0″	L4 x 4 x 3/8
5′-1″ - 8′-0″	L6 x 4 x 3/8 (LLV)
8′-1″ to 10′-0"	L7 x 4 x 3/8 (LLV)
10′-1″ to 12′-0″	L8 x 4 x ½ (LLV)

* Two angles at all openings in eight (8) inch walls.

3. At columns or vertical surfaces where lintels cannot bear on masonry, provide clip angles sized for structural capacity of lintel.

E. Miscellaneous Light Steel Framing

1. Light steel framing, bracing, supports, framing, clip angles, shelf angles, plates, etc., shall be of such shapes and sizes as indicated on the drawings and details or as required to suit the condition and shall be provided with all necessary supports and reinforcing such as hangers, braces, struts, clip angles, anchors, bolts, nuts, welds, etc., as required to properly support and rigidly fasten and anchor same in place and to steel, concrete, masonry and all other connecting and adjoining work.

2. All light steel framing steel shall be furnished and erected in accordance with the applicable requirements of the "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings" by the American Institute of Steel Construction and as specified herein.

F. Steel Bollards: Provide six (6) inches O.D. extra strong (Schedule 80) steel pipe, concrete filled, with base of steel plate for mounting to anchor bolts in concrete foundation. Rabbet top of steel pipe and insert 1/4" steel plate cap, flush with top of pipe. Weld top of cap to pipe and grind smooth and flush.

G. Countertop Supports: Steel framing as indicated or required to support countertops. Conceal framing under countertops and within wall behind countertops. Provide supports to withstand a concentrated load of not less than three hundred (300) lbs. applied at any point with a deflection not to exceed L/240 for the length of the countertop.

H. Masonry Support Steel

1. Provide galvanized steel, relieving angles, plates, accessories and other steel shapes for masonry support steel; for lintels refer to Para. E. herein.

2. Fabricate masonry support steel to allow final adjustment with the closest tolerances possible. Relieving angles which require cutting to fit masonry flashing shall be straightened without deflections.

3. Coordinate masonry support system with concrete work for locations of wedge inserts.

4. Install to meet requirements of building masonry work, face brick coursing and stone placement. Coordinate final adjustments with masonry work as work progresses.

I. Sleeves in Concrete Walls and Slabs

1. Sleeves through concrete walls shall be of Schedule 40 steel pipe with i.d. two (2) inches larger than o.d. of pipe or conduit (including insulation, if any) to be accommodated. Sleeves shall project one-half (1/2) inch on each side of finished wall. Provide rectangular one-quarter (1/4) inch steel plate collar at center, continuously welded to the perimeter of the sleeve, and six (6) inches wider than the o.d.

2. Slots in slabs shall be 12 gauge steel sheet, galvanized, of dimensions indicated, with strap anchors welded in place not more than twelve (12) inches on centers.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where miscellaneous metal is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 ERECTION

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction; including threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors as required.

B. Cutting, Fitting and Placement: Perform cutting, drilling and fitting required for installation of miscellaneous metal fabrications. Set work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items which are to be built into concrete, masonry, or similar construction.

C. Fitting Connections: Fit exposed connections accurately together to form tight hairline joints. Weld connections which are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Grind exposed joints smooth and touch up shop paint coat. Do not weld, cut or abrade the surfaces of exterior units which have been hot dip galvanized after fabrication, and are intended for bolted or screwed field connections.

D. Field Welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance, and quality of welds made, and methods used in correcting welding work.

E. Touch-Up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.

F. Field Touch-Up of Galvanized Surfaces: Touch-up shop applied galvanized coatings damaged during handling and installation. Use galvanizing repair coating specified herein for galvanized surfaces.

END OF SECTION

SECTION 055100

STEEL PAN STAIRS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment and services necessary to complete the steel pan stairs as indicated on the drawings and specified herein, including but not limited to, the following:

1. Steel pan stairs, including all clips, hangers, inserts, braces and other supports.

2. Steel pipe hand rails, guard rails and intermediate rails for steel stairs, including supports, brackets, and anchors.

1.3 RELATED SECTIONS

A. Structural steel - Section 051200.

B. Miscellaneous metals - Section 055000.

C. Installation of inserts in drywall furnished by this Section - Section 092900.

D. Finish painting - Section 099000.

1.4 QUALITY ASSURANCE

A. Qualification of Welders: Use only certified welders and the shielded arc process for all welding performed in connection with the work of this Section. Protect adjacent surfaces when field welding to prevent damage or stain. Welders and welding operators must be qualified by tests as provided by AWS.

B. Codes and Standards: In addition to complying with all pertinent codes and regulations, comply with:

1. "Specifications for Design, Fabrication and Erection of Structural Steel for Buildings" of the American Institute of Steel Construction.

2. "Code for Welding in Building Construction" of the American Welding Society.

3. "Metal Stairs Manual" of the National Association of Architectural Metal Manufacturers.

C. Conflicting Requirements: In the event of conflict between pertinent codes and regulations and the requirements of the referenced standards of these specifications, the provisions of the more stringent shall govern.

D. Field Measurements: If construction process permits, take field measurements prior to preparation of shop drawings and fabrication, where possible. Do not delay job progress. Allow for trimming and fitting wherever taking field measurements before fabrication might delay work.

E. Tolerances: Allow for construction tolerances as required.

F. Coordination: Coordinate this work with the work of all other trades interfacing with metal pan stairs, such as structural openings, sprinklers and standpipes, and other trades as required.

1.5 DRAWING SUBMISSION

A. General: It is the intent of the Working Drawings to display the layouts and general design parameters upon which the Shop Drawings shall be developed. Detail development and all connections shall be part of Shop Drawing Development.

B. Shop Drawings

1. Before any steel stairs are fabricated, submit shop drawings to the Architect for approval.

2. Show all locations, markings, quantities, materials, sizes and shapes, and indicate all methods of connecting, anchoring, fastening, bracing, for the stair construction, support and attachment to the work of other trades.

C. Engineering Data

1. Before any metal pan stairs are fabricated, submit engineering data drawings to the Architect for review. The Contractor is responsible for the structural design and supports for the stair system and must show his proposed system on these drawings.

2. These drawings must show all load conditions and design calculations relative to connections, fastening devices and anchorage, as well as size and gauge of stair members. Calculations and drawings must be prepared by a Structural Engineer licensed in the State of South Carolina and shall be signed and sealed by this Engineer.

1.6 SAMPLES SUBMISSION

A. Submit the following listed samples and other samples as may be requested by the Architect, to show the quality standards:

1. Railing bracket.

2. Exposed weld.

3. Exposed bolted connection.

4. Bent pipe railing.

B. Samples shall be submitted cleaned and shop primed and shall represent standards to which all respective materials used in the Project shall meet.

1.7 PERFORMANCE STANDARDS

A. Stairs and railings shall be constructed to conform to the following performance standards, unless greater required by Code:

1. Stairs and platforms shall support a live load of one hundred (100) psf and a concentrated live load of three hundred (300) lbs. and shall have a live load deflection limited to 1/360 of the span. Loads shall not apply simultaneously.

2. Railings shall withstand a two hundred (200) lb. force applied to rail from any direction, and a uniformly distributed load of 50 lbs./lin. ft. applied downward or horizontally, loads not to act simultaneously.

1.8 PRODUCT HANDLING

A. Protection: Use all means necessary to protect steel pan stair before, during and after installation and to protect the installed work and materials of all other trades.

B. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

PART 2 PRODUCTS

2.1 MATERIALS

A. Structural Steel: ASTM A 36.

B. Steel Sheets: ASTM A 245, Grade C, minimum ten (10) gauge for platforms, twelve (12) gauge minimum for treads and risers.

C. Steel Pipe: ASTM A 53, Type E., Grade A, and ASTM A 501. Use standard malleable iron fittings for steel pipe.

D. Malleable Iron Castings: ASTM A 47, Grade 35018.

E. Bolts and Nuts: ASTM A 307, Grade A bolts.

F. Machine Screws: ASME B 18.6.3.

G. Expansion Bolts: "Cinch" type, galvanized, of approved manufacture.

H. Threaded End Hanger Rods: Minimum 3/4" diameter, ASTM A 36.

I. Shop Paint: Shop prime all stairs and railings using Series 88 Azeron Primer made by Tnemec, ICI Devoe "Rust Guard" quick dry alkyd shop coat No. 41403, or "Interlac 393" by International Protection Coatings.

J. Bituminous Paint: Cold applied asphalt emulsion complying with ASTM D1187.

K. Concrete Fill and Reinforcing Materials

1. Concrete Materials and Properties: Comply with requirements in Division 3 Section "Cast-in-Place Concrete" for normal-weight, ready-mixed concrete with a minimum 28-day compressive strength of 3000 psi.

2. Nonslip-Aggregate Finish: Factory-packaged abrasive aggregate made from fused, aluminum-oxide grits or crushed emery; rustproof and nonglazing; unaffected by freezing, moisture, or cleaning materials.

3. Welded Wire Fabric: ASTM A 185, 6 by 6 inches – W1.4 by W1.4, unless otherwise indicated.

2.2 FABRICATION

A. General

1. Steel pan stair work shall be fabricated by an experienced manufacturer in accordance with approved shop drawings and best practices of the industry, using new and clean materials as specified, having structural properties sufficient to safely sustain or withstand strains and stresses to which material will be subjected.

2. Fabricate shop assemblies in largest practical sizes to minimize field work. All exposed surfaces shall be clean and free from all dirt, stains, grease marks, scratches, waves, dents, buckles, tool marks, rattles, and other objectionable defects which mar appearance or use of finished work.

3. Cutting: Cut materials by sawing, shearing, or blanking. Flame cutting will be permitted when ground back to clean edges. Cuts shall be made accurately, clean, sharp and free of burrs, without deforming adjacent metals.

4. Connections: Make connections with tight joints, capable of developing full strength of the members, flush. Locate joints where least conspicuous. Use concealed fasteners where possible. Weld or rivet shop connections; bolt, screw or weld field connections.

   a. Welding: Welds shall be continuous, except where spot welding is specifically permitted. Welding shall conform to the Standard Code of the American Welding Society. Exposed welds are required to be ground flush.
   b. Bolts and Screws: Make threaded connections tight with threads entirely concealed. Use lock nuts, or upset thread ends. Exposed bolts and screw head shall be flat and countersunk, unless otherwise indicated on drawings. Remove projecting ends of bolts and screws. Punch or drill holes; do not burn.

B. Stairs and Platforms

1. Provide stringers, risers, sub-treads and platforms matching profiles as shown. Form tread pan and riser in a continuous piece to receive the finished tread; tread shall be a minimum of twelve (12) gauge. Weld risers and treads to carrier angles which shall be welded to the structural steel stringers. Fasten countersunk bolts or stud welded clips through mesh for cement fill. Provide welded-on clips for the support of gypsum drywall soffits.

2. On intermediate platforms, provide metal bases formed of stringers. Miter and weld and grind smooth internal and external corners of metal bases. Form platform runs of minimum ten (10) gauge steel.

3. Countersink bolt heads and screws on finished surfaces or cut off flush with such surfaces.

4. Properly fit and securely fasten together all parts making exposed joints close fitting. Cut, drill, punch and tap as required for installation.

5. Make joints as strong and rigid as adjoining sections. Weld continuously along entire line of contact except where spot welding is indicated.

6. Separate dissimilar metals in or adjacent to work of this Section with a coat of bituminous paint on each surface prior to installation.

7. Closure and Filler Plates: Where indicated on drawings or as required, at least twelve (12) gauge sheet steel, securely fastened to top and bottom of stringer and adjacent wall, by welding or screws.

8. Struts, Hangers, Platform Headers and Subframing

    a. Provide supports as detailed and required, including all struts, clip angles, angles or hangers which are required and necessary for support of stair construction.
    b. Supports shall be of size suitable for the support load, as required. Struts, angles and hangers shall be supported by and directly connected to the structural framing. Struts and hangers, with their connections, shall be concealed.
    c. Provide other inserts, anchors and/or other subframing as may be required to complete the stair construction and properly support it on the structural framing.

C. Handrails, Railings, Posts and Brackets

1. Provide steel pipe of size shown on drawings, Schedule 40. Use heavier weight pipes and/or reinforce pipes internally as required to meet performance standards given in paragraph 1.7 herein. Fittings shall be flush type, malleable or cast iron. Wall brackets shall be steel design as detailed.

2. Handrail, post and railing spacing shall meet Code requirements.

3. Construction: Form direction changes in rails using solid bar stock or elbows. Connections shall be shop welded, except where expansion joints are required. Field connections shall be welded for continuity. All exposed welds shall be ground smooth and flush.

    a. If elbows are not available for angles shown, bends shall maintain full diameter of pipe, use mandrel, no kinks, ripples, flats are acceptable.

4. Fabricate steel tubing with wall thickness of 0.120".

5. Anchor posts to steel with steel flanges, angle type or floor type as required by conditions, welded to posts and bolted to the steel supporting members.

6. Secure handrails to walls with wall brackets. Provide brackets as shown on drawings. For installation in drywall, furnish Drywall Section steel plate to receive wall plate portion of bracket and anchor or bolt wall plate through drywall to supporting steel plate. Locate brackets at not more than 5'-0" o.c. unless otherwise shown.

7. Anchor rail ends into adjacent walls with steel flanges welded to rail ends and anchored into the wall construction as described above.

2.3 SHOP PAINTING

A. Scope: All ferrous metal shall be cleaned and shop painted with one coat of specified ferrous metal primer.

B. Cleaning: Conform to Steel Structures Painting Council Surface Preparation Specification SP 3 (latest edition) "Power Tool Cleaning" for cleaning of ferrous metals which are to receive shop prime coat.

C. Application

1. Apply shop prime coat immediately after cleaning metal. Apply paint in dry weather or under cover. Metal surfaces shall be free from frost or moisture when painted. Paint all metal surfaces including edges, joints, holes, corners, etc.

2. Paint surfaces which will be concealed after shop assembly prior to such assembly. Apply paint in accordance with approved paint manufacturer's printed instructions, and the use of any thinners, adulterants or admixtures shall be only as stated in said instructions.

3. Paint shall uniformly and completely cover the metal surfaces, 2.0 mils minimum dry film thickness. No work shall be shipped until the shop prime coat thereon has dried.

D. Touch-Up: In the shop, after assembly and in the field, after installation of work of this Section, touch-up damaged or abraded portions of shop prime paint with specified ferrous metal primer.

E. Apply one shop coat to fabricated metal items, except apply two (2) coats of paint to surfaces inaccessible after assembly or erection. Change color of second coat to distinguish it from the first.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where steel pan stairs are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. Work in the field shall comply with the same requirements as specified for shop work above.

B. Except where otherwise shown or specified for a particular item of work or for built-in work, fasten metal work to solid masonry with expansion bolts. Fastenings to wood plugs in masonry will not be accepted. Drill holes to the exact diameter of the bolts using a rotary drill for concrete and a percussion drill for other masonry. Thread screws full length to the head of the screw.

C. Provide connecting members needed for properly securing the work to masonry, drywall and structural framing, including bolts, machine screws, rods, hangers, inserts, sleeves, plates, anchors, expansion bolts, washers and other items as required. Furnish built-in items to drywall trades as required for proper anchorage.

D. Leave work exposed to view, including stair soffits, clean, smooth and neatly finished. All exposed welds shall be dressed smooth.

E. Include supplementary parts necessary to complete each item even though such work is not definitively shown or specified.

F. Coordinate and schedule the work of this Section with the work of other trades. Furnish anchors, sockets, fastenings and other miscellaneous items to be embedded in concrete or masonry, or required for securing metal work to other construction so as not to delay job progress.

G. Attach wall railings to the wall construction, using appropriate bolts and anchors to meet performance standards.

H. Install work plumb and true to the exact lines and levels, in the correct location and in proper relation to adjoining work.

I. Touch up marred and abraded shop paint of exposed surfaces after erection in the field.

J. Posts shall be set plumb within 1/8" vertical tolerance. Longitudinal members shall be parallel with each other and with floor surface or slope of stair to a tolerance of 1/8" in ten (10) linear feet. Center lines of members within each run of railing shall lie in the same vertical plane. Field joints of connecting sections shall be hairline.

3.3 TOUCH-UP PAINTING

A. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop coat, and paint exposed areas with same material used for shop painting. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.

END OF SECTION

SECTION 061600

GYPSUM SHEATHING

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment and services necessary to complete the gypsum sheathing as shown on the drawings and/or specified herein, including but not necessarily limited to the following:

1. Embedded glass reinforced gypsum (EGRG) sheathing board.

2. Sheathing joint-and-penetration treatment.

1.3 RELATED SECTIONS

A. Cold-Formed Metal Framing - Section 054000.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 (UL 263, CAN/ULC-S101) by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Fire-Resistance Ratings: Indicated by design designations from ULI and ULC "Fire Resistance Directory" and Products Certified for Canada.

B. ASTM International (ASTM):

1. ASTM C473 Standard Test Methods for Physical Testing of Gypsum Panel Products.

2. ASTM C518 Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

3. 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.

4. ASTM C1177 Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.

5. ASTM C1280 Standard Specification for Application of Gypsum Sheathing.

6. ASTM E72 Standard Test Methods of Conducting Strength Tests of Panels for Building Construction.

7. ASTM E96 Standard Test Methods for Water Vapor Transmission of Materials.

C. Single Source Responsibility: Except where specified otherwise, obtain gypsum board products, joint treatment, and accessories from single manufacturer or from manufacturers recommended by prime manufacturer of gypsum board products.

1.5 SUBMITTALS

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

B. Informational Submittals: Submit manufacturer's instructions, special procedures, and perimeter conditions requiring special attention.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials protected against damage from weather, direct sunlight, surface contamination, construction traffic, or other causes. Stack sheathing flat on leveled supports off the ground, under cover, and fully protected from weather.

1. Store and support sheathing board in flat stacks to prevent sagging.

2. Protect materials to keep them dry.

3. Protect gypsum board panels to prevent damage to edges, ends, and surfaces.

1.7 WARRANTY

A. Manufacturer's standard warranty for product exposed to weather without failure, when installed in accordance with manufacturer's requirements, for period of not less than 12 months.

B. Five years against manufacturing defects.

PART 2 PRODUCTS

2.1 GYPSUM SHEATHING

A. Fully embedded glass mat gypsum sheathing meeting the requirements of ASTM C1177.

1. Basis of Design: "DensGlass Gold Fireguard Type X" by Georgia Pacific.

a. Approved Alternate: "GlasRoc Brand Sheathing" by CertainTeed Gypsum, Inc.

2. Type and Thickness: Type X, 5/8 inch (15.9 mm) thick where indicated and as otherwise required to meet fire rating for specific element.

a. Flame Spread: ASTM E 84 (CAN/ULC-S102): 0 maximum.

b. Smoke Developed: ASTM E 84 (CAN/ULC-S102): 0 maximum.

3. Size: 48" by not less than 96" (1219 by not less than 2438 mm); longer lengths as available to reduce number of joints.

2.2 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

A. Silicone Sealant: Meeting ASTM C 920, Type S, Grade NS, compatible with glass fiber mesh sheathing tape and for covering exposed fasteners.

B. Glass-Fiber Mesh Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches (50 mm) wide, 10 by 10 or 10 by 20 threads/inch (390 by 390 or 390 by 780 threads/m), of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing board and with a history of successful in-service use.

2.3 ACCESSORY MATERIALS

A. Fasteners: Steel drill screws or nails, in lengths recommended by sheathing manufacturer for thickness of sheathing board to be attached, with organic-polymer or other corrosion- protective coating. For ceiling/soffit applications with Direct-Applied Exterior Finish Systems (DEFS) and painted ceilings/soffits, fasteners having a salt spray resistance of more than 800 hours according to ASTM B 117 are recommended.

1. For steel framing less than 0.0329 inch (0.835 mm) thick, attach sheathing with steel drill screws complying with ASTM C 1002.

2. For steel framing from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick, attach sheathing with drill screws complying with ASTM C 954.

3. For wood framing, attach with nails or screws of type and spacing as recommended by sheathing manufacturer.

PART 3 EXECUTION

3.1 GYPSUM SHEATHING INSTALLATION

A. Comply with GA-253, ASTM C 1280 and manufacturer's written instructions.

B. Cut boards at penetrations, edges, and other obstructions of work; fit tightly against abutting construction, unless otherwise indicated.

1. Install boards with a 3/8-inch (10 mm) setback where non-load-bearing construction abuts structural elements.

2. Install boards with a 1/4-inch (6 mm) setback where they abut masonry or similar materials that might retain moisture, to prevent wicking.

3. Allow no joints greater than 1/8 inch (3 mm).

C. Coordinate sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevents exterior moisture from passing through completed exterior wall assembly.

D. Apply fasteners so screw heads bear tightly against face of sheathing boards but do not cut into facing.

E. Do not bridge building expansion joints with sheathing; cut and space edges to match spacing of structural support elements.

F. Fasten sheathing to exterior of each stud with specified fasteners spaced 3/8" from ends and edges and approx. 8" o.c. at each stud. Install fasteners in accordance with manufacturer's recommendations using 2500-RPM maximum screw gun. Sheathing board shall be installed horizontally. Apply sealant between joints and trowel flush; and apply sealant around sheathing perimeter and at interface with other materials. Cover fastener heads with sealant and trowel flush.

G. Refer to Section 072700 for vapor permeable air barrier description.

3.2 SHEATHING JOINT-AND-PENETRATION TREATMENT

A. Seal sheathing joints according to sheathing manufacturer's written recommendations.

1. Short Term: Apply elastomeric sealant on joints and trowel flat. Apply sufficient quantity of sealant to completely cover joints after troweling. Seal other penetrations and openings.

2. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

END OF SECTION

SECTION 062000

CARPENTRY

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the carpentry work as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Blocking and miscellaneous wood, including plywood wall lining for telephone and electric closets.
2. Fire treated within exhibit walls where noted.
3. Rough hardware.
4. Installation only of finish hardware.
5. Installation only of doors and hollow metal frames.
6. Heavy duty counter support brackets.

1.3 RELATED SECTIONS

A. Architectural woodwork - Section 064023.

B. Roofing - Section 075433.

C. Steel doors and frames - Section 081113.

D. Wood doors - Section 081416.

E. Finish hardware - Section 087100.

1.4 QUALITY ASSURANCE

A. Lumber Standard: Comply with PS 20.

B. Plywood Standard: Comply with PS 1 and American Plywood Assoc. (APA).

C. Shop fabricate carpentry work to the extent feasible and where shop fabrication will result in better workmanship than feasible for on-site fabrication.

D. Grade Marks: Identify lumber and plywood by official grade mark.

1. Lumber: Grade stamp to contain symbol of grading agency certified by Board of Review, American Lumber Standards Committee, mill number or name, grade of lumber, species grouping or combination designation, rules under which graded where applicable, and condition of seasoning at time of manufacture.

    a. MC-15 or KD: Maximum of fifteen (15) percent moisture content.

E. Installation of doors, frames and hardware shall conform to the minimum standards of "Installation Guides for Doors and Hardware" of the Door and Hardware Institute.

1.5 SUBMITTALS

A. Pressure Treatment: Include certification by treating plant stating chemicals and process used, net amount of salts retained and conformance with applicable standards.

B. Fire-Retardant Treatment: Include certification by treating plant that treatment material complies with governing ordinances and that treatment will not bleed through finished surfaces.

1.6 PRODUCT HANDLING

A. Deliver carpentry materials to the site ready to use with each piece of lumber clearly marked as to grade, type and mill, and place in an area protected from the elements.

B. Deliver rough hardware in sealed kegs and/or other containers which shall bear labels as to type and kind.

C. Pile lumber for rough usage, when delivered to the site in stacks to insure drainage and with a minimum clearance of six (6) inches above grade. Cover stacks with tarpaulins or other watertight coverings. Store grounds and similar small sized lumber inside the building as soon as possible after delivery.

D. Do not store seasoned lumber in wet or damp portions of the building.

E. Protect fire retardant treated materials against high humidity and moisture during storage and erection.

F. Remove delivered materials which do not conform to specified grading rules or are otherwise not suitable for installation from the job site and replace with acceptable materials.

G. All items specified in Section 087100 of this specification entitled "Finish Hardware" shall be received, accounted for, stored and applied under this Section.

H. Hardware shall be sorted and stored in space assigned by Contractor and shall be kept at all times under lock and key. The safety and preservation of all items delivered will be the responsibility of the Contractor.

1.7 JOB CONDITIONS

A. Installer must examine the substrates and supporting structure and the conditions under which the carpentry work is to be installed, and notify the Contractor in writing of conditions detrimental to the work. Do not proceed with the installation until

unsatisfactory conditions have been corrected in a manner acceptable to the Installer and the Architect.

B. Coordination: Fit carpentry work to other work; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds and similar supports to allow proper attachment of other work.

PART 2 PRODUCTS

2.1 WOOD MATERIAL

A. General

1. All wood shall be sound, flat, straight, well seasoned, thoroughly dry and free from all defects. Warped or twisted wood shall not be used.

2. For miscellaneous wood blocking, grounds, furring as required, use Utility Grade Coastal Douglas Fir or Southern Pine, free from knots, shakes, rot or other defects, straight, square edges and straight grain, air seasoned with maximum moisture content of nineteen (19) percent. Wood shall be S4S, S-Dry, complying with PS-20.

3. For plastic laminate countertops or vanities provide 3/4" thick B-B EXT-APA plywood, fire retardant treated as specified herein, or "Duraflake FR" fire retardant composite board with hardwood edge, density of forty five (45) lbs./cubic foot, made by Willamette Industries, Inc.

4. For closet shelving, provide 3/4" thick A-A INT-APA plywood with 1/4" thick hardwood edges, fire retardant treated as specified herein.

5. Plywood and rough carpentry for telephone and electric closets, provide 3/4" thick C-D EXT-APA plywood, fire retardant treated as specified herein.

B. Wood Treatment

1. All interior wood material specified herein shall be fire retardant treated to comply with the AWPA standard U1 to achieve a flame spread rating of not more than 25 (UL Class "FR-S") when tested in accordance with UL Test 723 or ASTM E 84. The fire retardant chemicals used to treat the lumber must comply with FR-1 of AWPA Standard P49 and be free of halogens, sulfates and ammonium phosphate.

   a. After treatment, kiln dry to a moisture content of fifteen (15) percent; if wood is to be painted or finished, kiln dry to a moisture content of twelve (12) percent. Treatment shall be equal to "Dricon" made by Arch Wood Protection Inc. or approved equal. Provide UL approved identification on treated materials.

2. For exterior blocking, roofing and sheet metal, pressure treat wood with copper azole, Type B (CA-B); ammoniacal copper quat (ACQ) or similar preservative product that contains no arsenic or chromium. Preservative shall comply with AWPA Standard U1, (.25 lbs./cubic foot of chemical in wood).

a. After treatment, kiln dry to a maximum moisture content of fifteen (15) percent. Treatment shall be equal to "Wolmanized Natural Select" made by Arch Wood Protection Inc. or approved equal.

3. Treated wood which is cut or otherwise damaged shall be further treated in accordance with the AWPA Standard M-4.

2.2 HARDWARE

A. Rough Hardware for Treated Woods and Exterior Use: Hot-dipped galvanized or Type 304 stainless steel.

B. Nails: Common steel wire, untreated for interior work as per ASTM F 1667.

C. Bolts: Standard mild steel, square head machine bolts with square nuts and malleable iron or steel plate washers or carriage bolts with square nuts and cut washers conforming to the following:

1. Bolts: ASTM A 307, Grade A.

2. Nuts: ASTM A 563.

3. Lag Screws and Bolts: ASME B 18.2.1.

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

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

2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2; use stainless steel for treated woods and exterior use.

E. Wood Screws: ASME B 18.6.1.

F. Concrete and Masonry Anchors: Standard expansion-shield self-drilling type concrete anchors where so shown or noted on the drawings, or where approved by the Architect.

2.3 COUNTER SUPPORT BRACKETS

A. Heavy-Duty Shelf Standards and Brackets:

1. Heavy Duty support brackets: Rakks EH size per drawings.

2. Provide steel bent plates, tubes, and posts at countertop supports shown on drawings, capable of withstanding required load criteria. Finish to be primed and painted.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where carpentry is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION OF FINISH HARDWARE

A. Hardware shall be carefully fitted and securely attached, in accordance with these specifications and the instructions of the various manufacturers.

B. Unless otherwise noted, mount hardware units at heights established in Section 081113.

C. Install each hardware item in compliance with the manufacturer's instructions and recommendations. Wherever cutting and fitting is required to install hardware onto or into surfaces which are later to be painted or finished in another way, install each item completely and then remove and store in a secure place during the finish application. After completion of the finishes, re-install each item. Do not install surface-mounted items until finishes have been completed on the substrate.

D. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

E. Drill and countersink units which are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

F. Cut and fit threshold and floor covers to profile of door frames, with mitered corners and hair-line joints. Join units with concealed welds or concealed mechanical joints. Cut smooth openings for spindles, bolts and similar items, if any.

G. All keys used shall be construction keys which are to be tagged with fiber discs as approved, clearly labeled with identifying inscriptions and then neatly arranged in a temporary cabinet. All construction keys shall be returned to the Owner.

H. Adjusting and Cleaning

1. Adjust and check each operating item of hardware and each door, to ensure proper operation and function of every unit. Lubricate moving parts with type lubrication recommended by manufacturer (graphite type if no other recommended). Replace units which cannot be adjusted and lubricated to operate freely and smoothly as intended for the application made.

2. Final Adjustment: Wherever hardware installation is made more than one month prior to acceptance or occupancy of a space or area, return to the work during the week prior to acceptance or occupancy, and make a final check and adjustment of all hardware items in such space or area. Clean and re-lubricate operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.

3.3 INSTALLATION OF DOORS AND FRAMES

A. Preparation

1. Remove welded-in shipping spreaders installed at factory.

2. Prior to installation and with installation spreaders in place, adjust and securely brace standard steel door frames for squareness, alignment, twist, and plumb to the following tolerances:

   a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
   b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
   c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
   d. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.

3. Drill and tap doors and frames to receive non-templated mortised and surface-mounted door hardware.

B. Installation

1. General: Provide doors and frames of sizes, thicknesses, and designs indicated. Install steel doors and frames plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

2. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

   a. Install frames in accordance with ANSI/SDI A250.11, Recommended Erection Instructions for Steel Frames, unless more stringent requirements are specified herein.
   b. At fire-protection-rated openings, install frames according to NFPA 80.
   c. Where frames are fabricated in sections due to shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
   d. Install frames with removable glazing stops located on secure side of opening.
   e. Frames set in masonry walls shall have door silencers installed in frames before grouting.
   f. Remove temporary braces necessary for installation only after frames have been properly set and secured.
   g. Check plumb, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.

3. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor and secure with post-installed expansion anchors.

a. Floor anchors may be set with powder-actuated fasteners instead of post-installed expansion anchors if so indicated and approved on Shop Drawings.

4. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames conforming to the requirements of Section 072100 "Thermal Insulation."

5. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar; refer to Section 042000 "Unit Masonry" for installation of frames in masonry walls.

6. In-Place Concrete or Masonry Construction: Secure frames in place with post-installed expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.

7. In-Place Gypsum Board Partitions: Secure frames in place with post-installed expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.

8. Ceiling Struts: Extend struts vertically from top of frame at each jamb to supporting construction above, unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction above. Provide adjustable wedged or bolted anchorage to frame jamb members.

9. Installation Tolerances: Adjust steel door frames for squareness, alignment, twist, and plumb to the tolerance given in HMMA 841 of ANSI/NAAMM, current edition.

10. Steel Doors: Fit hollow metal doors accurately in frames to the tolerances given in HMMA 841 of ANSI/NAAMM, current edition.

    a. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

11. Glazing: Comply with installation requirements in Section 088000 "Glass and Glazing" and with standard steel door and frame manufacturer's written instructions.

    a. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c., and not more than 2 inches o.c. from each corner.

C. Wood Doors

1. Condition doors to average prevailing humidity in installation area prior to hanging.

2. Install doors in accordance with manufacturer’s instructions.

3. Fit door to frames and machine for hardware to whatever extent not previously worked at factory as required for proper fit and uniform clearance at each edge.

4. Clearances: Install doors to meet clearance requirements specified in Section 081416.

5. Fire-Rated Doors: Install in corresponding fire-rated frames in accordance with the requirements of NFPA No. 80. Provide clearances complying with the limitations of the authority having jurisdiction.

D. Adjustments: Check and readjust operating finish hardware items just prior to final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including doors or frames which are warped, bowed or otherwise unacceptable.

3.4 BLOCKING AND MISCELLANEOUS WOOD

A. General

1. Erect rough carpentry true to line, levels and dimensions required; squared, aligned, plumbed, and securely fastened in place.

2. Shim where required to true up furring, blocking and the like. Use wood or metal shims only.

3. Do all cutting, fitting, drilling and tapping of other work as required to secure work in place and to perform the work included herein. Do all the cutting and fitting of carpentry work, for the work of other trades as required.

B. Blocking and Miscellaneous Wood

1. Furnish and install all wood grounds, furring, blocking, curbs, bucks, nailers, etc., that may be necessary and required in connection with the carpentry and with the work described for any other trades and including required carpentry for electrical fixtures. All blocking and nailers shall be continuous wherever required, whether or not so indicated.

2. Blocking shall be as required for the proper installation of the finished work and for items in mechanical sections as required. Blocking, edgings, stops, nailing strips, etc., shall be continuous, unless distinctly noted otherwise. Provide blocking as required to install all equipment. Provide blocking and nailers where shown or required to fasten interior sheet metal work.

3. Fastening for wood grounds, furring and blocking shall be of metal and of type and spacing as best suited to conditions. Hardened steel nails, expansion screws, toggle bolts, self-clinching nails, metal plugs, inserts or similar fastenings shall be used, of suitable type and size to draw the members into place and securely hold same.

C. Rough Lumber for Roofing and Sheet Metal

1. Furnish and install all wood nailing strips and wood blocking required in connection with respective types of roofing, fans, flashings, and sheet metal work, using preservative treated wood as herein before specified.

2. Wood blocking shall be of sizes and shapes as indicated on the drawings and/or designed for the reception of curb flashings for roof ventilators and similar items.

3. All nailing strips and blocking shall be carried out in accordance with the printed installation instructions, and/or recommendations of the accepted manufacturer of

the roofing materials, and in coordination and cooperation with the sheet metal work trades.

4. All blocking and nailing strips shall be firmly secured in place using counter bored bolt and nut fastenings, or secured by any other proposed flush surfaced fastenings.

5. Wood nailing strips or blocking required to be embedded in concrete work shall be furnished in time due for placing, prior to start of concrete operations. Locations and spacings of nailing strips or blocking shall be performed in coordination with the concrete trades, as required for respective installations.

3.5 TELEPHONE AND ELECTRIC EQUIPMENT MOUNTING BOARDS

A. Furnish and install 3/4" thick plywood panels to the walls of the telephone and electric equipment rooms in accordance with the requirements of the local utility company.

B. Secure to wall using proper devices for substrates encountered, spaced twelve (12) inches o.c., maximum around the edges, 1-1/2" from corners, and in three (3) rows of three (3) each in the field. Recess fastening devices flush with the plywood surface. Adjacent panels shall be butted with 1/16" space between without lapping.

3.6 ROUGH HARDWARE

A. Securely fasten rough carpentry together. Nail, spike, lag screw or bolt as required by conditions encountered in the field and the Contract Documents.

B. Provide rough or framing hardware, such as nails, screws, bolts, anchors, hangers, clips, inserts, miscellaneous fastenings, and similar items of the best quality and of the proper size and kind to adequately secure the work together and in place, in a rigid and substantial manner.

C. Secure rough carpentry to masonry with countersunk bolts in expansion sleeves or other acceptable manner, with fastenings not more than sixteen (16) inches apart. Secure woodwork to hollow masonry with toggle bolts spaced not more than sixteen (16) inches apart.

D. Countersink bolts in nailers and other rough woodwork and include washers and nuts. Cut bolts off flush with surfaces and peen as may be required to receive finished work.

E. Inserts to secure wood nailers to concrete shall be malleable iron threaded inserts with 3/8" diameter bolts of length to allow for countersinking. Locate at end of each nailer and at intervals not exceeding thirty (30) inches o.c.

F. Furnish to the mason for building into the work, or attaching the work which is to be built in, anchors, bolts, wall plates bolted to masonry, corrugated wall plugs, nailing blocks, etc., which are required for the proper fastening and installation for the work or other items as called for in this Section.

G. Detailed instructions with sketches of necessary requirements, shall be given to the masonry trade showing the location and other details of such nailing devices.

3.7 CLEANING UP

A. General: Keep the premises in a neat, safe and orderly condition at all times during execution of this portion of the work, free from accumulation of sawdust, cut-ends and debris.

B. Sweeping

1. At the end of each working day, or more often if necessary, thoroughly sweep all surfaces where refuse from this portion of the work has settled.

2. Remove the refuse to the area of the job site set aside for its storage.

3. Upon completion of this portion of the work, thoroughly broom clean all surfaces.

END OF SECTION

SECTION 064023

ARCHITECTURAL WOODWORK

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the architectural woodwork as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Wood paneling.
2. Wood trim, moldings, base, frames and rails.
3. Wood casework and counters with special veneers.
4. Wood casework and counters with plastic laminate finish.
5. Hardware for casework.
6. Wood shelving.
7. Wood framing and rough lumber as required for work of this Section.
8. Wood grounds, blocking, nailers, furring as required for work of this Section.
9. All rough hardware and fastenings for work of this Section.
10. Drilling concrete and masonry, drilling and/or tapping metal work, as required, for the installation of work of this Section.
11. Back painting as specified herein.
12. Shop finish of work of this Section, except items indicated herein to be shop primed only.

1.3 RELATED SECTIONS

A. Carpentry - Section 062000.

B. Caulking between architectural woodwork and any wall, floor, or ceiling joints - Section 079200.

C. Wood doors - Section 081416.

D. Field finishing - Section 099000.

1.4 QUALITY STANDARDS

A. The quality standards of the Architectural Woodwork Institute, "Architectural Woodwork Standards," 2nd Edition, dated October 1, 2014, and enhancements 2019 shall apply to all workmanship including materials and installation, for architectural woodwork and by reference are made a part of this specification. All work shall conform to "Premium" grade requirements of the AWI "Architectural Woodwork Standards," unless otherwise modified herein.

B. In the event of a dispute as to the quality grade (or grades), the Contractor shall call upon the Architectural Woodwork Institute for an inspection under AWI's Quality Certification Program which shall include a QCP Inspection and Report. The Contractor agrees to abide by the decision of this Report.. The cost of said inspection and report shall be borne by the Contractor.

C. Employ only tradesmen experienced in the fabrication and installation of architectural woodwork.

D. Woodworking firm must be accredited by the AWI Quality Certification Program (QCP).

E. Provide fire test reports by an accredited testing laboratory of all woodwork demonstrating compliance with fire rating classification as required by Code,.

1.5 SUBMITTALS

A. Shop Drawings

1. Submit shop drawings of all woodwork specified and indicated on the drawings. Shop drawings shall indicate room plans and elevations at 3/4" equals 1'-0" scale and typical construction details at 3" equals 1'-0" scale. Shop drawings shall indicate all materials, thicknesses and finishes.

2. Shop drawings shall show all finish hardware, anchors, fastenings and accessories.

3. Shop drawings shall show all jointing, joint treatment and butt jointing in veneers and plastic laminate.

4. Shop drawings for wood paneling must show complete elevations of rooms to receive paneling as well as panel matching required by these specifications.

5. Shop drawings for cabinet work must show centerline height and horizontal location of all required internal wall blocking.

6. Where architectural woodwork deviates from AWI standards noted herein, shop drawings must identify these deviations.

B. Samples: Submit samples of each of the following items:

1. Plastic laminate, twelve (12) inches square, including a section of outside corner.

2. Transparent finish for each species of wood veneer laminated to particleboard, twelve (12) inches square, for each finish specified or shown.

3. Opaque finish wood veneer laminated to particleboard, twelve (12) inches square for each color, gloss and finish specified or shown.

4. Each finish type of wood panel, 24" wide x 36" high.

5. Each type and finish of each type of wood cornice, trim, molding, etc., eight (8) inches long, finish as specified.

6. Cabinet hardware.

C. Product Certificates: For each type of product.

1. Composite wood products.

2. Thermally fused laminate panels.

3. Glass.

4. Adhesives.

1.6 QUALIFICATIONS

A. The work of this Section shall be provided by a firm having a minimum of five (5) years' experience on projects of similar size and quality to that specified and shown.

1.7 COORDINATION

A. Coordinate the work of this Section with other appropriate Sections of the specifications to insure proper scheduling for fabrication and installation of the work specified herein

B. Coordinate with partition and finish trades to insure that proper provisions are made for the installation of the work specified herein.

C. Verify all dimensions in the field prior to fabrication of all Architectural Woodwork to assure proper fit.

1.8 PRODUCT HANDLING

A. All materials and work of this Section shall be protected from damage, from time of shipment from shop to final acceptance of work. Cover, ventilate, and protect work of this Section from damage caused by weather, moisture, heat, staining, dirt, abrasions, any other causes which may adversely affect appearance or use, or which may cause

deterioration of finish, warping, distortion, twisting, opening of joints and seams, delamination, loosening, etc., of work of this Section.

B. Keep all finish carpentry, millwork, and cabinet work under cover both in transit and at the premises. Do not deliver any finish carpentry, millwork or cabinet work before it is required for installation. Protect such work to avoid damage in transit, during erection and after erection until acceptance of the building; use all such methods to provide the proper protection. Remove such protection when directed by the Architect.

C. Deliver finish carpentry, millwork, and cabinet work in a dry stable condition; protect same against injury and dampness. Do not store or install finish carpentry, millwork or cabinet work until after the concrete, masonry and plaster work are thoroughly dry.

D. Damaged or defective items of work of this Section are subject to rejection and replacement with new by Contractor, at no cost to Owner.

1.9 JOB CONDITIONS

A. Humidity Controls: The ambient relative humidity at the site, including both the storage and the installation areas, shall be maintained between 25% and 55% prior to delivery and through the life of the installation.

B. Determine equilibrium moisture content and maintain required temperature and relative humidity as required for a tolerance of plus or minus one (1) percent of the specified optimum moisture content until woodwork receives specified finishes. Refer to "Guide to Wood Species Selection," AWI, for method of determining equilibrium moisture content values.

C. Examination of Substrate and Conditions: The installer must examine the substrate and the conditions under which the work of this Section is to be performed, and notify the Contractor in writing of unsatisfactory conditions. Do not proceed with work under this Section until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

D. Areas to receive architectural woodwork must be fully enclosed with windows and/or curtain wall installed and glazed, exterior door in place, HVAC systems operational and temporary openings closed. Any plaster, wet grinding and concrete work shall be fully dry.

E. Architectural woodwork shall be allowed to come to equilibrium on site for 7 days prior to installation.

PART 2 PRODUCTS

2.1 BASIC REQUIREMENTS

A. Wood Moisture Content: Provide kiln-dried (KD) lumber with an average moisture content range of nine (9) to twelve (12) percent for exterior work and six (6) to eleven (11) percent for interior work.

B. Measurements: Before proceeding with woodwork required to be fitted to other construction, obtain field measurements and verify all dimensions of shop drawing details as required for accurate fit.

C. Compatibility of Grain and Color: Architect reserves the right to select materials for best compatibility between visually related members and veneers.

D. Machine and sand woodwork to comply with requirements of Standards for specified grade.

E. Fabricate woodwork to dimensions, profiles and details shown. Rout or groove back of flat trim members, kerf backs of other wide flat members except plywood or veneered members.

F. Miter joints by joining, splining and gluing to comply with requirements for the specified grade.

G. Inspect each piece of lumber and plywood or each unit of woodwork after drying; do not use twisted, warped, bowed of otherwise damaged or defective wood.

2.2 GENERAL - MATERIALS

A. Softwood lumber shall conform to the requirements of the latest edition of American Lumber Standards Simplified Practice Recommendation R-16. Grades shall conform to the grading rules of the Association having jurisdiction, and shall bear the official grade and trademark of the Inspection Bureau of the Association and a mark of mill identification.

B. Framing and Rough Lumber: No. 1 KD grade Southern Pine or Dense Construction grade Douglas Fir, having extreme fiber in bending stress of at least 1700 psi, surfaced four sides (S4S). Provide fire retardant treatment meeting requirements of Section 062000.

C. Grounds, Blocking, Nailers, Furring: Southern Pine, Douglas Fir or Sitka Spruce, grade to suit particular purpose and to be straight, square edged, straight grained, surfaced four sides (S4S), and which will retain nails and screws without splitting. Provide fire retardant treatment.

D. Wood Veneers and Lumber: Provide AWI Premium Grade materials and workmanship. For species not listed in the AWS comply with the following:

1. Provide AWS Lumber Grade Premium and AWS Grade AA Veneer, book-matched, minimum 6 inch face veneer width. Kiln dry to 6-8 percent moisture content. Components shall be free of defects and sapwood. Match adjacent pieces for color and grain pattern.

2. Single-Source Requirement for Wood Veneers and Solids: Intent is to provide wood which matches as closely as possible throughout the project. Provide wood veneers and solids from the same distributor, and from the same flitches and solids sources to the greatest extent possible.

E. Lumber: AWI Section 3 with the following requirements:

1. Hardwood for Transparent Finish: Premium Grade, select Rift Sawn _____ matching adjoining veneers unless otherwise shown or specified, and free from cat's eyes, bird's eyes, burls, curls or cross grains.

2. Hardwood for Opaque Finish: Any hardwood which, when finished, will not show any grain, imperfection or other surface defects when used with the opaque finish specified.

F. Plywood: AWI Section 4; Veneer core, particleboard, or plywood core unless otherwise specified, and with the following requirements:

1. Hardwood: Premium Grade, face veneers as shown or specified

2. Particleboard: Premium Grade, fire retardant for wall paneling only equal to Duraflake FR and Duraflake for cabinets. In addition, particleboard and MDF shall be certified to the following EPP CPA 4-19 formaldehyde emission limits:

a. Particleboard meets 0.18 ppm.

b. MDF meets 0.21 ppm.

3. Edges: Banded with hardwood in accordance with Premium Grade Standards.

G. Wood Species and Cut for Transparent Finish: Refer to finish schedule.

1. Architect's control samples for transparent finish, veneer grain and figure characteristics are available for review at the office of the Architect.

H. Veneer Matching Requirements:

1. Matching Between Adjacent Veneer Leaves: Book match and architectural end match.

2. Matching Within Individual Panel Faces: Balance and Center Match.

3. Method of Matching Panels: Blueprint-matched panels and components

I. Finishing (Wood)

1. Transparent Finish for Paneling, Casework and Trim
    a. AWI Factory Finish System "Conversion Varnish", System 5, Transparent.
    b. AWI Premium Grade.
    c. Stain: Refer to finish schedule.
    d. Degree of Sheen: Refer to finish schedule.
2. Opaque Finish for Casework
    a. AWI Factory Finish System "Conversion Varnish", System 5, Opaque".
    b. AWI Premium Grade.
    c. Degree of Sheen: Refer to finish schedule.
    d. No grain to show.

2.3 PLASTIC LAMINATE

A. Face Sheets: NEMA Publication LD3, Grade GP50, Type I, 0.05" thick, as manufactured by EGGER or approved equal by Formica, Nevamar, Wilson-Art. Color, pattern and finish as indicted in the finish schedule.

B. Backing Sheets: Non-decorative, high-pressure plastic laminate, NEMA LD3, Grade BK20, 0.02" thick.

C. Edges: Finish with plastic laminate to match face and applied before face sheets are applied, unless otherwise shown or specified.

2.4 METAL

A. Steel
    1. Structural Steel Shapes and Plates: ASTM A 36.
    2. Hot-Rolled Carbon Steel Sheets: Commercial quality, ASTM A 569, may be used for concealed parts only.
    3. Finishes
        a. Primer for Unexposed Metal: Zinc chromate primer.

2.5 GLASS

A. Comply with the requirements of Section 088000, glass shall be clear tempered glass.

2.6 MISCELLANEOUS PRODUCTS

A. Fasteners

1. Wood Screws: FS FF-S-111, type, size, material and finish as required for the condition of use.

2. Nails: FS FF-N-105, type, size, material and finish as required for the condition of use.

3. Anchors: Type, size, material and finish as required for the condition of use.

4. Staples: Upholstery type staples of sufficient strength to hold fabric taut in place without sagging.

B. Adhesives

1. For Laminating Plastic Laminate Surfaces: Urea resin, Type II, as recommended by fabricator.

2. For All Other Uses: polyvinyl acetate resin emulsion or other type as recommended by the fabricator..

2.7 CABINETS WITH PLASTIC LAMINATE FINISH

A. General

1. Fabricate all cabinetry and millwork to the "Premium Grade" standards of the AWI, Section 10.

2. Face construction of cabinets shall be "Flush Overlay."

3. Provide 3/4" thick doors, drawer fronts and fixed panels (including thickness of plastic) except where required to be thicker by Standards; and provide flush units.

4. Provide dust panels of 1/4" thick plywood or tempered hardboard above compartments and drawers, except where located directly below countertops.

5. Exposed Edges: Plastic laminate matching exposed panel surfaces. Ease exposed edge of overlap sheet.

B. Plastic Laminate

1. Plastic Laminate for Horizontal Surfaces: 0.050" thick, general purpose type (high pressure).

2. Plastic Laminate for External Vertical Surfaces: 0.028" thick, general purpose type (high pressure).

3. Plastic Laminate for Post Forming: 0.042" thick, post forming (high pressure).

4. Plastic Laminate for Cabinet Linings: 0.020" thick, cabinet liner (high pressure).

5. Plastic Laminate for Concealed Panel Backing: 0.020" thick, backer type (high pressure).

6. Plastic Laminate Colors and Patterns: As selected by the Architect from manufacturer's standard satin finish products. Acceptable Manufacturers: Wilson-Art, Nevamar, Formica.

C. Shop Assembly: All work shall be shop assembled. Work that is too large for entrance into the use area shall be fabricated in attachable sections with provisions for reconnection in the using space.

D. Material Thicknesses: See drawings for general materials thicknesses. Minimum thickness of solid lumber for web frames, trim, bases, etc., shall be 3/4". Minimum thickness of plywood and particleboard shall be 3/4".

E. Sizes: See drawings for woodwork sizes required. The manufacturer shall check field dimensions and verify all openings and actual field conditions prior to fabrication of work.

F. Manufacturer is responsible for rigidity and structural stability.

2.8 PLASTIC LAMINATE COUNTERTOPS AND VANITIES

A. Grade: Same as AWI grade required for cabinet work; plastic laminate finish.

B. Construction

1. Provide back-splash and end-splash, where detailed; top-mounted square butt joint, fully covered with matching plastic laminate, eased edges.

2. Exposed Counter Edges: Plastic laminate matching surface, except as otherwise indicated. Ease exposed edges of overlap sheet.

3. Cut openings for equipment to be installed. Comply with equipment manufacturer's requirements, but provide internal corners of 1/8" minimum radius. Smooth saw cut and ease edges.

4. Seal cut edges of counter at openings for sinks and other "wet" equipment, using waterproofing compound recommended by plastic manufacturer and compatible with laminating adhesive.

2.9 BUILT-IN CABINETS, WOODWORK WITH WOOD VENEER FINISH

A. Construction: Details of cabinet and wood work construction shall conform to design as detailed on the drawings and shall be constructed in accordance with AWI Section 10, Premium Grade.

B. Finishing: All work shall be factory pre-finished. No field finishing will be permitted, except minor retouching that is necessary after installation to leave work in perfect

condition. Field touch-up shall be accomplished using the same finishes as originally applied at the factory. All finishes shall be free from runs, sags and other visual defects. All wood shall be thoroughly hand smoothed and hand sanded to remove all traces of machine and tool marks. All steel or other metal components shall be deburred, thoroughly cleaned and degreased prior to finishing. Requirements for surface preparation shall be in accordance with AWI Standards specified. Surfaces shall be finished as follows:

1. Wood Species and Cut for Exposed Surfaces: As specified hereinabove.
    a. Grain Direction: Vertically for drawer fronts, doors, and fixed panels.
    b. Matching of Veneer Leaves: Book match.
    c. Vertical Matching of Veneer Leaves: End match.
    d. Veneer Matching within Panel Face: Running match.
    e. Veneer Matching within Room: Provide casework veneers in each room or other space from a single flitch with doors, drawer fronts, and other surfaces matched in a sequenced set with continuous match where veneers are interrupted perpendicular to the grain.
2. Semiexposed Surfaces: Provide surface materials indicated below:
    a. Surfaces Other Than Drawer Bodies: Compatible species to that indicated for exposed surfaces, stained to match.
    b. Drawer Sides and Backs: Solid-hardwood lumber, stained to match species indicated for exposed surfaces.
    c. Drawer Bottoms: Hardwood plywood.
3. All wood veneer surfaces shall be given transparent finish as specified herein.
4. Backing Veneer: Provide backing veneer, of same thickness and strength as face veneer for balanced construction, where plywood surface not exposed, not semi-exposed, or not to be finished. Note that interior surface of cabinets, closets, are to be finished.

C. Edge Banding: All visible edges of case and body members fabricated from plywood shall be banded. Transparent finished wood veneer panels shall be banded with wood species to match face veneers.

2.10 CABINET HARDWARE

A. Architectural Woodwork Hardware: Provide the following items, or their approved equal, as required:

1. Hinges: Hafele concealed hinges.

2. Catches: Magnetic; top and bottom.

3. Pulls: Selected by the Architect.

4. Locks: Directed by the Architect.

5. Drawer Slides (24" maximum width): Accuride, Model 7434, full extension, 100 lb. capacity.

    a. Drawer Slides (16" maximum width) Easy Close: Accuride Model 3832C, full extension, 100 lb. capacity.

6. Shelf Supports: Pin and grommet system equal to No. 282.01.701 pin and 282.50.704 grommet made by Hafele.

7. Finish: Satin Stainless Steel.

8. Closet Hardware: Oval wardrobe rails, chrome plated steel with center bracket and wall support brackets made by Hafele or approved equal.

2.11 WOOD FOR RAILS, CAPS, TRIM, BASES, MOLDINGS AND FRAMES

A. Quality Standard: For the following types of interior architectural woodwork, comply with indicated standards as applicable.

1. Standing and Running Trim: AWI Section 6.

2. Miscellaneous Millwork: AWI Section 6.

3. Stair Handrails: AWI Section 7.

B. Wood Work for Transparent Finish: Except as otherwise indicated, comply with the following:

1. Grade: Premium.

2. Species of Solid Wood: Quarter Sawn Species as noted on drawings.

C. Woodwork for Paint Finish: Except as otherwise indicated, comply with the following:

1. Grade: Premium.

2. Species of Solid Wood: Solid, paint grade, sound clear Poplar or Birch.

2.12 HARDWOOD VENEERED PLYWOOD PANELS

A. Type: Interior grade, hot press laminated with waterproof adhesive, pre-finished, with face veneers and core construction as specified herein, meet AWI Section 8 standards.

B. Core Construction: Shall be fire retardant treated, meeting requirements of Section 062000; type at fabricator's option.

1. Where the core is free of urea formaldehyde, provide a layer of veneer over the substrate prior to application of finish veneer to prevent telegraphing of patterns of the adhesive.

C. Thickness: 3/4" thick.

D. Face Veneers: _____ (Species), _____slice, (Plain, quartered, rift, half-round, or rotary), _____figure. (No figure, fiddleback, mottle, ropey, ribbon stripe, pomelle, birds-eye, etc.)

E. Matching between adjacent veneer leaves: _____(Book match, slip match, and architectural end match, or continuous end match).

F. Matching within individual panel faces: _____(Sequence matched or blueprint matched panels and components).

G. Veneer Flitch Selection: Flitch number(s) _____ have been _____(pre-purchased or pre-selected) by _____, and is to be utilized where indicated on drawings. The flitches contains _____square feet, and is available at _____(veneer vendor) for inspection and pricing. The woodwork sub-contractor is responsible for any additional veneer required. Any additional veneer is subject to Architects selection and approval.

H. Finish: Veneers shall be finely sanded and clear factory pre-finished using AWI System noted herein.

I. Panel Sizes: See drawings for panel sizes required.

J. Exposed edges of panels shall be solid sections matching face veneer.

K. Where wood doors are set in veneered wood paneling, veneer on door shall be sequenced to fit veneer pattern; doors to meet the requirements of Section 081416.

2.13 FABRICATION - GENERAL

A. Provide lumber framing for architectural woodwork, complete with all bracing and fastening devices as required for a rigid installation, and as required to sustain the imposed loads.

B. Do all fabrication from field measurement with provision for scribing as required to meet built-in conditions.

C. Coordinate the work of this Section with the work of other trades.

D. Fabricate units in largest practicable sections. Assemble in the shop for trial fit, disassemble for shipment and reassemble with concealed fasteners.

E. Maintain relative humidity and temperature during fabrication, storage and finishing operations matching that of the areas of installation.

F. Details indicate the required type and quality of construction. Modifications to conform to manufacturer's standards will be considered providing they comply with the Contract Documents, maintain the profiles shown and subject to acceptance by the Architect.

G. Reinforcing shown is minimum. Provide additional reinforcing as required to ensure a rigid assembly. Exposed surfaces shall be free from dents, tool marks, warpage, buckle, glue and open joints, or other defects affecting serviceability or appearance. Accurately fit all joints, corners and miters. Conceal all fasteners. Make threaded connections up tight so that threads are entirely concealed.

H. Factory finish all items where possible. Defer final touch-up, cleaning and polishing until after delivery and installation.

I. Comply with AWI, Premium Grade standards for sanding, filling countersunk fasteners, back priming and similar preparations for the finishing of architectural woodwork, as applicable to each unit of work.

J. Prepare all countersunk wood screw attachments for wood plugs. Wood plugs shall match surrounding species and grain direction; putty filling is not acceptable.

2.14 FABRICATION - SPECIFIC ITEMS

A. Casework

1. Include all preparations for mechanical, electrical, telephone and plumbing work required.

2. Provide cabinet hardware for casework as shown.

3. Provide dust panels in body webs and between drawer units.

4. Provide wood veneers for exposed surfaces as specified herein before.

5. Hollow core doors will not be permitted.

6. Provide matching veneers for edge treatments of case body members where transparent finishes are indicated or specified.

7. Provide drawers with slides as specified. Drawers shall not rest on web body frames.

8. Provide wood veneers for transparent finish, of matching and continuing grain, for drawer and door edges.

B. Paneling

1. General Paneling Requirements

a. Panel type shall be AWI, Premium Grade construction.

b. Panel joints shall be flush type unless otherwise shown.

c. Provide concealed wood blocking and framing, anchors, clips, splines, supporting and attaching devices.

d. Provide cut-outs to receive attachments, mechanical and electrical work as required.

2. Wood Veneer Paneling

a. Comply with AWI Section 8.

b. Provide veneers as specified and as shown, including all matching requirements. Run veneer in the direction shown.

3. Stile and Rail Paneling

a. Comply with AWI Section 8.

b. All exposed edges of panel cores shall be edge banded.

c. Grain direction shall be as shown.

C. Closet and Storage Shelving

1. Provide closet and storage shelving in accordance with AWI Section 600, Custom Grade, unless otherwise shown or specified.

2. Exposed edges shall have hardwood edge bands.

D. Standing and Running Trim: Provide standing and running trim of the sizes, profiles, species and finish as specified or shown and complying with AWI Section 6, Premium Grade.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where architectural woodwork is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 FRAMING

A. Use specified framing lumber, sizes and spacing as indicated on drawings and as required to support loads.

B. Framing shall be cut square on bearings, closely fitted, accurately set to required lines and levels, rigidly secured in place at bearings and connection with nails, lag screws and/or bolts as required by conditions.

3.3 GROUNDS, BLOCKING, NAILERS AND FURRING

A. Provide all wood grounds, blocking, nailers, furring, and the like for work of this Section, where shown and where required, dressed to size indicated or required to suit the condition. Install grounds, blocking, nailers, furring, etc., rigidly, in proper alignment, trued with a long straight edge.

3.4 ROUGH HARDWARE

A. Provide all rough hardware, such as nails, screws, bolts, anchors, hangers, clips and similar items. Hardware shall be of the proper size and kind to adequately secure the work together and in place, in a rigid and substantial manner. Use galvanized hardware at exterior walls, and at other locations where subject to moisture or where water will be present.

B. Secure wood to concrete and to solid masonry with countersunk bolts in expansion sleeves or other approved manner, to steel with countersunk bolts, to hollow masonry and to drywall with heavy duty countersunk toggle bolts. Space fastenings not more than sixteen (16) inches apart. Hardened cut nails, power-driven fastenings, or other suitable devices may be used where approved by the Architect.

C. Connections and fastenings shall be made in such manner as will compensate for swelling and shrinkage and shall permit the work to remain permanently in place without any splitting or opening of joints.

3.5 INSTALLATION OF CABINET FINISH HARDWARE

A. All items of finish hardware furnished under this Section shall be carefully fitted and secured in place as part of the work of this Section. Locations and positioning of hardware shall be subject to the Architect's approval. Care shall be taken not to mar or damage hardware, or other work. Install doors plumb and true. Hardware shall be fitted to assure operation without forcing.

B. After preliminary fitting of hardware, the Contractor shall remove trim for painting and finishing work; after which he shall reinstall the hardware in a permanent manner.

C. Upon completion of the work, before final acceptance of the building by the Owner, the Contractor shall, in the presence of the Architect, show that all hardware is in satisfactory working order; fit all keys in their respective locks and, upon acceptance of the work, shall tag and deliver all keys to the Architect and Owner.

D. When directed by the Owner, at any time during the first year after the completion of the Contract, the Contractor shall return to the building and adjust and refit the work and hardware, and leave such items in satisfactory working order.

3.6 GENERAL INSTALLATION

A. Wall anchorage and general installation procedures for cabinetry work shall conform to AWI Section 10, Article entitled "EXECUTION", Sub-Article 6.1 with all related sub-paragraphs.

B. Install the work plumb, level, true and straight with no distortions. Shim as required using concealed shims. Install to a tolerance of 1/8" in 8'-0" for plumb and level (including countertops), and with 1/16" maximum offset in flush adjoining surfaces, 1/8" maximum offset in revealed adjoining surfaces.

C. Scribe and cut work to fit adjoining work, and refinish cut surfaces or repair damaged finish at cuts.

D. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for a complete installation.

3.7 TRIM, MOLDINGS, ETC.

A. Install with minimum number of joints possible, using full-length pieces for each run. Stagger joints in adjacent and related members. Cope at returns, miter corner.

B. Joints of all trim and/or moldings shall be set tight, miter exterior angles and cope interior angles. Joints, except end joints less than twelve (12) feet apart, will not be permitted in straight runs of trim and/or moldings and rails.

C. Secure all trim and/or moldings with glue and blind nail with finishing nails. Set exposed nail heads in finished work and putty. Sand all work to remove any tool marks and irregularities.

D. Wood shall receive finish as specified in Section 099000 - Painting.

3.8 WOOD RAILS

A. Wood shall be planed straight, square and level, then sanded smooth with flush finished surfaces. Joints shall occur over supports. Right angle joints shall be mitered.

B. All exposed fastening devices shall be countersunk and set below finished wood surfaces, and fitted with matching wood plugs; sand plugs and finish smooth and flush with exposed surfaces.

C. Handrails shall be capable of withstanding a force of two hundred (200) lbs. applied to rail at any point from any direction.

D. Provide all hardware and metal supports required for complete installation as detailed on drawings.

3.9 VENEERED WOOD PANELS

A. Provide a system of concealed panel hanger clips, shims and corresponding wall clips to support the panel system. Face nailing shall not be permitted.

B. Hang the panels in the designated locations. Panels shall be straight, level, flat and flush with adjoining panels.

C. Where reveals are indicated, keep panels spaced so that reveals are parallel and of widths shown.

3.10 CLOSET AND STORAGE SHELVING

A. Provide closet and storage shelving at the locations shown. Provide hang rods where shown. Set adjustable center hangers.

3.11 CABINET WORK AND MILLWORK

A. General

1. Materials and workmanship shall conform to the Quality Standards of the Architectural Woodwork Institute specified herein and to the drawings.

2. Cabinet work and millwork shall be performed by experienced cabinet work and millwork company, having craftsmen skilled in their trade.

3. Fabricate all cabinet work and millwork completely in the shop, in complete and/or as large units as practical, leaving only fitting, assembly, installation and a minimum of fabrication and finishing to be done at the building. Assembled work shall be rigidly secured and permanently fastened together with concealed fasteners.

4. Afford Architect every facility for inspection of work at shop or mill at such times as the Architect may select.

5. As far as practicable, use concealed fastenings for joining and assembling the work. Where this is impossible, the means of securing shall be placed in inconspicuous places and methods of joining and assembling submitted for Architect's approval prior to fabrication.

6. Mill all finish wood accurately to detail, with clean cut moldings, profiles and lines, machined, sanded smooth, housed, jointed, blocked, put together in the best manner, with provision for swelling and shrinkage, and to assure the work remaining in place without warping, splitting or opening of joints.

7. Cut trim to dimensions and profiles shown, from solid stock.

8. Make all trim and the like in single lengths wherever possible; joints mitered, glued and splined. Continuous members shall have tight flush joints, doweled or splined and glued.

9. Make all joints hairline tight, fitted accurately and joined with hardwood splines or dowels, glued together, or by other method approved by Architect. Use screws, not nails, for fastenings.

10. Gluing shall, where practicable, be by the hot plate press method and glued surfaces shall be in close contact throughout. Glue stains on finished work will not be permitted.

11. Cover surface fastenings, where permitted, with matching wood plugs or wood putty. Finish exposed edges of plywood with matching solid stock. Lock miter external corners; tongue and groove internal corners to allow for contraction and expansion.

12. Machine sand with grain, finish with hand sanding, leave exposed surfaces free from machine or tool marks that will show through the finish.

13. Work which adjoins drywall, concrete, or other finish shall be fitted and scribed in a careful manner and ample allowance shall be given for cutting and scribing.

14. Erect work true to lines, levels and dimensions, square, aligned and plumb, securely and rigidly fastened in place.

B. Cabinet Work: Provide all items of cabinet work indicated on drawings and as herein specified.

1. Tops, sides, backs, bottoms, dividers, shelves, fronts, doors and drawer fronts shall be of plywood or flakeboard core, with the specified wood veneer or plastic laminate as indicated on drawings.

2. Drawer sides and backs shall be 1/2" thick solid clear selected white birch, suitable for clear finish. Drawer bottom shall be 3/8" thick plywood with clear selected white birch veneers, suitable for clear finish.

3. Cabinet doors and drawers shall be flush mounted.

4. Adjustable shelves in cabinets shall have grommets spaced 2" o.c.

5. Fixed shelves shall be dadoed into side supports and glued.

6. Shelves shall be 3/4" thick for spans up to 30"; for spans in excess of 30" to 48" shelves shall be 1" thick.

7. All cabinets shall have closed top, sides, bottom, and back with veneers to match face work. Cabinets to fit accurately into indicated locations; scribe moldings permitted only where indicated.

8. Countertops, counters, counter fronts, shelves, etc., indicated on drawings to have plastic laminate, shall have plastic laminate shop applied to 3/4" thick core, with plastic laminate backing sheet on underside or back of countertops, counters and shelves. Plastic laminate shall be pressure laminated to core with laminate at external corners. Provide concealed wood framing to support plastic laminate counters, securely fastened to wall and to underside of counters.

C. Countertops shall be installed to support a minimum concentrated live load of 150 lbs. acting downward at mid span at outer edge of counter without causing deformation and damage.

3.12 WOOD BASES

A. Provide plywood backing, toggle bolted to substrate, if substrate not suitable for securing wood base.

B. Machine wood bases from specified wood, to profiles indicated on drawings.

C. Set base level and plumb. Where indicated on drawings, face of wood base shall be flush with wall above. Glue wood base to substrate or to plywood backing, and screw or nail wood base to substrate or to plywood backing with countersunk wood screws or with finishing nails, recess wood screw heads, and spackle with wood putty, set and spackle nails with wood putty. Do not nail or fasten wood base to floor. Ends of wood base shall be either splined or ship lapped.

D. Where no wood backing occurs, screw apply base at each stud with screw countersunk and wood putty applied and sanded smooth and flush with base.

3.13 WOOD DOOR FRAMES

A. Where indicated on drawings, provide wood frames and bucks for wood doors. Bucks shall be braced, set straight and plumb and have anchors for building into adjoining construction; space anchors not over two (2) feet apart (one foot from corners). Machine wood frames from specified solid wood to profiles indicated on drawings. Set frames plumb, level, square; securely attached to adjoining construction. Wood frames, bucks and trim shall conform to details.

3.14 PAINTING AND FINISHING

A. General: All painting and finishing work of this Section shall be shop applied, unless otherwise noted, as specified below. All painting and finishing shall match approved samples. Field finish painting, where specified below, shall be by painting Subcontractor, as specified for in Painting Section.

B. Schedule of Painting and Finishing

1. Shop Primer On:

a. Wood bases.

b. Wood trim and moldings to be field finish painted.

c. Ferrous metal work.

2. Shop Natural Finish On:

a. Wood paneling.

b. Wood cabinets with wood veneers.

C. Back-Painting: All work of this Section in contact with concrete or masonry or other moisture areas and all concealed surfaces of cabinet and millwork, shall be back-painted with one (1) coat of oil based paint prior to installation, shop applied where practicable.

D. Field Touch-Up: Field touch-up shall be the responsibility of the installing Subcontractor, and shall include the filling and touch-up of exposed job made nail or screw holes, refinishing of raw surfaces resulting from job fitting, repair of job inflicted scratches and mars, and final cleaning up of the finished surfaces.

3.15 CLEAN UP AND PROTECTION

A. Clean Up: At regular intervals during the course of the work, all debris and excess material shall be cleaned up and removed from the site. Upon completion of installation, clean all spaces of debris caused by woodwork installation.

B. Protection: Protect all woodwork from marring, defacement of other damage until final completion and acceptance of the project by the Owner. Repair or replace all defective units prior to final inspection as directed by the Architect. Any units that cannot be satisfactorily repaired in the opinion of the Architect shall be replaced with new units of same original design, at no additional cost to the Owner.

END OF SECTION

SECTION 071900

WATER REPELLENT COATING

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. The Work of this Section includes all labor, materials, equipment and services necessary to complete the water repellent coating as shown on the drawings and/or specified herein, including but is not necessarily limited to the following:

1. Water repellent coating applied to masonry walls.

1.3 RELATED SECTIONS

A. Masonry - Section 042000.

1.4 QUALITY ASSURANCE

A. Installer: A firm with not less than three (3) years of successful experience in application of water repellents of types required on substrates similar to those of this project.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's specifications, installation instructions and general recommendations for water repellents. Include data substantiating that materials are recommended by manufacturer for applications indicated and comply with requirements.

B. Samples: Submit sixteen (16) inch square samples of each substrate indicated to receive liquid water repellent, with repellent treatment as specified applied to half of each sample.

1.6 JOB CONDITIONS

A. Water and Substrate Conditions: Do not proceed with application of water repellent (except with written recommendation of manufacturer, when ambient temperature is less than fifty (50) degrees F., or when substrate surfaces have cured for less than a period of two (2) months, or when rain or temperatures below forty (40) degrees F. are predicted for a period of twenty-four (24) hours, or earlier than three (3) days after surfaces became wet from rainfall or other moisture sources, or when substrate is frozen, or at surface temperatures of less than forty (40) degrees F.

1.7 PRODUCT HANDLING

A. Protection: Use all means necessary to protect the materials of this Section, before, during and after installation and to protect the installed work and materials of all other trades.

B. Replacements: In the event of damage, immediately make all repairs and replacements necessary.

1.8 WARRANTY

A. Provide written warranty from the product manufacturer stating that materials and workmanship shall be free of defects (no water penetration due to failure of coating) for a period of ten (10) years from date of acceptance of the Project, and the manufacturer shall remedy any defects in the work that occur within this time limit.

PART 2 PRODUCTS

2.1 MATERIALS

A. Provide one of the following products and include manufacturer's certification to effect that product complies with or exceeds required warranty requirements specified above:

1. Clear Double 7; Hydrozo Coatings Co.

2. Chem-Trete BSM; Huls America.

3. Prime-A-Pell 200; Chemprobe Corp.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where water repellent coating is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 PREPARATION

A. Test Application: Prior to performance of water repellent work, including bulk purchase/delivery of products, prepare a sample application in an unobtrusive location and in a manner acceptable to Architect, for purpose of demonstrating final effect (visual and physical/chemical) of planned installation. Proceed with work only after Architect's acceptance of test application.

B. Clean substrate of substances which might interfere with penetration/adhesion of water repellents. Test for moisture content, to ensure that surface is sufficiently dry.

C. Coordination with Sealants: Delay application of water repellents until installation of sealants has been completed in joints adjoining surfaces to be coated with repellent.

D. Protect adjoining work from spillage or blow over of water repellent. Cover adjoining and nearby surfaces of aluminum and glass where there is possibility of water repellent being deposited on surfaces. Cover live plant materials with drop cloths. Clean water repellent from adjoining surfaces immediately after spillage. Comply with manufacturer's recommendations for cleaning.

3.3 INSTALLATION

A. Apply a heavy saturation spray coating of water repellent on surfaces indicated for treatment using low pressure spray equipment. Comply with manufacturer's instructions and recommendations, using airless spraying procedure unless otherwise indicated.

B. Apply a second saturation spray coating, repeating first application if required by manufacturer to meet warranty requirements. Comply with manufacturer's instructions for limitations on drying time between coats and after rainstorm wetting of surfaces between coats.

END OF SECTION

SECTION 072100

THERMAL INSULATION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. The Work of this Section includes all labor, materials, equipment, and services necessary to complete the thermal insulation as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Cavity wall insulation within masonry cavity.
2. Blanket insulation.
3. Attachment devices.

1.3 RELATED SECTIONS

A. Masonry - Section 042000.

B. Roof insulation - Section 075423

C. Firestops and smokeseals - Section 078413.

D. Curtain wall insulation - Section 084413.

E. Acoustical insulation - Section 092900.

1.4 SUBMITTALS

A. Submit product data for each type of product indicated, including re-cycled content.

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for insulation products.

1.5 QUALITY ASSURANCE

A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

B. Vertical and Lateral Fire Propagation Test Characteristics: The exterior wall assembly is required to comply with NFPA 285 "Standard Method of Test for the Evaluation of Flammability Characteristics of Exterior Nonload-bearing Wall Assemblies Containing Combustible Components." The base wall, stud cavity insulation, wall sheathing, air barrier, continuous wall rigid insulation and exterior cladding are components that are

required to be to be evaluated as part of this specific assembly test. The basis of design product listed below is a component of the design test assembly selected by the Architect.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect foam-plastic board insulation as follows:

1. Do not expose to sunlight except to necessary extent for period of installation and concealment.

2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site before installation time.

3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 PRODUCTS

2.1 CAVITY WALL INSULATION WITHIN MASONRY CAVITY

A. Provide extruded polystyrene board insulation equal to Styrofoam "Commercial Styrofoam XPS St-100 Series" manufactured by Dupont, HFC compliant or approved equal conforming to ASTM C 578, Type IV with a maximum flame spread and smoke developed indices of 15 and 165 respectively.

1. Boards shall be 16" wide x 96" long; boards shall be 1" thick unless otherwise noted on the drawings.

2. Insulation shall have an aged R value of not less than 5.6/inch.

2.2 GLASS-FIBER BLANKET INSULATION

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CertainTeed Corporation.

2. Guardian Building Products, Inc.

3. Johns Manville.

4. Knauf Insulation.

5. Owens Corning.

6. Mason Insulation Products

B. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 30 percent.

C. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

1. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

D. Reinforced-Foil-Faced, Glass-Fiber Blanket Insulation: ASTM C 665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim Kraft, or foil-scrim polyethylene.

1. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

E. Sustainability Requirements: Provide glass-fiber blanket insulation as follows:

1. Free of Formaldehyde: Insulation manufactured with 100 percent acrylic binders and no formaldehyde.

2. Low Emitting: Insulation tested according to ASTM D 5116 and shown to emit less than 0.05-ppm formaldehyde.

2.3 ACCESSORIES

A. Adhesive for Bonding Insulation: The type recommended by the insulation manufacturer, and complying with fire-resistance requirements.

1. For bonding rigid polystyrene insulation to masonry or concrete, provide adhesive equal to "Foamgrab PS" made by Dacor Products Co. or equal made by ChemRex Inc. or Miracle Adhesives.

B. Protection Board: Premolded, semi-rigid asphalt/fiber composition board, 1/4" thick, formed under heat and pressure, standard sizes.

2.4 INSULATION FASTENERS

A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position indicated with self-locking washer in place.

1. Products: Subject to compliance with requirements, provide one of the following:

a. AGM Industries, Inc.; Series T TACTOO Insul-Hangers.
b. Gemco; Spindle Type.

2. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.

3. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch in diameter; length to suit depth of insulation indicated.

4. Affix plate with stainless steel staple or screw.

B. Insulation Fastening System at CMU and Concrete: Provide Ramset Insulfast system or approved mechanically fastening system.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where thermal insulation is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION, GENERAL

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

B. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.

C. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

D. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

E. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.3 INSTALLATION OF CAVITY-WALL INSULATION

A. Install pads of adhesive spaced approximately 24 inches o.c. both ways on inside face, and as recommended by manufacturer. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates.

1. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 042000 "Unit Masonry."

3.4 INSTALLATION OF BLANKET INSULATION FOR FRAMED CONSTRUCTION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Glass-Fiber Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.

2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.

3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.

4. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

5. Vapor-Retarder-Faced Blankets: Tape joints and ruptures in vapor-retarder facings, and seal each continuous area of insulation to ensure airtight installation.

a. Exterior Walls: Set units with facing placed toward interior of construction as indicated on Drawings.

3.5 PROTECTION

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

END OF SECTION

SECTION 072700

VAPOR PERMEABLE AIR BARRIER LIQUID MEMBRANE

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. The Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. The Work of this Section includes all labor, materials, equipment, and services necessary to complete the vapor permeable air barrier liquid membrane as shown on the drawings and/or specified herein, including, but not necessarily limited to, the following:

1. Vapor permeable/air barrier applied over sheathing board and cold formed metal framing and CMU.

2. Materials and installation to bridge and seal the following air leakage pathways and gaps:

a. Connections of the walls to the roof.
b. Connections of the walls to the foundations.
c. Seismic and expansion joints.
d. Openings and penetrations of window frames, storefront, curtain wall.
e. Door frames.
f. Piping, conduit, duct and similar penetrations.
g. Masonry ties, screws, bolts and similar penetrations.
h. All other air leakage pathways in the building envelope.

1.3 RELATED SECTIONS

A. Unit masonry – Section 042000.

B. Cold formed metal framing, including sheathing - Section 054000.

1.4 SUBMITTALS

A. Provide evidence to the Architect of licensing and certification under the Air Barrier Association of America's (ABAA's) Quality Assurance Program

B. Submit shop drawings showing locations and extent of air barrier and details of all typical conditions, intersections with other envelope systems and materials, membrane counter-flashings, and details showing how gaps in the construction will be bridged, how inside and outside corners are negotiated and how miscellaneous penetrations such as conduits, pipes electric boxes and the like are sealed.

C. Submit manufacturer's product data sheets for each type of membrane, including manufacturer's printed instructions for evaluating, preparing, and treating substrate,

temperature and other limitations of installation conditions, technical data, and tested physical and performance properties.

D. Submit manufacturer's data showing solids content of fluid applied membranes and coverage rates and wet film thickness upon application in order to achieve minimum dry film thickness required by this specification.

E. Submit manufacturer's installation instructions.

F. Submit certification by air barrier manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs).

G. Submit certification of compatibility by air barrier manufacturer, listing all materials on the project that it connects to or that come in contact with it, including sealant as specified in Section 054000 for caulking joints between sheathing panels.

H. Submit samples, 3 by 4 inch minimum size, of each air barrier material required for Project.

I. Test results of air permeability testing of primary air barrier material (ASTM E 2178-01)

J. Test results of assembly in accordance with ASTM E 2357.

K. Proof that the air barrier is part of an NFPA 285 approved wall assembly

1.5 PERFORMANCE REQUIREMENTS

A. Provide air barrier constructed to perform as a continuous air barrier, and as a liquid water drainage plane flashed to discharge to the exterior any incidental condensation or water penetration. Membrane shall accommodate movements of building materials by providing expansion and control joints as required, with accessory air seal materials at such locations, changes in substrate and perimeter conditions.

B. Provide an air barrier assembly that has been tested in accordance with the Air Barrier Association of America's (ABAA's) approved testing protocol to provide air leakage results not to exceed:

1. 0.004 cfm/sf @ 1.57 psf as per ASTM E2178

C. NFPA 285 Compliance

1.6 QUALITY ASSURANCE

A. Installer Qualifications:

1. The air barrier contractor shall be, during the bidding period as well as for the duration of the installation, officially recognized as a Licensed Contractor by the Air Barrier Association of America (ABAA). The contractor shall carry liability insurance and bonding.

2. Each worker who is installing air barriers must be either a Certified Applicator or an installer who is registered with ABAA.

3. Each Lead Certified Applicator can supervise a maximum of five registered installers. The Certified Applicator shall be thoroughly trained and experienced in

the installation of air barriers of the types being applied. Lead Certified Applicators shall perform or directly supervise all air barrier work on the project.

B. Single-Source Responsibility: Obtain air barrier materials from a single manufacturer regularly engaged in manufacturing the product.

C. Provide products which comply with all state and local regulations controlling use of volatile organic compounds (VOCs).

D. Field-Constructed Mock-Ups: Prior to installation of air barrier, apply air barrier as follows to verify details under shop drawing submittals and to demonstrate tie-ins with adjoining construction, and other termination conditions, as well as qualities of materials and execution:

1. Construct typical exterior wall panel, 8 feet long by 8 feet wide (one of CMU and one of sheathed areas, incorporating back-up wall, cladding, window and doorframe and sill, insulation, flashing, building corner condition, and typical penetrations and gaps; illustrating materials interface and seals.

E. Test mock-up in accordance with ASTM E 783 and ASTM E1105 for air and water infiltration.

F. Manufacturer shall be on-site at least once a week to observe installation and provide written report within 3 days.

G. Manufacturer shall confirm all termination details and compatibility with materials being terminated to.

H. Provide fire blocking as required by New York City Building within exterior assembly.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original packages with seals unbroken, labeled with manufacturer's name, product, date of manufacture, and directions for storage.

B. Store materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by air barrier manufacturer. Protect stored materials from direct sunlight.

C. Avoid spillage. Immediately notify Owner, Architect if spillage occurs and start clean up procedures.

D. Clean spills and leave area as it was prior to spill.

1.8 WARRANTY

A. System Warranty: Provide the manufacturer’s five (5) year material warranty, including the primary air barrier and installed accessory sealant and membrane materials..

PART 2 PRODUCTS

2.1 MATERIALS

A. Fluid-Applied Membrane: Henry Air-Bloc 17MR Vapor Permeable Fluid-Applied Membrane or W.R. Grace Perm-A-Barrier VP or approved equal. Trade names used herein are those of the Henry Company

B. Transition Membrane: Blueskin SA or Blueskin VP 160

C. Window and Door Opening Flashing: Metal Clad

D. Liquid Applied Flashing: Henry Air-Bloc LF

E. Thru-Wall Flashing: Blueskin TWF

F. Primer: Blueskin LVC Adhesive.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where the above grade waterproof membrane is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected to permit proper installation of the work.

3.2 SURFACE PREPARATION

A. All surfaces must be sound, dry, clean and free of oil, grease, dirt, excess mortar or other contaminants.

B. Cracks in masonry and concrete up to 1/2" wide shall be filled with a trowel application of Liquid Applied Flashing or Sealant and allowed to skin over prior to application of the fluid-applied membrane to the surface. Alternatively, the cracks may be sealed with a strip of Transition Membrane applied to the substrate.

C. Joints in Sheathing up to 1/2” can be treated with Liquid Applied Flashing or Sealant.

D. Surfaces should be tied in with beams, columns, etc. using strips of Transition Membrane lapped a minimum of 3" on both substrates. Mechanical attachment should be made to all window and door frames, or a properly designed sealant joint provided.

3.3 TRANSITION MEMBRANE

A. Align and position self-adhering transition membrane, remove protective film and roll firmly into place with heavy roller. Ensure minimum 2" overlap at all ends and side laps.

B. Tie-in to window frames, metal door frames, etc., and at the interface of dissimilar materials as indicated on the Drawings.

C. Promptly roll all laps and membrane with a counter top roller to effect seal.

D. Ensure all preparatory work is complete prior to applying Liquid Applied Membrane

3.4 THRU-WALL FLASHING MEMBRANE

A. Ensure all preparatory work is complete prior to applying Thru-Wall Flashing.

B. Align and position the leading edge of Thru-Wall Flashing with the front horizontal edge of the foundation walls or shelf angles, partially remove protective film and roll membrane over surface and up vertically.

C. Roll firmly into place. Ensure minimum 2” overlap at all end and side laps.

D. Ensure through-wall flashing membrane extends fully to the exterior face of the exterior masonry veneer. Trim off excess as directed by the consultant.

E. Apply through-wall flashing membrane along the base of masonry veneer walls, over windows, doors and all other wall openings. Membrane shall form continuous flashing and shall extend up a minimum of 4-1/2" up the back-up wall.

F. When flashing at window openings, wrap the entire window opening with air barrier flashing membrane.

3.5 FLUID-APPLIED MEMBRANE APPLICATION

A. Apply fluid-applied membrane to wall substrates in a continuous coat at manufacturer’s recommended rate by spray or trowel to provide a minimum wet film thickness of 0.090" (90 mils) for rough surfaces like CMU and 0.070” (70 mils) for smooth sheathing.

1. Minimum dry film thickness shall be 0.048” (48 mils) on CMU and 0.037" (37 mils) on smooth sheathing.

B. Overlap liquid membrane on to transition membrane at connections a minimum of 1".

C. Apply fluid-applied membrane around masonry ties to ensure a complete seal.

D. Do not leave membrane exposed for any longer than 180 days.

E. Penetrations: Seal all penetrations with Liquid Applied Flashing or Sealant or other procedures in accordance with manufacturer’s instructions.

3.6 PROTECTING AND CLEANING

A. Protect air barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

C. Protect air barrier from exposure to the elements as required by the manufacturer.

D. Remove any masking materials after installation. Clean any stains on materials that would be exposed in the completed work using procedures as recommended by manufacturer.

1. Schedule work to ensure that the air and vapor barrier system is covered as soon as possible after installation. Protect air and vapor barrier system from damage during subsequent operations. If the air and vapor barrier system cannot be permanently covered within 180 days after installation, apply temporary UV protection.

3.7 FIELD QUALITY CONTROL

A. Air Barrier Association of America Installer Audits: Cooperate with ABAA's testing agency. Allow access to work areas and staging. Notify ABAA in writing of schedule for Work of this Section to allow sufficient time for testing and inspection. Do not cover Work of this Section until testing and inspection is accepted. Arrange and pay for site inspections by ABAA to verify conformance with the material Manufacturer's instructions, the site Quality Assurance Program used by ABAA, and this section of the project specification.

1. Audits and subsequent testing shall be carried out at the following rate:

a. Up to 10,000 ft^2 of air barrier contract requires one (1) audit.
b. 10,001 – 35,000 ft^2 of air barrier contract requires two (2) audits.
c. 35,001 – 75,000 ft^2 of air barrier contract requires three (3) audits.
d. 75,001 - 125,000 ft^2 of air barrier contract requires four (4) audits.
e. 125,001 – 200,000 ft^2 of air barrier contract requires five (5) audits.
f. 200,001 ft^2 and over of air barrier contract requires six (6) audits.

2. Forward written audit reports to the Architect within 10 working days of the inspection and test being performed.

3. If the inspections reveal any defects, promptly remove and replace defective work at no additional cost to the Owner.

B. Air barriers will be considered defective if they do not pass tests and inspections.

1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.

2. Remove and replace deficient air-barrier components for retesting as specified above.

C. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

END OF SECTION

SECTION 075423

THERMOPLASTIC-POLYOLEFIN (TPO) ROOFING

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. The Work of this Section includes all labor, materials, equipment, and services necessary to complete the thermoplastic membrane roofing as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Single-ply TPO sheet membrane roofing, fully adhered installation.
2. Roof insulation and cover board.
3. Walkway pads.

1.3 RELATED SECTIONS

A. Wood blocking - Section 062000.

B. Sheet Metal Flashing - Section 076200.

C. Roof Specialties and Accessories - Section 077100.

D. Drains and vents - Division 22.

1.4 DESCRIPTION OF THE SYSTEM

A. The membrane roofing system specified herein shall consist of factory fabricated large sections of sheet membrane fully adhered over the rigid roof insulation. Provide flashing at roof penetrations and vertical surfaces.

1.5 QUALITY ASSURANCE

A. Qualifications

1. The membrane roofing system specified herein shall be the product of a manufacturer who can furnish supporting evidence of experience in the manufacture of the membrane roofing system and of having been regularly engaged in this business for not less than 5 years. Such experience shall be in projects similar to the requirements for this project.

2. The details and specifications are based on a particular manufacturer. It is not the intention of this specification to restrict competition; if a manufacturer other than the one specified is selected, it shall be his obligation and responsibility to modify and adjust his materials to suit the encountered conditions and to consult and coordinate his work with other trade Contractors to assure that the installation will be watertight and function for use intended and that the guarantee will be issued to the Owner.

B. Installer: A firm with not less than 5 years of successful experience in installation of roofing systems similar to those required for this project and which is acceptable to or licensed by the manufacturer of the primary roofing materials.

C. UL Listing: Provide system which has been tested and listed by UL for application indicated and which has a "Class A" rating.

D. Membrane roofing system shall be ENERGY STAR® compliant (highly reflective) and high emissivity roofing (emissivity of at least 0.9 when tested in accordance with ASTM E 408).

E. High Albedo Roofing Materials: Roofing shall have a Solar Reflectance index (SRI) of 79 or above.

1.6 SUBMITTALS

A. Product Data: Submit manufacturer's product information, including published specifications, which completely describe the preparation of surfaces and application of roofing systems.

B. Shop Drawings: Submit complete shop drawings showing details, dimensions, fabrication and fastening elements for each condition encountered, layout of each sheet noting seam locations, perimeter and penetration flashing and other details where roofing abuts other materials and/or conditions.

C. Samples: Submit the following for review:

1. Membrane w/splice, 6" x 6".

2. Rigid insulation, 6" x 6".

3. Flashing materials, 6" x 6".

4. Notarized Certificates of Compliance.

5. Submit a letter from membrane manufacturer issuing sample guarantee and approving the applicator, prior to pre-application conference.

D. Submit copies of pre-roofing conference records.

E. Submit a letter signed by the manufacturer and Contractor acknowledging that the submitted roofing system complies with ASCE-7 and FM 1-165, for wind speed code requirements based on height and geographic location of project.

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the site ready for use in the manufacturer's original and unopened containers and packaging, bearing labels as to type, and brand. Delivered materials shall match approved samples. Fire classification labels shall be intact and visible.

B. Store materials under cover in a dry and clean location, off the ground and remove materials which are damaged, torn or otherwise not suitable for installation and replace with acceptable materials.

C. Keep insulation and membrane dry, before and during installation. Remove wet materials from project site.

D. Store roofing materials on platforms or pallets, above ground on roof level and cover with tarpaulins or on other suitable watertight covering. Store membrane, and handle, in such a way as to prevent damage to edges or ends.

1.8 PREROOFING CONFERENCE

A. Prior to ordering of materials, a preroofing conference will be held to discuss the specified roofing system, and its proper application. Conference shall include installer, roofing manufacturer, installers of related work, Architect and representatives of Owner. Record discussions and agreements and furnish copy to each participant. Provide at least 72 hours' advance notice to participants prior to convening conference.

B. Coordinate application of the roofing system in such a manner that the complete installation is weather-tight and in accordance with guarantee requirements.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Work shall not be installed when the roof deck is damp, wet or spotted with frost or if the ambient temperature is 35 deg. F. and falling or if there is a forecast for inclement weather which will be adverse to the proper installation of the roofing system.

1.10 WARRANTY

A. Provide warranty for the roofing work as specified in this section. Warrantee shall state that installed work shall be free from defects of materials and workmanship for manufacturer’s 20 years from date of Substantial Completion.

B. Warranty shall be in a form acceptable to the Architect and shall be duly executed by officers or principals of the manufacturer.

C. Contractor shall inform the Architect if conditions exist which will interfere with issuance of the specified warranty. Start of work shall imply that the warranty as specified above will be issued.

D. In addition to manufacturer's warranty, provide roofing Installers warranty for a period of 2 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 TPO SHEET ROOFING MEMBRANE

A. Fabric-Reinforced TPO Sheet: ASTM D 6878, internally fabric- or scrim-reinforced, uniform, flexible TPO sheet.

1. Thickness: 80 mils.

2. Exposed Face Color: White.

3. Basis of Design: Provide "Sure-Weld" as manufactured by Carlisle or an approved equal acceptable to the Architect.

2.2 ACCESSORY MATERIALS

A. Membrane Flashing: Manufacturer's standard unreinforced thermoplastic polyolefin sheet flashing, 60 mils thick minimum, of same color as membrane.

B. Bonding Adhesives, Mastics and Splicing Cement: Compatible with the materials with which they will come in contact; solvent based.

C. Lap Sealant: For sealing the exposed edge of the splices and as otherwise required shall be of a consistency recommended by the manufacturer.

D. Prefabricated Pipe Seal Assemblies: Provide assemblies to accommodate vents, pipe penetrations and other similar roof penetrations.

E. Sealers: Provide sealers and other similar accessory materials as recommended by the manufacturer.

F. Materials: The materials provided shall be part of a roofing system developed by the approved manufacturer and shall in every respect be compatible with each other and with the substrates and conditions encountered in the field.

G. Cant Strips, Tapered Edge Strips, and Flashing Accessories: Types recommended by membrane manufacturer, including adhesive tapes, flashing cements, and sealants.

H. Membrane Adhesive: As recommended by membrane manufacturer for particular substrate and project conditions, formulated to withstand ASCE 7-98 and 1-90 wind uplift force requirements of the geographic area of the building.

1. Provide adhesives that comply with local requirements limiting amounts of volatile organic compounds.

I. Roof Insulation: Minimum 2" boards, flat and tapered (1/4" per foot) polyisocyanurate board roof insulation conforming to ASTM C 1289 faced with proper facing to allow membrane to be adhered to it without delamination. Roof insulation must have an LTTR R-Value of 6.0/inch at 75 deg. F. when tested in accordance with ASTM C 1303. Provide thickness required by Code.

1. Manufacturer of roofing system must pre-approve use of insulation in writing.

2. Surface Burning Characteristics: Maximum flame spread of 25.

J. Cover Board: ASTM C 1177, glass-mat, water-resistant gypsum substrate, 1/4" thick; provide "Dens-Deck" by Georgia-Pacific Corporation, or equal.

K. Walkway Pads: Factory-formed, non-porous, heavy-duty, solid rubber, slip resisting, surface textured walkway pads approximately 3/16" thick and acceptable to roofing system manufacturer.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where roofing is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. Nailers

1. Continuous pressure treated nailers shall be firmly anchored to resist a force of 75 pounds per lineal foot in any direction. The thickness of the nailer shall be such that the top of the nailer is flush with the surface to which the membrane is attached at the horizontal plane.

2. Nailers shall be installed continuous at perimeters and around all roof penetrations unless otherwise noted.

B. Insulation

1. Clean the deck prior to installing the insulation. Mechanically attach insulation to deck using FM approved fasteners in pattern to meet FM 1-165 minimum and ASCE 7-98 wind uplift requirements, including greater requirements for corners

and perimeters as required. For tapered insulation, follow pattern of taper to insure correct pitch.

2. Moderately butt end joints over flutes, stagger joints in adjacent boards. Do not install more insulation in any one day than can be covered by the membrane roof sheets.

3. Where two layers of insulation or cover boards are required, stagger joints 2 feet in length and width in both directions.

4. Neatly cut around all projections encountered and at abutting vertical surfaces. Where large gaps occur fill with a urethane foam pack.

C. Cover Board: Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6" in each direction. Loosely butt cover boards together and fasten to roof deck.

D. Sheet Membrane Application (Fully Adhered): Where required by manufacturer, install membrane by unrolling over prepared substrate, lapping adjoining sheets. Apply adhesive to surfaces to be bonded and roll into place when adhesive has properly cured. Treat seams with cleaner and prime finish with 4” seam tape and apply sealant to exposed sheet edges, tapering application as recommended by manufacturer. Install mechanical fasteners, flashings and counterflashings, and accessories at locations and as recommended by manufacturer.

E. Splicing

1. Fold the top sheet back about 12" and clean both mating surfaces at the splice area using clean rags with membrane manufacturer's recommended cleaner.

2. Apply the inseam tape primer with a synthetic scrub pad at a rate of 375 lineal feet of 5" splice per gallon. Allow tape primer to dry to the touch.

3. Roll the top sheet toward the splice area until the cemented area is nearly touching the cement on the bottom sheet along the entire length of the splice. Allow the top sheet to fall freely into place avoiding stretching and wrinkling. Roll the splice with a 2" wide steel roller, using positive pressure, toward the outer edge of the splice.

4. Solvent clean the splice edge, extending at least 1" onto the top and bottom membranes. Apply a bead of lap sealant completely covering the splice edge, feathering the lap sealant with a preformed putty knife or trowel.

5. Lap sealant application shall be completed on all splices by the end of each working day.

F. Membrane Flashing

1. Perimeter flashing and flashing around vents and other roof penetrations shall be preformed using the recommended flashing, compatible with the approved roofing system and utilizing the longest pieces practicable.

2. The splice between the flashing and the main roof sheet should be completed before bonding the flashing to the vertical surface. Seal this splice at least 3" beyond the fasteners which attach the membrane to the horizontal nailer.

3. Bonding adhesive shall be applied to both the flashing and the surface to which it is being bonded. After the adhesive has dried to the point where it does not string or stick to a dry finger touch, roll the flashing into the adhesive. Take care to assure that the flashing is not bridging where there is any change of direction of the flashing (e.g., where the parapet meets the roof deck).

4. Nail the flashing at the top every 12" on center maximum under metal counterflashing or cap. Metal counter is specified under Section 076200.

G. Pipe Flashing

1. Flashing for pipes, conduits and other similar items which are scheduled to penetrate (pass through) the membrane shall be provided with factory prefabricated elements when such use is possible. When prefabricated devices are not possible field fabricated seals shall be used.

2. Bases of the pipe seals shall be spliced to the membrane roofing sheet as specified above for sheet laps and the top portion shall be secured to the pipe with a stainless steel clamping ring and continuously sealed with sealant in a watertight manner.

3. Field fabricated pipe seals shall be fabricated with base and cap membrane flashing which shall be spliced to the membrane and to itself and continuously sealed with sealant in a watertight manner.

H. Drains: At drain locations, where the insulation is tapered to form a smooth transition from roof surface to membrane, the membrane sheet shall be accurately cut-out so as to fit the encountered clamping ring, and shall be secured to the ring with the addition of the approved mastic in a secure, neat and watertight manner.

I. Curbs, Corners

1. Field fabricated outside corners shall consist of approved membrane flashing which shall have not less than 6" horizontal legs which shall be spliced to the roof membrane and vertical legs as required which shall be nailed at 12" o.c. maximum. Corners shall be lapped a minimum of 3" and be secured by splicing to each flashing section

2. Field fabricated inside corners shall consist of approved membrane flashing with 6" horizontal legs which shall be spliced to the roof membrane, with vertical legs as required which shall be nailed at 12" o.c. maximum. Corners shall be lapped a minimum 6" and secured by splicing to each flashing section.

3. Install lap type sealant along all seams to insure a watertight installation.

J. Daily Seal: Care should be exercised to ensure that the water does not flow beneath any completed sections of roof. Temporarily seal loose edge of membrane with sealant when weather is threatening.

1. Mix the two components thoroughly according to the instructions on the label.

2. Apply the sealant at a rate of 100 lineal feet per gallon, (on smooth surface) 12" back from edge of sheet onto exposed substrate surface. If necessary, use a trowel to spread material in order to achieve complete seal.

3. After embedding membrane in sealant, check for continuous contact. Then weight the edge, providing continuous pressure over the length of the cutoff. The recommended weight for the continuous pressure is a 10-foot length of 2-1/2" tubing filled with dry sand.

4. When work is resumed, pull sheet free before continuing installation.

K. Walkway Installation: Install walkway products in locations indicated. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.3 CLEANING AND PROTECTION

A. From time to time during the progress of the work and at the completion of the work, remove all rubbish, debris, dirt, equipment and unused materials from the site. Clean adjoining surfaces which may have been soiled by roofing work.

B. Protect installed roofing from damage and abuse by other trades. Repair damages to watertight conditions at no additional cost to the Owner.

C. Exercise care to protect installed work. Work which does become damaged in any way or is not watertight, shall be repaired and/or replaced as directed to the satisfaction of Architect and/or Owner at no additional cost or time.

END OF SECTION

SECTION 076200

SHEET METAL FLASHING

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the sheet metal flashing as indicated on the drawings and/or specified herein, including, but not limited to, the following:

1. Aluminum cap flashing.

2. Aluminum flashing elsewhere, where metal flashing is indicated on drawings.

1.3 RELATED SECTIONS

A. Unit Masonry - Section 042000.

B. Roofing - Section 073113.

C. Roof specialties and accessories – Section 077100.

1.4 PERFORMANCE

A. All work shall comply with building code wind requirements

1.5 SUBMITTALS

A. Shop Drawings: Submit, showing all materials, finishes, fastenings, joint details, fabrication, construction and relation to adjoining construction.

B. Samples: Submit 12" x 12" samples of flashing materials and finishes.

1.6 WARRANTY

A. The Contractor shall warrant that all Metal Flashing Work executed under this Section will be free from defects in materials and workmanship for a period of ten (10) years from date of acceptance of the Project, and he shall remedy any defects in the Metal Flashing Work.

1.7 PRODUCT HANDLING

A. Protection: Use all means necessary to protect the materials of this Section before, during and after installation and to protect the installed work and materials of all other trades.

B. Replacements: In the event of damage, immediately make all repairs and replacements necessary at no additional cost to the Owner.

PART 2 PRODUCTS

2.1 MATERIALS

A. Aluminum Flashing: ASTM B 209, alloy 3003 H-14 with Kynar 500 (70%) painted, 0.040" thick.

1. Accessories and Fastenings: AISI, Types 316 stainless steel.

B. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded fro 15-mil dry film thickness per coat. Provide inert-type non-corrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where sheet metal work is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 METAL FLASHING INSTALLATION

A. Reference Standard: Conform to the requirements of 5th Edition of the Sheet Metal and Air Conditioning Contractors Association (SMACNA) Architectural Sheet Metal Manual.

B. General: Fabricate and install metal flashing work in accordance with details and specifications of above Reference Standard, with manufacturer's instructions, and as herein specified, to provide a watertight installation. Apply metal flashing to smooth, even, sound, clean, dry surfaces free from defects. Make provisions to allow for expansion and contraction of metal flashing work. Wherever practicable, shop form all metal flashing work and deliver ready for installation. Form metal flashing work accurately to required profiles, with flat surfaces, straight edges and corners, free from defects. Fold exposed metal edges back not less than 1/2" and form drip.

C. Nailing: Confine to sheets twelve (12) inches or less in width. Confine nailing to one edge only, locate nails where concealed. Use No. 12 x 1" long flat headed, annular threaded, Type 302 stainless steel nails for nailing to wood blocking; use one (1) inch long masonry nails for nailing to concrete. Space nails four (4) inches o.c. maximum.

D. Joining: Join metal flashings with one (1) inch locked and soldered seams except at slip joints. Mallet seams flat and solder full length of seam as specified below.

E. Slip Joints: Locate slip joints not more than twenty four (24) feet apart and not more than eight (8) feet from corners. Form slip joints as three (3) inch wide joints with cover piece behind flashing, and fill locked ends neatly with sealant.

F. Miscellaneous Flashing: Provide all other miscellaneous metal flashing not specifically mentioned herein, but indicated on drawings and/or required to provide a watertight installation.

G. Separation of Dissimilar Materials: Back paint surfaces of metal flashing in contact with dissimilar metals or with concrete or masonry with bituminous paint.

H. Through-Wall Flashings: Provide through-wall flashings as shown. Form bonding features so as not to puddle water on surface. Lap cross joints to interlock design pattern at least three (3) inches. Stop typical flashings in mortar joint 1/2" from exterior face of wall.

END OF SECTION

SECTION 077100

ROOF SPECIALTIES AND ACCESSORIES

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. The Work of this Section includes all labor, materials, equipment and services necessary to complete the roof specialties and accessories as shown on the drawings and/or specified herein, including but not necessarily limited to the following:

1. Roof hatches.

2. Roof smoke vents.

1.3 RELATED SECTIONS

A. Roofing - Section 075423.

B. Sheet metal flashing - Section 076200.

1.4 SUBMITTALS

A. Before any roof specialties and accessories are delivered to the job site, submit shop drawings showing profiles and anchoring devices.

1.5 PRODUCT HANDLING

A. Protection: Use all means necessary to protect the materials of this Section before, during and after installation and to protect the installed work and materials of all other trades.

B. Replacements: In the event of damage, immediately make all repairs and replacements necessary.

PART 2 PRODUCTS

2.1 ROOF HATCH

A. Provide thermally broken shop-primed, galvanized steel roof hatch units of sizes shown on drawings, with 1" rigid insulation at curbs and door and standard self-lifting mechanism. Provide manufacturer's standard hardware, including hold-open device, hinges, latch and operating handles for inside operation. Construct units for 40 lbs. per sq. ft. live load.

B. Safety Railing System: Manufacturer's standard complete system including rails, clamps, fasteners, safety barrier at railing opening, and all accessories required for a complete installation.

1. Height: 42 inches above finished roof deck.

2. Test load per code requirements.

3. Provide self-latching gate fabricated of same materials as safety railing system.

C. Provide units manufactured by Bilco, Babcock-Davis, Milcor or approved equal.

2.2 SMOKE VENTS

A. Provide shop primed galvanized steel heat and smoke vent units of sizes shown on drawings, with 1" rigid insulation at curbs and door, standard lifting mechanism and automatic heat and smoke sensitive release devices. Provide manufacturer's standard hardware including hold-open device, hinges, latch and operating handles for inside and outside operation.

B. Provide units manufactured by Bilco, Babcock-Davis, Milcor or approved equal.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where roof specialties and accessories are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. General: Comply with manufacturer's instructions and recommendations. Coordinate with installation of roof deck and other substrates to receive accessory units, and with roof insulation, roofing and flashing; as required to ensure that each element of the work performs properly, and that combined elements are waterproof and weathertight. Anchor units securely to supporting structural substrates, adequate to withstand lateral and thermal stresses as well as inward and outward loading pressures.

B. Isolation: Where metal surfaces of units are to be installed in contact with non-compatible metal or corrosive substrates, including wood, apply bituminous coating on concealed metal surfaces, or provide other permanent separation.

C. Cap Flashing: Where cap flashing is required as component of accessory, install to provide adequate waterproof overlap with roofing or roof flashing (as counter flashing). Seal with thick bead of mastic sealant, except where overlap is indicated to be left open for ventilation.

D. Operational Units: Test operational units with operable components. Clean and lubricate joints and hardware. Adjust for proper operation.

3.3 CLEANING AND PROTECTION

A. Clean exposed metal surfaces in accordance with manufacturer's instructions. Touch up damaged metal coatings.

END OF SECTION

SECTION 078100

SPRAYED FIRE-RESISTIVE MATERIALS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. The Work of this Section includes all labor, materials, equipment, and services necessary to complete the sprayed fire-resistive materials as shown on the drawings and/or specified herein, including, but not necessarily limited to, the following:

1. Spray-on fireproofing for structural steel and metal decking.
2. Seal coat over fireproofing in special areas.
3. Preparation of surfaces.
4. Field quality control.

1.3 RELATED SECTIONS

A. Structural steel – Section 051200.

B. Metal decking – Section 053100.

C. Firestops and smokeseals – Section 078413.

1.4 SUBMITTALS

A. Product Data: For each fire-resistive product specified.

B. Shop Drawings: Submit structural framing plans indicating the following:

1. Locations and types of surface preparations required before applying sprayed fire-resistive material.
2. Extent of sprayed fire-resistive material for each construction and fire-resistance rating, including the following:
    a. Applicable fire-resistive design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
    b. Minimum thicknesses needed to achieve required fire-resistance ratings of structural components and assemblies.
3. Identify restrained and unrestrained assemblies on shop drawings, show required thickness of fireproofing for each assembly.

C. Product Certificates: Signed by manufacturer of sprayed fire-resistive material certifying that the products furnished comply with requirements.

D. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.

E. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

F. If primer is to be used steel and/or metal deck, submit certifications by supplier of primer that primer is compatible with materials, and will not impair the required performance of the installed fireproofing. Such certification shall be accompanied by evidence that the primer was successfully used in conjunction with the fireproofing material in a UL test applicable to the construction. Submit certification prior to application of primer.

1. Coordinate with Section 051200 – Structural Steel and 053100 – Metal Deck, and Structural Drawings prior to application of primer.

G. Product Test Reports: Indicate that physical properties of proposed sprayed fire-resistive materials comply with specified requirements based on comprehensive testing of current product formulations by a qualified testing and inspecting agency according to requirements specified in "Quality Assurance" Article.

H. Code Compliance: Proposed product must comply with prevailing Building Code and be approved by those individuals having jurisdiction.

I. Letter from manufacturer stating that the UL Design selected for the project is not load restricted.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer certified, licensed, or otherwise qualified by sprayed fire-resistive material manufacturer as having the necessary experience, staff, and training to install manufacturer's products according to specified requirements. A manufacturer's willingness to sell its sprayed fire-resistive materials to Contractor or to an installer engaged by Contractor does not in itself confer qualification on the buyer.

B. Submit data indicating that products containing no detectable asbestos as determined according to the method specified in 40 CFR, Part 763, Subpart E, Appendix E, Section 1, "Polarized Light Microscopy."

C. Mockups: After processing of initial submittals and before delivery and installation of fireproofing materials, prepare a sample installation of fireproofing work, approximately 100 sq. ft. in area; providing an example of each type required, applied on each different substrate, to produce each different rating as required and reasonably representative of entire sprayed on fireproofing work, for joint approval by representative of fire resistant material manufacturer and Owner. Work in other areas shall not proceed until mock-up has been completed. Mock-up work which remains in compliance with requirements and is in undamaged and acceptable condition may be retained as final work in place.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to Project site in original, unopened packages with intact and legible manufacturers' labels identifying product and manufacturer; date of manufacture; shelf life, if applicable; and fire-resistance ratings applicable to Project.

B. Use materials with limited shelf life within period indicated. Remove from Project site and discard materials whose shelf life has expired.

C. Store materials inside, under cover, aboveground, so they are kept dry until ready for use. Remove from Project site and discard materials that have deteriorated.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply sprayed fire-resistive material when ambient or substrate temperatures are 40 deg F. or lower, unless temporary protection and heat is provided to maintain temperatures at or above this level for 24 hours before, during, and for 24 hours after product application.

B. Ventilation: Ventilate building spaces during and after application of sprayed fire-resistive material to achieve a minimum of four air changes per hour. Use natural means or, where this is inadequate, forced-air circulation until fire-resistive material dries thoroughly.

1.8 SEQUENCING

A. Sequence and coordinate application of sprayed fire-resistive materials with other related work specified in other Sections to comply with the following requirements:

1. Provide temporary enclosures for interior applications to prevent deterioration of fire-resistive material due to exposure to unfavorable environmental conditions.

2. Avoid unnecessary exposure of fire-resistive material to abrasion and other damage likely to occur during construction operations subsequent to its application.

3. Do not apply fire-resistive material to metal roof deck substrates until roofing has been completed; prohibit roof traffic during application and drying of fire-resistive material. Fireproofing shall be considered dry when the moisture content is 6% or less.

4. Do not begin applying fire-resistive material until clips, hangers, supports, sleeves, and other items penetrating fire protection are in place.

5. Defer installing ducts, piping, and other items that would interfere with applying fire-resistive material until application of fire protection is completed.

6. Do not install enclosing or concealing construction until after fire-resistive material has been applied, inspected, tested, and corrections have been made to defective applications.

7. Protect permanently exposed walls, floor or special surfaces.

1.9 WARRANTY

A. General Warranty: The special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Special Warranty: Submit a written warranty, executed by Contractor and cosigned by Installer, agreeing to repair or replace sprayed fire-resistive materials that fail within the specified warranty period.

1. Failures include, but are not limited to, cracking, flaking, eroding in excess of specified requirements; peeling; and delaminating of sprayed fire-resistive materials from substrates due to defective materials and workmanship within the specified warranty period.

2. Not covered under the warranty are failures due to damage by occupants and Owner's maintenance personnel, exposure to environmental conditions other than those investigated and approved during fire-response testing, and other causes not reasonably foreseeable under conditions of normal use.

C. Warranty Period: Three (3) years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 CONCEALED SPRAYED FIRE-RESISTIVE MATERIALS

A. General: For concealed applications of sprayed fire-resistive materials, provide manufacturer's standard products complying with requirements indicated in this Article for material composition and physical properties representative of installed products.

1. Steel members are to be considered unrestrained unless specifically noted otherwise.

B. UL design listings must state that the loading was determined by Allowable Stress Design Method or Load and Resistance Factor Design Method. UL design listings requiring a load restriction factor will not be allowed.

C. Material Composition: As follows:

1. Cementitious sprayed fire-resistive material consisting of factory-mixed, dry formulation of gypsum or Portland cement binders and lightweight mineral or synthetic aggregates mixed with water at Project site to form a slurry or mortar for conveyance and application.

D. Physical Properties: Minimum values, unless otherwise indicated, or higher values required to attain designated fire-resistance ratings, measured per standard test methods referenced with each property listed as follows:

1. Dry Density: Minimum 15 lb./cu. ft. for average and individual densities regardless of density indicated in referenced fire-resistive design, or greater if required to attain fire-resistance ratings indicated, per ASTM E 605 or AWCI Technical Manual 12-A, Appendix A, "Alternate Method for Density Determination."

2. Thickness: Provide minimum average thickness required for fire-resistive design shown on approved submittals.

    a. Fireproofing shall be of thicknesses and density to meet the requirements of the State of South Carolina Building Code.

3. Bond Strength: Not less than 200 lbf/sq. ft. per ASTM E 736.

4. Compressive Strength: 5.21 lbf/sq. in. as determined in the laboratory per ASTM E 761. Minimum thickness of sprayed fire-resistive material tested shall be 0.75 inch and minimum dry density shall be as specified, but not less than 15 lb./cu. ft.

5. Corrosion Resistance: No evidence of corrosion per ASTM E 937.

6. Deflection: No cracking, spalling, delamination, or the like per ASTM E 759.

7. Effect of Impact on Bonding: No cracking, spalling, delamination, or the like per ASTM E 760.

8. Air Erosion: Maximum weight loss of 0.025 g/sq. ft. in 24 hours per ASTM E 859. For laboratory tests, minimum thickness of sprayed fire-resistive material is 0.75 inch, maximum dry density is 15 lb./cu. Ft., test specimens are not prepurged by mechanically induced air velocities, and tests are terminated after 24 hours.

9. Fire-Test-Response Characteristics: Provide sprayed fire-resistive materials with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

    a. Flame Spread: 10 or less.
    b. Smoke Developed: 0.

10. Fungal Resistance: No observed growth on specimens per ASTM G 21.

E. Products: Subject to compliance with requirements, provide products by one of the following:

1. Cementitious Sprayed Fire-Resistive Material

    a. Type 5GP; SouthWest, Carboline.
    b. Monokote Type MK-6; GCP Applied Technologies.
    c. Cafco 300; Isolatek International Corp., Cafco Products.
    d. Type F3; Promat Firetemp.

2.2 SPRAYED FIRE-RESISTIVE MATERIALS FOR EXPOSED FIREPROOFING AND FOR ALL FIREPROOFING IN BUILDINGS 420’ HIGH OR HIGHER

A. General: For exposed applications of sprayed fire-resistive materials, provide manufacturer's standard products complying with requirements indicated for material composition and for minimum physical properties of each product listed, measured by standard test methods referenced with each property.

1. Steel members are to be considered unrestrained unless specifically noted otherwise.

B. UL design listings must state that the loading was determined by Allowable Stress Design Method or Load and Resistance Factor Design Method. UL design listings requiring a load restriction factor will not be allowed.

C. Cementitious Sprayed Fire-Resistive Material: Factory-mixed, dry, cement aggregate formulation, chloride-free formulation of Portland cement binders, additives, and inorganic aggregates, mixed with water at Project site to form a slurry or mortar for conveyance and application, complying with the following requirements:

1. Dry Density: Values for average and individual densities as required for fire-resistance ratings indicated, per ASTM E 605 or AWCI Technical Manual 12-A, Appendix A, "Alternate Method for Density Determination," but with an average density of not less than 22 lb./cu. ft.

2. Bond Strength: 2000 psf minimum per ASTM E 736.

3. Compressive Strength: 100 psi per ASTM E 761.

4. Corrosion Resistance: No evidence of corrosion per ASTM E 937.

5. Deflection: No cracking, spalling, delamination, or the like per ASTM E 759.

6. Effect of Impact on Bonding: No cracking, spalling, delamination, or the like per ASTM E 760.

7. Air Erosion: Maximum weight loss of 0.025 g/sq. ft. per ASTM E 859.

8. Combustion Characteristics: Passes ASTM E 136.

9. Fire-Test-Response Characteristics: Provide sprayed fire-resistive materials with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

    a. Flame Spread: 10 or less.
    b. Smoke Developed: 0.

10. Fungal Resistance: No observed growth on specimens per ASTM G 21.

11. For exterior applications of sprayed fire-resistive material, provide manufacturer's formulation approved for surfaces exposed to the exterior.

D. Products: Subject to compliance with requirements, provide one of the following:

1. Cement-Aggregate Cementitious Sprayed Fire-Resistive Material:

    a. Pyrocrete 239; Carboline Co., Fireproofing Products Div.
    b. Monokote Type Z106HY; GCP Applied Technologies.
    c. F4; Promat Firetemp.
    d. Cafco 400, Isolatek International Corp; Cafco Products.

2.3 AUXILIARY FIRE-RESISTIVE MATERIALS

A. General: Provide auxiliary fire-resistive materials that are compatible with sprayed fire-resistive materials and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistive designs indicated.

B. Adhesive for Bonding Fire-Resistive Material: Product approved by manufacturer of sprayed fire-resistive material, used where required by manufacturer to insure proper bond.

C. Metal Lath: Expanded metal lath fabricated from material of weight, configuration, and finish required to comply with fire-resistive designs indicated and fire-resistive product manufacturer's written recommendations. Include clips, lathing accessories, corner beads, and other anchorage devices required to attach lath to substrates and to receive sprayed fire-resistive material.

D. Sealer for Sprayed Fire-Resistive Material in Elevator Shafts and Open Area Plenums: Transparent-drying, water-dispersible protective coating by manufacturer of fire-resistive material.

1. Product: Subject to compliance with requirements, provide "Firebond Concentrate" by GCP Applied Technologies, or similar product recommended by the manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, to determine whether they are in satisfactory condition to receive sprayed fire-resistive material. A substrate is in satisfactory condition if it complies with the following:

1. Substrates are free of oil, grease, rolling compounds, incompatible primers, loose mill scale, dirt, or other foreign substances capable of impairing bond of fire-resistive material with substrate under conditions of normal use or fire exposure.

2. Objects penetrating fire-resistive material, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.

3. Substrates are not obstructed by ducts, piping, equipment, and other suspended construction that will interfere with applying fire-resistive material.

B. Do not proceed with installation of fire-resistive material until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of substances that could impair bond of fire-resistive material, including oil, grease, rolling compounds, incompatible primers, and loose mill scale.

B. For exposed applications, repair substrates to remove any surface imperfections that could affect uniformity of texture and thickness in finished surface of sprayed fire-

resistive material. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.

C. Cover other work subject to damage from fallout or overspray of fire-resistive materials during application. Provide temporary enclosure as required to confine spraying operations, protect the environment, and ensure maintenance of adequate ambient conditions for temperature and ventilation.

3.3 INSTALLATION

A. Comply with fire-resistive material manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to convey and spray on fire-resistive material, as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.

B. Install metal lath, as required, to comply with fire-resistance ratings and fire-resistive material manufacturer's written recommendations for conditions of exposure and intended use. Securely attach lath to substrate in position required for support and reinforcement of fire-resistive material. Use anchorage devices of type recommended in writing by fire-resistive material manufacturer. Attach lathing accessories where indicated or required for secure attachment to substrate.

C. Coat substrates with adhesive before applying fire-resistive material where required to achieve fire-resistance rating or as recommended in writing by fire-resistive material manufacturer for material and application indicated.

D. Extend fire-resistive material in full thickness over entire area of each substrate to be protected.

E. Spray apply fire-resistive materials to maximum extent possible. Following the spraying operation in each area, complete the coverage by method recommended by the manufacturer.

F. Where sealers are used, apply products that are tinted to differentiate them from the sprayed fire-resistive material over which they are applied.

G. Maintain ambient conditions during installation and for cure period following installation, as recommended by manufacturer. Provide ventilation and avoid excessive rate of drying.

H. Fireproofing to the underside of roof deck assemblies shall be done only after roofing application is complete, all roof mounted mechanical equipment is in place, and the roof is watertight.

I. No fireproofing shall be applied prior to completion of concrete work on steel decking.

J. Installation Sequence of Fireproofing: All patching and repairing of sprayed fireproofing, due to cutting by other trades or testing and inspection, shall be performed under this Section.

K. Provisions shall be made for ventilation to properly dry the fireproofing after application. In enclosed areas lacking natural ventilation, air circulation and ventilation must be provided.

3.4 FIELD QUALITY CONTROL (FREQUENCY PER BELOW UNLESS MORE STRINGENT PER BUILDING CODE)

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and to prepare test reports.

1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.

B. Testing and inspecting of completed applications of sprayed fire-resistive material will take place in successive stages, in areas of extent and using methods as follows. Do not proceed with application of fire-resistive material for the next area until test results for previously completed applications of fire-resistive material show compliance with requirements.

1. For each 1000-sq. ft. area, or partial area, on each floor, testing and inspecting agency will evaluate the following characteristics. Tested values must equal or exceed values indicated and values required for approved fire-resistance design.

a. Thickness for Floors, Roofs, and Walls: From the average of 10 measurements from a 144-sq. in. sample area, with sample width of not less than 6 inches per ASTM E 605.

2. Thickness for Structural Frame Members: From a sample of 25 percent of structural members per floor, taking 9 measurements at a single cross section for structural frame beams or girders, 7 measurements of a single cross section for joists and trusses, and 12 measurements of a single cross section for columns per ASTM E 605.

3. For each 10,000 sq. ft. area, or partial area, on each floor, testing and inspection agency will evaluate the following characteristics. Tested values must equal or exceed values indicated and values required for approved fire resistance design.

a. Bond Strength for Floors, Roofs, Walls, and Structural Framing Members: Cohesion and adhesion at frequency and from sample size indicated for determining thickness of each type of construction, per ASTM E 736.

4. Density for Floors, Roofs, Walls, and Structural Frame Members: At frequency and from sample size indicated for determining thickness of each type of construction, per ASTM E 605 or AWCI Technical Manual 12-A, Appendix A, "Alternate Method for Density Determination."

5. When testing discovers applications of fire-resistive material not in compliance with requirements, testing and inspecting agency will perform additional random testing to determine extent of noncompliance.

C. Remove and replace applications of fire-resistive material where test results indicate that they do not comply with specified requirements for cohesion and adhesion or for density, or both.

D. Apply additional fire-resistive material per manufacturer's written instructions where test results indicate that thickness does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.5 CLEANING, PROTECTING, AND REPAIR

A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.

B. Cure exposed sprayed fire-resistive material according to product manufacturer's written recommendations to prevent premature drying.

C. Protect fire-resistive material, according to advice of product manufacturer and Installer, from damage resulting from construction operations or other causes so fire protection will be without damage or deterioration at the time of Substantial Completion.

D. Coordinate application of fire-resistive material with other construction to minimize the need to cut or remove fire protection. As installation of other construction proceeds, inspect fire-resistive material and patch any damaged or removed areas.

1. Patch and repair fireproofing where Owner’s Testing Agency has performed tests.

E. Repair or replace work that has not been successfully protected.

END OF SECTION

SECTION 078413

FIRESTOPS AND SMOKESEALS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the firestops and smokeseals as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Penetrations through fire-resistance-rated floor and roof construction including both empty openings and openings containing cables, pipes, ducts, conduits, and other penetrating items.

2. Penetrations through fire-resistance-rated walls and partitions including both empty openings and openings containing cables, pipes, ducts, conduits, and other penetrating items.

3. Penetrations through smoke barriers and construction enclosing compartmentalized areas involving both empty openings and openings containing penetrating items.

4. Sealant joints in fire-resistance-rated construction.

5. Penetrations at each floor level in shafts and/or stairwells.

6. Construction joints, including those between top of fire rated walls and underside of floors above.

1.3 RELATED SECTIONS

A. Cast-in-place concrete - Section 033000.

B. Joint sealers - Section 079200.

C. Drywall - Section 092900.

D. Piping penetrations - Division 22.

E. Duct penetrations - Division 23.

F. Protection of Emergency Fuel Lines – Division 23

G. Cable and conduit penetrations - Division 26.

H. Communications -Division 27

1.4 REFERENCES

A. ASTM E 814 "Standard Method of Fire Tests of Through-Penetration Firestops."

B. UL 1479, UBC 7-5 (Both are same as A. above).

C. ASTM E 136 "Standard Test Method for Assessing Combustibility of Materials."

D. UL 263, UBC 7-1 "Fire Tests of Building Construction and Materials"

E. UL 2079 "Tests For Fire Resistance of Building Joint Systems."

F. ASTM E 1399 "Test For Dynamic Movement Conditions."

G. ASTM E 1966 (Same as E. above).

H. ASTM G 21 "Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi."

I. ASTM E 1725 "Standard Test Methods for Fire Tests of Fire-Resistive Barrier Systems for Electrical System Components"

J. UL 1489 "Fire Tests of Fire Resistant Pipe Protection Systems Carrying Combustible Liquids"13

K. Test Requirements: ASTM E 2307, "Standard Test Method for Determining Fire Resistance of Perimeter Fire Barrier Systems Using Intermediate-Scale, Multi-story Test Apparatus."

L. Inspection Requirements: ASTM E 2174, "Standard Practice for On-site Inspection of Installed Firestops."

M. Published Through-Penetration Systems by recognized independent testing agencies.

1. UL Fire Resistance Directory, Volume II of current year.

2. Warnock Hersey Certification Listings, current year.

3. Omega Point Laboratories, current year.

N. International Firestop Council Guidelines for Evaluating Firestop Systems Engineering Judgments.

O. NFPA 101 – Life Safety Code

P. NFPA 70 – National Electric Code

Q. NFPA 72 – National Fire Alarm and Signaling Code

1.5 SUBMITTALS

A. Submit manufacturer's product literature for each type of firestop material to be installed. Literature shall indicate product characteristics, typical uses, performance,

limitation criteria, test data and indication that products comply with specified requirements.

B. Submit shop drawings detailing materials, installation methods, and relationships to adjoining construction for each firestop system, and each kind of construction condition penetrated and kind of penetrating item. Include firestop design designation of qualified testing and inspection agency evidencing compliance with requirements for each condition indicated.

1. Submit documentation, including illustrations, for proposed UL listed (or equal) firestop and smokeseal assembly required for the Project.

C. Safety Data Sheets: Submit SDS for each firestop product.

D. Submit qualifications of firestop installer, including letter from firestop manufacturer of products proposed to be installed, wherein manufacturer approves or recognizes as trained/ or certifies installer for installation of that manufacturer's products.

E. Engineering Judgment: For those firestop applications that exist for which no qualified tested system is available through a manufacturer, an engineering judgment derived from similar qualified tested system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineering judgment documents must follow requirements set forth by the International Firestop Council.

F. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For fire-resistive joint system sealants, documentation including printed statement of VOC content.

2. Laboratory Test Reports for Credit IEQ 4: For fire resistive joint and penetration system sealants and sealant primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

1.6 QUALITY ASSURANCE

A. General: Provide firestopping systems that are produced and installed to resist the spread of fire and the passage of smoke and other gases.

B. Installation Responsibility: Assign installation of through-penetration firestop systems and fire-resistive joint systems in Project to a single sole source firestop specialty contractor unless preformed devices are utilized.

1. Installer Qualifications (one of the following):

a. A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors
b. A firm that has been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."
c. A manufacturer's Accredited Firestop Specialty Contractor (see Part 2.0 for list of acceptable manufacturers).

d. A firm experienced in installing through-penetration firestop systems similar in material, design, and extent to that indicated for this project, whose work has resulted in construction of a minimum of five projects with a record of successful performance.

C. Single Manufacturer Sourcing: Source all firestop products and required accessories from a single manufacturer. See Part 2.0 for list of acceptable manufacturers.

D. Firestopping materials shall conform to Flame (F) and Temperature (T) ratings as required by local building code and as tested by nationally accepted test agencies per ASTM E 814 or UL 1479. The F-rating must be a minimum of one (1) hour, but not less than the fire resistance rating of the assembly being penetrated. T-rating, when required by code authority, shall be based on measurement of the temperature rise on the penetrating item(s). The fire test shall be conducted with a minimum positive pressure differential of 0.01 inches of water column.

1. Penetrations in Horizontal Assemblies: Provide firestopping with ratings determined in accordance with UL 1479 or ASTM E 814.

   a. F-Rating: Minimum of 1-hour rating, but not less than the fire-resistance rating of the floor construction being penetrated.
   b. T-Rating: When penetrant is located outside of a wall cavity, minimum of 1-hour rating, but not less than the fire-resistance rating of the floor construction being penetrated
      1). T-ratings shall be achieved by utilizing a Low Bio Persistent Endothermic Mat incorporating foil scrim on both sides.
   c. W-Rating: Class 1 rating in accordance with water leakage test per UL 1479.

2. Penetrations in Smoke Barriers: Provide firestopping with ratings determined in accordance with UL 1479 or ASTM E 814.

   a. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at both ambient and elevated temperatures.

E. Firestopping products shall be asbestos free and free of any PCBs.

F. Do not use any product containing solvents or that requires hazardous waste disposal.

G. Do not use firestop products which after curing, dissolve in water.

H. Do not use firestop products that contain ceramic fibers.

I. Mock-Up: Prepare job site mock-ups of each typical Firestop System proposed for use in the project. Approved mock-ups will be left in place as part of the finished project and will constitute the quality standard for the remaining work.

J. For firestopping exposed to view, traffic, moisture, and physical damage, provide products that do not deteriorate when exposed to these conditions.

1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.

2. For floor penetrations with annular spaces exceeding 4 inches or more in width and exposed to possible loading and traffic, provide firestop systems capable of

supporting the floor loads involved either by installing floor plates or by other means.

3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

K. Mold Resistance: Provide penetration firestopping with mold and mildew resistance rating of less than or equal to 1 as determined by ASTM G 21.

L. Firestopping Materials are either "cast-in-place" (integral with concrete placement) or "post-installed." Provide cast-in-place firestop devices prior to concrete placement.

M. Firestop systems do not reestablish the structural integrity of load bearing partitions or assemblies, or support live loads and traffic. Installer shall consult the Structural Engineer prior to penetrating any load bearing assembly.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in manufacturer's original unopened containers with manufacturer's name, product identification, lot numbers, UL or Warnock Hersey labels, and mixing and installation instructions, as applicable.

B. Store materials in the original, unopened containers or packages, and under conditions recommended by manufacturer.

C. All firestop materials shall be installed prior to expiration of shelf life.

1.8 PROJECT CONDITIONS

A. Verify existing conditions and substrates before starting work

B. Do not use materials that contain solvents, show sign of damage or are beyond their shelf life.

C. During installation, provide masking and drop cloths as needed to prevent firestopping products from contaminating any adjacent surfaces.

D. Conform to ventilation requirements if required by manufacturer's installation instructions or Material Safety Data Sheet.

E. Weather Conditions: Do not proceed with installation of firestop products when temperatures are in excess or below the manufacturer's recommendations.

F. Schedule installation of firestop products after completion of penetrating item installation but prior to covering or concealing of openings.

G. Coordinate this work as required with work of other trades.

1.9 SEQUENCING AND SCHEDULING

A. Firestop & Life Safety Design: Obtain all required tested firestop systems before installation and document on shop drawings. Where possible, identify all conditions where tested firestop systems will not meet Project conditions. Obtain Engineering Judgements (EJs) for these conditions from firestop manufacturer and confirm advance approval from Authorities Having Jurisdiction (AHJs).

B. Pre-Installation Conference: Convene a pre-installation conference to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work. Invite all applicable parties including installers, general contractors, and firestop manufacturer's representative to conference.

C. Sequence: Perform work of this and other sections in proper sequence to prevent damage to the firestop systems and to ensure that their installation will occur prior to enclosing or concealing work.

D. Install all firestop systems after voids and joints are prepared sufficiently to accept the applicable firestop system.

E. Do not cover firestop systems until they have been properly inspected and accepted by the authority having jurisdiction.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with requirements, provide products of one of the following manufacturers:

1. Basis-of-Design: Hilti, Inc., Plano, TX, (800) 879-8000, www.hilti.com

2. Firestop systems and products from manufacturers listed below shall be considered in accordance with contract provisions and performance requirements listed in this document:

a. Specified Technologies Inc.
b. 3M; Fire Protection Products Division

2.2 FIRESTOPPING, GENERAL

A. Compatibility: Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by firestopping manufacturer based on testing and field experience.

B. Accessories: Provide components for each firestopping system that are needed to install fill materials. Use only components specified by the firestopping manufacturer and approved by the qualified testing and inspecting agency for the designated fire-resistance-rated systems. Accessories include but are not limited to the following items:

1. Permanent forming/damming/backing materials including the following:

a. Semirefractory fiber (mineral wool) insulation.
b. Sealants used in combination with other forming/damming materials to prevent leakage of fill materials in liquid state.
c. Fire-rated form board.
d. Joint fillers for joint sealants.

2. Temporary forming materials.

3. Substrate primers.

4. Collars.

5. Steel sleeves.

C. Applications: Provide firestopping systems composed of materials specified in this Section that comply with system performance and other requirements.

D. Smokeseals at top of partitions shall be flexible to allow for partition deflection.

E. Rated and non fire rated smokeseals utilized at joints and penetrations for walls and floors must have acoustical performance qualities. Provide manufacturer's standard non-sag, paintable, non-staining latex sealant complying with ASTM C839, ASTM C919 and the following:

a. Sealant effectively reduces airborne sound transmission through head-of-wall and bottom-of-wall joints and openings to accommodate through-penetrations in building construction as demonstrated by testing representative assemblies in accordance with ASTM E90.
b. Lightweight, semi-foam smoke and acoustical sealant with movement capability of minimum 12.5% in accordance with ISO 11600.
c. Latex sealant according to ASTM C 834 class OP -18°C with shrinkage according to ASTM C 1241 < 29 % C.
d. Acoustical Sealant to maintain STC ratings at sound rated partitions as indicated on the drawings.
e. Sealant has flame-spread and smoke-developed ratings of less than 25 as tested in accordance with ASTM E84.
f. Sealant is mold and mildew resistant per ASTM G21 with a rating of one (1), "no growth".
g. Proposed acoustic sealant materials and methods shall conform to applicable governing codes having local jurisdiction.
h. Smokeseals at top of partitions shall be flexible to allow for partition deflection.

2.3 FILL MATERIALS FOR THROUGH-PENETRATION FIRESTOP SYSTEMS

A. Intumescent, Latex Sealant: Single-component, Intumescent, latex formulation.

1. Basis of Design: Hilti Intumescent Firestop Sealant (FS-ONE MAX)

2. Substitution requests shall be considered in accordance with contract provisions. The following are acceptable:

a. STI Intumescent Latex Sealant
b. 3M Fire Barrier Sealant CP 25WB+
c. Or Approved Equal

3.

B. Intumescent Putty: Non-hardening, dielectric, water-resistant putty containing no solvents, inorganic fibers, or silicone compounds.

1. Basis of Design: Hilti Firestop Putty Stick (CP 618)

2. Substitution requests shall be considered in accordance with contract provisions. The following are acceptable:

    a. STI SSP Putty
    b. 3M Fire Barrier Moldable Putty
    c. Or Approved Equal

C. Intumescent Wrap Strips: Single-component, elastomeric sheet with aluminum or polyethylene foil on one side.

1. Basis of Design: Hilti Firestop Wrap Strips (CP 648)

2. Substitution requests shall be considered in accordance with contract provisions. The following are acceptable:

    a. STI SSW Intumescent Wrap Strips
    b. 3M Fire Barrier Wrap Strips
    c. Or Approved Equal

3.

D. Mortar: Prepackaged dry mix composed of a blend of inorganic binders, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a non-shrinking, homogeneous mortar.

1. Basis of Design: Hilti Firestop Mortar (CP 637)

2. Substitution requests shall be considered in accordance with contract provisions. The following are acceptable:

    a. STI SSM Firestop Mortar
    b. 3M Fire Barrier Mortar
    c. Or Approved Equal

E. Moldable putty pads by

1. Basis of Design: Hilti Firestop Putty Pad (CP 617)

2. Substitution requests shall be considered in accordance with contract provisions. The following are acceptable:

    a. STI SSP Putty Pads
    b. 3M Fire Barrier Moldable Putty Pads
    c. Or Approved Equal

F. Silicone Foam: Two-component, polyurethane foam thatexpands and cures in place to produce a flexible, non-shrinking foam.

1. Basis of Design: Hilti Firestop Foam (CP 660)

2. Substitution requests shall be considered in accordance with contract provisions. The following are acceptable:

    a. 3M Fire Block Foam
    b. Or Approved Equal

G. Silicone Sealant: Moisture-curing, single-component, silicone-based, neutral-curing elastomeric sealant of grade indicated below:

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces and non-sag formulation for openings in vertical and other surfaces requiring a non-slumping/gunnable sealant, unless firestop system limits use to non-sag grade for both opening conditions.

2. Basis of Design: Hilti Firestop Silicone Sealant Self Leveling (CFS-S SIL SL)

3. Substitution requests shall be considered in accordance with contract provisions. The following are acceptable:

   a. STI Self Leveling Silicone Firestop Sealant
   b. 3M Fire Barrier Water Tight Sealant 1003 SL
   c. Or Approved Equal

H. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic or polypropylene sleeve lined with an intumescent strip, an extended rectangular flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

1. Basis of Design: Hilti Cast-in Firestop Sleeve (CP 680)

2. Substitution requests shall be considered in accordance with contract provisions. The following are acceptable:

   a. STI SpecSeal Cast In Firestop Device
   b. 3M Fire Barrier Cast-In Device
   c. Or Approved Equal

I. Low Voltage Cable Management Devices: Factory-assembled round or rectangular metallic sleeve device for use with cable penetrations. Round devices shall contain an integrated smoke seal fabric membrane that can be opened and closed for re-penetration. Rectangular devices shall be modular to accommodate future use.

1. Basis of Design: Hilti Firestop Modular Sleeve System or Firestop Speed Sleeve (CFS-MSL or CP 653, respectively)

2. Substitution requests shall be considered in accordance with contract provisions.

   a. STI EZ Path
   b. 3M Fire Barrier Pass-Through Device Square
   c. Or Approved Equal

J. Drop-In Firestop Devices: Factory-assembled devices for use with combustible or noncombustible penetrants in cored holes within concrete floors. Device shall consist of galvanized steel sleeve lined with an intumescent strip, an extended rectangular flange attached to one end of the sleeve for fastening to concrete floor, and neoprene gasket.

1. Basis of Design: Hilti Drop-In Device (CFS-DID)

2. Substitution requests shall be considered in accordance with contract provisions.

K. Firestop Collars : Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

1. Basis of Design: Hilti Firestop Collar (CP643)

2. Substitution requests shall be considered in accordance with contract provisions. The following are acceptable:

   a. STI SSC Intumescent Firestop Collar
   b. 3M Fire Barrier Plastic Pipe Device
   c. Or Approved Equal

L. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized-steel sheet.

1. Basis of Design: Hilti Firestop Composite Sheet (CFS-COS)

2. Substitution requests shall be considered in accordance with contract provisions. The following are acceptable:

   a. STI SpecSeal Composite Sheet
   b. 3M Fire Barrier Composite Sheet CS-195+
   c. Or Approved Equal

M. Blocks/Plugs: Non curing, re-penetrable intumescent materials used for large size/complex penetrations made to accommodate cable trays and bundles, multiple steel and copper pipes, electrical busways in raceways.

1. Basis of Design: Hilti Firestop Block (CFS-BL)

2. Substitution requests shall be considered in accordance with contract provisions. The following are acceptable:

   a. 3M Fire Barrier Block B258
   b. Or Approved Equal

N. Tub Box Kit: Cast-in place pre-formed plastic tub box kit with three support legs for use with drain piping assembly associated with bathtub installations.

1. Basis of Design: Hilti Tub Box Kit (CP 681)

2. Substitution requests shall be considered in accordance with contract provisions. The following are acceptable:

   a. STI Firestop Cast in Tub Box
   b. 3M Fire Barrier Cast In Tub Box Assembly
   c. Or Approved Equal

O. Endothermic Mats: Low Bio Persistent Endothermic Mat incorporating foil scrim on both sides. Mat evaluated for protection of cable pathways and liquid fuel lines, for firestopping of through-penetrations and membrane-penetrations, and for achieving T-ratings

1. Basis of Design: Hilti Endo-Shield (CFP-ES) . No substitutions

2.4 FIRE-RESISTIVE ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealant Standard: Provide manufacturer's standard chemically curing, elastomeric sealant of base polymer indicated that complies with ASTM C 920 requirements, including those referenced for Type, Grade, Class, and Uses, and requirements specified in this Section applicable to fire-resistive joint sealants.

1. Sealant Colors: Color of exposed joint sealants as selected by the Architect.

B. Single-Component, Neutral-Curing Silicone Sealant: Type S; Grade NS; Class 25; exposure-related Use NT, and joint-substrate-related Uses M, G, A, and (as applicable to joint substrates indicated) O.

1. Additional Movement Capability: Provide sealant with the capability to withstand 33 percent movement in both extension and compression for a total of 66 percent movement.

C. Multi-Component, Non-Sag, Urethane Sealant: Type M; Grade NS; Class 25; exposure-related Use NT, and joint-substrate-related Uses M, A, and (as applicable to joint substrates indicated) O.

1. Additional Movement Capability: Provide sealant with the capability to withstand 40 percent movement in extension and 25 percent in compression for a total of 65 percent movement in joint width existing at time of installation, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C 719, and remain in compliance with other requirements of ASTM C 920 for uses indicated.

D. Single-Component, Non-Sag, Urethane Sealant: Type S; Grade NS; Class 25; and Uses NT, M, A, and (as applicable to joint substrates indicated) O.

2.5 PRE-FORMED FIRE RESISTIVE MATERIALS FOR JOINTS

A. Firestop Top Track Seal: One-piece, pre-formed, polyurethane foam based, firestop seal for use with standard head-joint top tracks and slip-type head joints in fire-rated construction at top of partition to maintain continuity of the fire-resistance-rated assembly indicated. Provide in width and configuration required to accommodate depth and installation of studs and designed to saddle-over the top track.

1. Use only firestop top track seal product that has been UL 2079 tested for specific fire-rated construction conditions conforming to construction assembly type, space requirements and fire-rating required for each application.

2. Performance Requirements:

a. Movement: +/- 50 percent.
b. Surface Burning Characteristics (U.L. 723) ASTM E84: Flame Spread: 10; Smoke Development: 20.
c. Mold-Mildew Performance (ASTM G21-96): Class 0.
d. VOC (LEED): 0.18 lb./gallon.
e. LBC (Living Building Challenge) compliant; International Living Future Institute, 1501 East Madison Street, Suite 150, Seattle WA. 98122.

3. Basis of Design: Hilti Firestop Top Track Seal (CFS-TTS)

B. Perimeter Fire Barrier System: One-piece, pre-formed, polyurethane foam based, firestop seal for use with building perimeter joints between fire-resistance-rated floors and exterior wall assemblies.

1. Use only firestop perimeter joint device that has been ASTM E2307 tested for specific fire-rated construction conditions conforming to construction assembly type, space requirements, and fire-rating required for each application.

2. Basis of Design: Hilti Edge of Slab QuickSeal (CFS-EOS QS)

2.6 MINERAL FIBER/CERAMIC WOOL NON-COMBUSTIBLE INSULATION (FIRE SAFING)

A. Provide min. 4 pcf safing insulation; Thermafiber Safing Mineral Wool Insulation by Thermafiber, Inc. (an Owens Corning company), Roxul Safe Fire Safing Insulation by Rockwool, Mineral Wool Safing by Johns Manville or approved equal to suit conditions and to comply with fire resistance and firestop manufacturer's requirements.

B. Material shall be classified non-combustible when tested per ASTM E 136.

C. For pre-condensed mineral wool products, the following shall serve as the basis of design:

1. Hilti Speed Plug (CP 777)

2. Hilti Speed Strips (CP 767)

3. Hilti Top Track Plug (CFS-TTS MD P FS)

2.7 HILTI TOP TRACK COVER (CFS-TTS MD C FS)MIXING

A. For those products requiring mixing prior to application, comply with firestopping manufacturer's directions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other procedures needed to produce firestopping products of uniform quality with optimum performance characteristics for application indicated.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions with Installer present, for compliance with requirements for opening configuration, penetrating items, substrates, and other conditions affecting performance of firestopping. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean out openings and joints immediately prior to installing firestopping to comply with recommendations of firestopping manufacturer and the following requirements:

1. Remove all foreign materials from surfaces of opening and joint substrates and from penetrating items that could interfere with adhesion of firestopping.

2. Clean opening and joint substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with firestopping. Remove loose particles remaining from cleaning operation.

3. Remove laitance and form release agents from concrete.

B. Priming: Prime substrates where recommended by firestopping manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent firestopping from contacting adjoining surfaces that will remain exposed upon completion of work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestopping materials. Remove tape as soon as it is possible to do so without disturbing seal of firestopping with substrates.

3.3 CONDITIONS REQUIRING FIRESTOPPING

A. Interior Walls and Partitions

1. Construction joints between top of fire rated walls and underside of floors above, shall be firestopped.

2. Firestop system installed shall have been tested by either UL or Omega Point, including exposure to hose stream test and including for use with steel fluted deck floor assemblies.

3. Firestop system used shall allow for deflection of floor above.

B. Penetrations

1. Penetrations include conduit, cable, wire, pipe, duct, or other elements which pass through one or both outer surfaces of a fire rated floor, wall, or partition.

2. Except for floors on grade, where a penetration occurs through a structural floor or roof and a space would otherwise remain open between the surfaces of the penetration and the edge of the adjoining structural floor or roof, provide firestopping to fill such spaces in accordance with ASTM E 814.

3. These requirements for penetrations shall apply whether or not sleeves have been provided, and whether or not penetrations are to be equipped with escutcheons or other trim. If penetrations are sleeved, firestop annular space, if any, between sleeve and wall of opening.

C. Provide firestopping to fill miscellaneous voids and openings in fire rated construction in a manner essentially the same as specified herein before.

3.4 INSTALLING THROUGH PENETRATION FIRESTOPS

A. General: Comply with the through penetrations firestop manufacturer's installation instructions and drawings pertaining to products and applications indicated.

B. Install forming/damming materials and other accessories of types required to support fill materials during their application and in the position needed to produce the cross-

sectional shapes and depths required to achieve fire ratings of designated through-penetration firestop systems. After installing fill materials, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

C. Install fill materials for through penetration firestop systems by proven techniques to produce the following results:

1. Completely fill voids and cavities formed by openings, forming materials, accessories, and penetrating items.

2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.

3. For fill materials that will remain exposed after completing work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.5 INSTALLING FIRE RESISTIVE JOINT SEALANTS

A. General: Comply with ASTM C 1193, and with the sealant manufacturer's installation instructions and drawings pertaining to products and applications indicated.

B. Install joint fillers to provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability and develop fire resistance rating required.

C. Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross sectional shapes and depths relative to joint width that optimum sealant movement capability. Install sealants at the same time joint fillers are installed.

D. Tool no sag sealants immediately after sealant application and prior to the time skinning or curing begins. Form smooth, uniform beads of configuration indicated or required to produce fire resistance rating, as well as to eliminate air pockets, and to ensure contact and adhesion of sealants with sides of joint. Remove excess sealant from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

3.6 INSTALLING FIRESAFING INSULATION

A. Install fire safing insulation utilizing welded or screw applied galvanized steel impaling pins and retaining clips; space clips or pins 24" o.c. maximum.

B. Completely fill voids in areas where safing insulation is required. At spandrel conditions/floor edges, depth of insulation top to bottom shall be at least four (4) inches.

C. Cover top of all safing insulation with firestop sealant or spray.

3.7 FIELD QUALITY CONTROL

A. Inspecting agency employed and paid by the Owner will examine completed firestopping to determine, in general, if it is being installed in compliance with requirements.

B. Inspecting agency will report observations promptly and in writing to Contractor, Owner and Architect.

C. Do not proceed to enclose firestopping with other construction until reports of examinations are issued.

D. Where deficiencies are found, Contractor must repair or replace firestopping so that it complies with requirements.

3.8 CLEANING

A. Clean off excess fill materials and sealants adjacent to openings and joints as work progresses by methods and with cleaning materials approved by manufacturers of firestopping products and of products in which openings and joints occur.

B. Protect firestopping during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated firestopping immediately and install new materials to product firestopping complying with specified requirements.

END OF SECTION

SECTION 079200

JOINT SEALERS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment and services necessary to complete the joint sealers work as shown on the drawings and/or specified herein, including but not necessarily limited to the following:

1. Flashing reglets and retainers.
2. Exterior wall joints not specified to be sealed in other Sections of work.
3. Interior wall joints not specified to be sealed in other Sections of work, including caulking to fill between architectural woodwork and any wall, floor and/or ceiling imperfections.
4. Control and expansion joints in walls.
5. Joints at wall penetrations.
6. Joints between items of equipment and other construction.
7. All other joints required to be sealed to provide a positive barrier against penetration of air and moisture.

1.3 RELATED SECTIONS

A. Roofing - Division 7.

B. Firestop sealants – Section 078413.

C. Aluminum windows – Section 085113.

D. Glazing sealants - Section 088000.

E. Sealant within drywall construction - Section 092900.

F. Sealant at tile work - Section 093000.

1.4 QUALITY ASSURANCE

A. Qualification of Installers: Use only personnel who are thoroughly familiar, skilled and specially trained in the techniques of sealant work, and who are completely familiar with the published recommendations of the sealant manufacturer.

B. Pre-Construction Field Adhesion Testing: Before installing elastomeric sealants, field test their adhesion to project joint substrates according to the method in ASTM C 794 and C 1521 that is appropriate for the types of Project joints.

C. Perform testing per ASTM C 1248 on interior and exterior sealants to determine if sealants or primers will stain adjacent surfaces. No sealant work shall start until results of these tests have been submitted and the Architect has given written approval to proceed with the work.

1.5 SUBMITTALS

A. Shop Drawings: Submit shop drawings showing all joint conditions, indicating relation of adjacent materials, all sealant materials (sealant, bond breakers, backing, primers, etc.), and method of installation.

1. Submit joint sizing calculations certifying that movement capability of sealant is not being exceeded.

B. Samples: Submit the following:

1. Color samples of sealants, submit physical samples (not color chart).

2. Sealant bond breaker and joint backing.

C. Product Data: Submit manufacturer's technical information and installation instructions for:

1. Sealant materials, indicating that material meets standards specified herein.

2. Backing rods.

D. Submit manufacturer's certification as required by Article 1.6 herein.

E. Submit results of testing required in Article 1.4 herein.

1.6 MANUFACTURER'S RESPONSIBILITY AND CERTIFICATION

A. Contractor shall require sealant manufacturer to review the Project joint conditions and details for this Section of the work. Contractor shall submit to the Architect written certification from the sealant manufacturer that joints are of the proper size and design, that the materials supplied are compatible with adjacent materials and backing, that the materials will properly perform to provide permanent watertight, airtight or vaportight seals (as applicable), and that materials supplied meet specified performance requirements.

1.7 ENVIRONMENTAL CONDITIONS

A. Temperature: Install all work of this Section when air temperature is above forty (40) degrees F. and below eighty (80) degrees F., unless manufacturer submits written instructions permitting sealant use outside of this temperature range.

B. Moisture: Do not apply work of this Section on surfaces which are wet, damp, or have frost.

1.8 PRODUCT HANDLING

A. Protection: Use all means necessary to protect the materials of this Section, before, during and after installation and to protect the installed work and materials of all other trades.

B. Replacements: In the event of damage, immediately make all repairs and replacements necessary.

C. Storage

1. Store sealant materials and equipment under conditions recommended by their manufacturer.

2. Do not use materials stored for a period of time exceeding the maximum recommended shelf life of the material.

3. Material shall be stored in unopened containers with manufacturers' name, batch number and date when shelf life expires.

1.9 GUARANTEE

A. Provide a written, notarized guarantee from the manufacturer stating that the applied sealants shall show no material failure for a period of twenty (20) years.

B. Contractor to provide a written, notarized, guarantee stating that the applied sealants shall show no failure due to improper installation for a period of five (5) years.

C. Guarantee shall be in a form acceptable to the Owner and executed by an authorized individual.

D. Include in guarantee provision, agreement to repair and/or replace, at Contractor's expense, sealant defects which develop during guarantee period, because of faulty labor and/or materials.

PART 2 PRODUCTS

2.1 SEALANT MATERIALS

A. Exterior Wall Sealant: Provide one (1) part non-sag sealant equal to "DOWSIL 790" or "DOWSIL 795" made by The Dow Chemical Company, "Silpruf SCS 2000" or "LM SCS 2700" made by G.E., "Spectrem 1" or "Spectrem 3" made by Tremco or "Sonolastic 150" by Sonneborn conforming to the minimum standards of ASTM C 920, Type S, Grade NS, Class 50.

B. Interior Sealant: Provide a one (1) part acrylic based sealant conforming to ASTM C 834, equal to "AC-20+ Silicone" made by Pecora, Masterseal NP 520 by BASF or equal made by Tremco.

C. Colors: Colors selected from manufacturer's standard selection.

2.2 MISCELLANEOUS MATERIALS

A. Back-Up Materials: Provide back-up materials and preformed joint fillers, non-staining, non-absorbent, compatible with sealant and primer, and of a resilient nature, equal to "HBR" made by Nomaco Inc. or approved equal, twenty-five (25) percent wider than joint width. Materials impregnated with oil, bitumen or similar materials shall not be used. Provide back-up materials only as recommended by sealant manufacturer in writing.

B. Provide bond breakers, where required, of polyethylene tape as recommended by manufacturer of sealant.

C. Provide primers recommended by the sealant manufacturer for each material to receive sealant. Note that each exterior joint must be primed prior to sealing.

D. Provide solvent, cleaning agents and other accessory materials as recommended by the sealant manufacturer.

E. Materials shall be delivered to the job in sealed containers with manufacturer's original labels attached. Materials shall be used per manufacturer's printed instructions.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where joint sealers are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. Sealant Installation Standard: Comply with instructions and recommendations of the manufacturer and in accordance with ASTM C 1193 for use of joint sealants as applicable to materials, applications and conditions required by this Project where more stringent installation requirements are specified herein, such requirements shall apply.

B. Sample Section of Sealant

1. During sealant installation work in exterior wall, the manufacturer of sealant shall send their representative to the site, under whose supervision a section of the wall (used as "control section") shall be completed for purposes of determining performance characteristics of sealant in joints. Architect shall be informed of time and place of such installation of control section.

2. Control section shall be installed according to specification given herein and shall not be considered as acceptable until written acceptance is provided by the Architect.

3. Accepted control section shall be standard to which all other sealant work must conform.

C. Supervision: The Contractor shall submit to the Architect written certification from the sealant manufacturer that the applicators have been instructed in the proper application of their materials. The Contractor shall use only skilled and experienced workmen for installation of sealant.

D. Apply sealant under pressure with a hand or power actuated gun or other appropriate means. Gun shall have nozzle of proper size and provide sufficient pressure to completely fill joints as detailed. Neatly point or tool joint to provide the contour as indicated on the drawings.

E. Preparation and Application

1. Thoroughly clean all joints, removing all foreign matter such as dust, oil, grease, water, surface dirt and frost. Sealant must be applied to the base surface. Previously applied film must be entirely removed.

2. Stone, masonry and concrete surfaces to receive sealant shall be cleaned where necessary by grinding, water blast cleaning, mechanical abrading, or combination of these methods as required to provide a clean, sound base surface for sealant adhesion.

   a. Do not use any acid or other material which might stain surfaces.
   b. Remove laitance by grinding or mechanical abrading.
   c. Remove loose particles present or resulting from grinding, abrading, or blast cleaning by blowing out joints with compressed air, oil and water free, or vacuuming joints prior to application of primer or sealant.

3. Clean non-porous surfaces such as metal and glass chemically. Remove protective coatings on metallic surfaces by solvent that leaves no residue and is compatible with sealant. Use solvent and wipe dry with clean, dry lint free paper towels. Do not allow solvent to air dry without wiping. Clean joint areas protected with masking tape or strippable films as above after removal of tape film.

4. Do not seal joints until they are in compliance with drawings, or meet with the control section standard.

5. Joint Size and Sealant Size: Joints to receive sealant shall be at least 1/4" wide. In joint 1/4" to 3/8" wide, sealant shall be 1/4" deep. In joints wider than 3/8" and up to 1" wide, sealant depth shall be one half the joint width. For joints wider than 1", sealant depth shall be as recommended by the sealant manufacturer. Depth of joint is defined as distance from outside face of joint to closest point of the filler.

6. Primer: Thoroughly clean joints and apply primer to all surfaces that will receive sealant. Apply primer on clean, dry surfaces, and prior to installation of joint backing. Completely wet both inner faces of the joint with primer. Mask adjacent surfaces of joint with non-staining masking tape prior to priming. Apply primer with clean brush and only when temperature is above 45 deg. F.

7. Joint Backing: In joints where depth of joint exceeds required depth of sealant, install joint backing (after primer is dry) in joints to provide backing and proper joint shape for sealant. Proper shape for sealant is a very slight "hourglass" shape, with back and front face having slight concave curvature. Use special blunt

T-shaped tool or roller to install joint backing to the proper and uniform depth required for the sealant. Joint backing shall be installed with approximately twenty-five (25) percent compressions. Do not stretch, twist, braid, puncture, or tear joint backing. Butt joint backing at intersections.

8. Bond Breaker: Install bond breaker smoothly over joint backing so that sealant adheres only to the sides of the joint and not backing.

9. Sealant Application: Apply sealant in accordance with the manufacturer's application manual and manufacturer's instructions, using hand guns or pressure equipment, on clean, dry, properly prepared substrates, completely filling joints to eliminate air pockets and voids. Mask adjacent surfaces of joint with non-staining masking tape. Force sealant into joint in front of the tip of the "caulking gun" (not pulled after it) and force sealant against sides to make uniform contact with sides of joint and to prevent entrapped air or pulling of sealant off of sides. Fill sealant space solid with sealant.

10. Tooling: Tool exposed joints to form smooth and uniform beds, with slightly concave surface conforming to joint configuration per Figure 5A in ASTM C 1193. Finished joints shall be straight, uniform, smooth and neatly finished. Remove masking tape immediately after tooling of sealant and before sealant face starts to "skin" over. Neatly remove any excess sealant from adjacent surfaces of joint, leaving the work in a neat, clean condition.

11. Replace sealant which is damaged during construction process.

3.3 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed and cured sealant joints as follows:

   a. Perform 5 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
   b. Perform one test for each 5,000 feet of joint length thereafter or one test per each floor per elevation.

2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.

   a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

3. Inspect tested joints and report on the following:

   a. Whether sealants filled joint cavities and are free of voids.
   b. Whether sealant dimensions and configurations comply with specified requirements.
   c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine

if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.

4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.

5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

END OF SECTION

SECTION 081113

STEEL DOORS AND FRAMES

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the steel doors and frames work as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Interior and exterior hollow metal doors and frames for fire-rated and unrated door openings.
2. Trimmed openings.
3. Interior hollow metal vision panels.
4. Preparation of metal doors and frames to receive finish hardware, including reinforcements, drilling and tapping necessary.
5. Preparation of hollow metal doors to receive glazing where required.
6. Steel louvers for hollow metal doors.
7. Furnishing anchors for building into masonry and drywall.
8. Factory prime painting of work of this Section.

1.3 RELATED SECTIONS

A. Unit Masonry - Section 042000.

B. Installation of doors and frames - Section 062000.

C. Wood Doors - Section 081416.

D. Finish Hardware - Section 087100.

E. Glass and Glazing - Section 088000.

F. Gypsum Drywall - Section 092900.

G. Painting and Finishing - Section 099000.

1.4 SUBMITTALS

A. Product Data: Include construction details, material descriptions, core descriptions, label compliance, compliance with standards referenced herein, sound and fire-resistance ratings, and finishes for each type of door and frame specified.

B. Shop Drawings: Show fabrication and installation of doors and frames. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, reinforcement for surface applied hardware, dimensions of profiles and hardware preparation, location and installation requirements of door and frame hardware and reinforcements, and details of joints and connections. Show anchorage and accessories.

C. Door Schedule: Submit schedule of doors and frames using same reference numbers for details and openings as those on Drawings.

1. Coordinate glazing frames and stops with glass and glazing requirements.

D. Oversize Construction Certification: For door assemblies required to be fire rated and exceeding limitations of labeled assemblies, submit certification of a testing agency acceptable to authorities having jurisdiction that each door and frame assembly has been constructed to comply with design, materials, and construction equivalent to requirements for labeled construction.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing custom steel doors and frames similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

B. Testing Agency Qualifications: An independent agency qualified according to ASTM E 329 for testing indicated.

C. Source Limitations: Obtain custom steel doors and frames through one source from a single manufacturer.

D. Fire-Rated Door and Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated.

1. Test Pressure: Test according to NFPA 252 or UL 10C. After 5 minutes into the test, the neutral pressure level in furnace shall be established at 40" or less above the sill.

2. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a testing agency acceptable to authorities having jurisdiction that doors comply with standard construction requirements for tested and labeled fire-protection-rated door assemblies except for size.

3. Temperature-Rise Rating: At exit enclosures, provide doors that have a temperature-rise rating as required by prevailing Building Code in 30 minutes of fire exposure.

E. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9. Label each individual glazed lite.

F. Smoke-Control Door Assemblies: Comply with NFPA 105 or UL 1784.

G. Fire rated assemblies must have UL approved label.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver doors and frames palleted, wrapped, or crated to provide protection during transit and Project site storage. Do not use nonvented plastic.

B. Inspect doors and frames, on delivery, for damage. Minor damage may be repaired provided refinished items match new work and are approved by Architect; otherwise, remove and replace damaged items as directed.

C. Store doors and frames under cover at building site. Conform to the requirements of ANSI/SDI A250.11 for site storage unless more stringent requirements are noted herein. Place units on minimum 4-inch high wood blocking. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber. If wrappers on doors become wet, remove cartons immediately. Provide minimum 1/4-inch spaces between stacked doors to permit air circulation.

PART 2 PRODUCTS

2.1 FABRICATION - GENERAL

A. Fabricate hollow metal units to be rigid, neat in appearance and free from defects, warp or buckle. Accurately form metal to required sizes and profiles. Weld exposed joints continuously, grind, dress, and make smooth, flush and invisible. Metallic filler to conceal manufacturing defects is not acceptable.

B. Unless otherwise indicated, provide countersunk flat Phillips or Jackson heads for exposed screws and bolts.

C. Prepare hollow metal units to receive finish hardware, including cutouts, reinforcing, drilling and tapping in accordance with Finish Hardware Schedule and templates provided by hardware suppliers. Comply with applicable requirements of ANSI A115 "Specifications for Door and Frame Preparation for Hardware."

D. Locate finish hardware as shown on final shop drawings in accordance with locations noted herein.

2.2 MANUFACTURERS

A. Provide products manufactured by Steelcraft, Curries, Ceco Door Products, Fleming, Pioneer or approved equal meeting these specifications.

B. Exterior Doors and Frames

1. Basis of Design (door): Energy Efficient – TrioE 777E Door by Curries or approved equal.

2. Basis of Design (frame): Curries Company (CU) – Mercury Thermal Broken Frame by Curries or approved equal..

2.3 FRAMES

A. Materials

1. Frames for exterior openings shall be made of commercial grade cold-rolled steel conforming to ASTM A 1008, Type B not less than 14 ga., and shall have a hot dipped galvannealed coating conforming to ASTM A 924 and A 653 with A60 coating. The zinc-alloy coating shall be a dull matte surface treated for paint adhesion.

2. Frames for interior openings shall be either commercial grade cold-rolled steel conforming to ASTM A 1008, Type B or commercial grade hot-rolled steel conforming to ASTM A 1011, Commercial Steel, Type B. Metal thickness shall be not less than sixteen (16) ga. for frames in openings 4'-0" or less in width; not less than fourteen (14) ga. for frames in openings over 4'-0" in width.

B. Design and Construction

1. All frames shall be welded units with integral trim, of the sizes and shapes shown on approved shop drawings. Knock-down frames are not permitted.

2. Thermal Break Frames: Subject to the same compliance standards and requirements as standard hollow metal frames. Tested for thermal performance in accordance with NFRC 102, and resistance to air infiltration in accordance with NFRC 400. Where indicated provide thermally broken frame profiles available for use in both masonry and drywall construction. Fabricate with 1/16” positive thermal break and integral vinyl weatherstripping.

3. All finished work shall be strong and rigid, neat in appearance, square, true and free of defects, warp or buckle. Molded members shall be clean cut, straight and of uniform profile throughout their lengths.

4. Jamb depths, trim, profile and backbends shall be as shown on drawings.

   a. Frames at drywall partitions shall be formed with double return backbends to prevent cutting into drywall surface.

5. Welded frames shall have corners mitered and reinforced and faces of welded frames shall be continuously back welded full depth and width of frame conforming to NAAMM Standard HMMA-820; face joints shall be hairline.

6. Minimum depth of stops shall be 5/8”.

7. Frames for multiple or special openings shall have mullion and/or rail members which are closed tubular shapes having no visible seams or joints. All joints between faces of abutting members shall be securely welded and finished smooth.

   a. Mullions shall have 16 ga. internal steel stiffeners welded not less than 4" o.c.

8. Hardware Reinforcements

a. Frames shall be mortised, reinforced, drilled and tapped at the factory for fully-templated mortised hardware only, in accordance with approved hardware schedule and templates provided by the hardware supplier. Where surface-mounted hardware is to be applied, frames shall have reinforcing plates.

b. Minimum thickness of hardware reinforcing plates shall be as follows (contractor shall provide larger and thicker plates as required to accommodate weight of door):
   1). Hinge and pivot reinforcements - seven (7) ga., 1-1/4" x 10" minimum size.
   2). Strike reinforcements - twelve (12) gauge.
   3). Flush bolt reinforcements - twelve (12) gauge.
   4). Closer reinforcements - twelve (12) gauge.
   5). Reinforcements for surface mounted hardware - twelve (12) gauge.

9. Floor Anchors

   a. Provide adjustable floor anchors, providing not less than two (2) inch height adjustment.
   b. Minimum thickness of floor anchors shall be fourteen (14) gauge.

10. Jamb Anchors

   a. Frames for installation in masonry walls shall be provided with adjustable jamb anchors of the wire type. Anchors shall be not less than 0.156" diameter steel wire. The number of anchors provided on each jamb shall be as follows:
      1). Frames up to 7'-6" height - three (3) anchors.
      2). Frames 7'-6" to 8'-0" height - four (4) anchors.
      3). Frames over 8'-0" height - one (1) anchor for each 2'-0" or fraction thereof in height.
   b. Frames for installation in stud partitions shall be provided with steel anchors of suitable design, not less than eighteen (18) gauge thickness, securely welded inside each jamb as follows:
      1). Frames up to 7'-6" height - four (4) anchors.
      2). Frames 7'-6" to 8'-0" height - five (5) anchors.
      3). Frames over 8'-0" height - five (5) anchors plus one additional for each 2'-0" or fraction thereof over 8'-0".
   c. Frames to be anchored to previously placed concrete or masonry shall be provided with minimum 3/8" concealed bolts set into expansion shields or inserts at six (6) inches from top and bottom and twenty-four (24) inches o.c. Reinforce frames at anchor locations with sixteen (16) gauge sheet steel stiffeners welded to frame at each anchor.

11. Anchors in exterior frames and in masonry walls shall be hot dip galvanized per ASTM A 153.

12. Frames for installation in masonry wall openings more than 4'-0" in width shall have an angle or channel stiffener factory welded into the head. Such stiffeners shall be not less than twelve (12) gauge steel and not longer than the opening width and shall not be used as lintels or load bearing members.

13. Dust cover boxes (or mortar guards) of not thinner than twenty-six (26) gauge steel shall be provided at all hardware mortises on frames to be set in masonry or plaster partitions.

14. Ceiling Struts: Minimum 3/8" thick x 2" wide steel.

15. All frames shall be provided with a steel spreader temporarily attached to the feet of both jambs to serve as a brace during shipping and handling.

16. Loose glazing stops shall be of cold rolled steel, not less than twenty (20) gauge thickness, butted at corner joints and secured to the frame with countersunk cadmium-or zinc-plated screws. Interior frames may be provided with snap-on glazing stops.

17. Except on weather-stripped frames, drill stops to receive three (3) silencers on strike jambs of single door frames and two (2) silencers on heads of double-door frames.

C. Finish: After fabrication, all tool marks and surface imperfections shall be removed, and exposed faces of all welded joints shall be dressed smooth. Frames shall then be chemically treated to insure maximum paint adhesion and shall be coated on all surfaces with one coat of rust-inhibitive baked-on alkyd primer standard with the manufacturer which is fully cured before shipment to a dry film thickness of 2.0 mils.

1. Frames set in masonry walls shall be grouted in as described in Section 042000 "Unit Masonry." These frames shall have surfaces in contact with grout shop coated with epoxy coating equal to Series 27 FC Typoxy made by Tnemec or approved equal spray applied at 4 to 6 mils, passing NFPA 101, Class A for smoke and flame spread, tested per ASTM E 84.

2.4 HOLLOW METAL DOORS

A. Materials: Doors shall be made of commercial quality, level, cold rolled steel conforming to ASTM A 1008, Commercial Steel, Type B and free of scale, pitting or other surface defects. Face sheets for interior doors shall be not less than eighteen (18) gauge. Face sheets for exterior doors shall be not less than sixteen (16) gauge and shall have a hot dipped galvannealed coating conforming to ASTM A 924 and A 653, A60 coating. The zinc alloy coating shall be a dull matte surface treated for paint adhesion.

B. Exterior Doors (Energy Efficient): Face sheets fabricated of commercial quality hot-dipped zinc coated steel that complies with ASTM A924 A60. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model, and ANSI/SDI A250.4 for physical performance level.

1. Design: Flush panel.

2. Core Construction: Foamed in place polyurethane and steel reinforced core with no stiffener face welds.

a. Provide 16 gauge steel vertical reinforcements 6 inches apart and welded in place. Foamed in place polyurethane core is chemically bonded to all interior surfaces. No face welding is permitted.

b. Thermal properties to rate at a fully operable minimum U-Factor 0.36 and R-Value 2.53, including insulated door, Mercury thermal-break frame and threshold.
c. Kerf Type Frames: Thermal properties to rate at a fully operable minimum U-Factor 0.36 and R-Value 2.5, including insulated door, kerf type frame, and threshold.

C. Design and Construction

1. All doors shall be of the types and sizes shown on the approved shop drawings, and shall be fully welded seamless construction with no visible seams or joints on their faces or vertical edges. Minimum door thickness shall be 1-3/4".

2. All doors shall be strong, rigid and neat in appearance, free from warpage or buckles. Corner bends shall be true and straight and of minimum radius for the gauge of metal used.

3. Face sheets shall be stiffened by continuous vertical formed steel sections spanning the full thickness of the interior space between door faces. These stiffeners shall be not less than twenty-two (22) gauge spaced not more than six (6) inches apart and securely attached to face sheets by spot welds not more than five (5) inches o.c. Spaces between stiffeners shall be sound deadened and thermal insulated the full height of the door with an inorganic non-combustible batt type material.

4. Door faces shall be joined at their vertical edges by a continuous weld extending the full height of the door. All such welds shall be ground, filled and dressed smooth to make them invisible and provide a smooth flush surface.

5. Top and bottom edges of all doors shall be closed with a continuous recessed steel channel not less than fourteen (14) gauge, extending the full width of the door and spot welded to both faces. Exterior doors shall have an additional flush closing channel at their top edges and, where required for attachment of weather stripping, a flush closure also at their bottom edges. Openings shall be provided in the bottom closure of exterior doors to permit the escape of entrapped moisture.

6. Edge profiles shall be provided on both vertical edges of doors as follows:

   a. Single-acting swing doors - beveled 1/8" in two (2) inches.
   b. Double acting swing doors - rounded on 2-1/8" radius.
   c. No square edge doors permitted.

7. Hardware Reinforcements

   a. Doors shall be mortised, reinforced, drilled and tapped at the factory for fully templated hardware only in accord with the approved hardware schedule and templates provided by the hardware supplier. Where surface-mounted hardware (or hardware, the interrelation of which is to be adjusted upon installation - such as top and bottom pivots, floor closers, etc.) is to be applied, doors shall have reinforcing plates.
   b. Minimum gauges for hardware reinforcing plates shall be as follows (contractor shall provide larger and thicker plates as required to accommodate weight of door):

1). Hinge and pivot reinforcement - seven (7) gauge.
2). Reinforcement for lock face, flush bolts, concealed holders, concealed or surface mounted closers - twelve (12) gauge.
3). Reinforcements for all other surface mounted hardware - sixteen (16) gauge.

8. Glass Moldings and Stops

a. Where specified or scheduled, doors shall be provided with hollow metal moldings to secure glazing by others in accordance with glass opening sizes shown on drawings.
b. Fixed moldings shall be securely welded to the door on the security side.
c. Loose stops shall be not less than twenty (20) gauge steel, with mitered corner joints, secured to the framed opening by cadmium or zinc-coated countersunk screws spaced eight (8) inches o.c. Snap-on attachments will not be permitted. Stops shall be flush with face of door.

D. Finish: After fabrication, all tool marks and surface imperfections shall be dressed, filled and sanded as required to make all faces and vertical edges smooth, level and free of all irregularities. Doors shall then be chemically treated to insure maximum paint adhesion and shall be coated, on all exposed surfaces, with manufacturer's standard rust-inhibitive alkyd primer as specified for frames which shall be fully cured before shipment.

E. Flatness: Doors shall maintain a flatness tolerance of 1/16" maximum, in any direction, including in a diagonal direction.

2.5 LABELED DOORS AND FRAMES

A. Labeled doors and frames shall be provided for those openings requiring fire protection ratings as scheduled on drawings. Such doors and frames shall be labeled by Underwriters' Laboratories or other nationally recognized agency having a factory inspection service.

B. If any door or frame specified by the Architect to be fire-rated cannot qualify for appropriate labeling because of its design, size, hardware or any other reason, the Architect shall be so advised before fabricating work on that item is started.

2.6 HARDWARE LOCATIONS

A. The location of hardware on doors and frames shall be as noted in "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames" of the Door Hardware Institute unless otherwise required by prevailing Handicapped Codes.

2.7 CLEARANCES

A. Fabricate doors and frames to meet edge clearances as follows:

1. Jambs and Head: 1/8" plus or minus 1/16".

2. Meeting Edges, Pairs of Doors: 1/8" plus or minus 1/16".

3. Bottom: 3/4" if no threshold, 3/8" at threshold.

B. Fire rated doors shall have clearances as required by NFPA 80.

2.8 MANUFACTURING TOLERANCES

A. Manufacturing tolerance shall be maintained within the limits given in HMMA 841 of ANSI/NAAMM, current edition.

2.9 PREPARATION FOR FINISH HARDWARE

A. Prepare door and frames to receive hardware:

1. Hardware supplier shall furnish hollow metal manufacturer approved hardware schedule, hardware templates, and samples of physical hardware where necessary to insure correct fitting and installation.

2. Preparation includes sinkages and cut-outs for mortise and concealed hardware.

B. Provide reinforcements for both concealed and surface applied hardware:

1. Drill and tap mortise reinforcements at factory, using templates.

2. Install reinforcements with concealed connections designed to develop full strength of reinforcements.

2.10 REJECTION

A. Hollow metal frames or doors which are defective, have hardware cutouts of improper size or location, or which prevent proper installation of doors, hardware or work of other trades, shall be removed and replaced with new at no cost.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where steel doors and frames are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. Refer to Section 062000 for installation procedures for all work of this Section.

END OF SECTION

SECTION 081416

WOOD DOORS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment and services necessary to complete the wood doors as shown on the drawings and/or specified herein, including but not limited to, the following:

1. Solid core flush wood doors.

2. Fire rated flush wood doors.

1.3 RELATED SECTIONS

A. Installation of wood doors - Section 062000.

B. Hollow metal frames - Section 081113.

C. Finish hardware - Section 087100.

D. Glass and glazing – Section 088000.

E. Field painting – Section 099000.

1.4 SUBMITTALS

A. Product Data: Submit door manufacturer's product data, specifications and installation instructions for each type of wood door.

1. Include details of core and edge construction and trim for openings.

2. Include factory finish specifications.

3. Include certifications to show compliance with specifications.

4. Include certification to show compliance with AWI and WDMA requirements specified herein.

B. Shop Drawings: Submit shop drawings indicating location and size of each door, elevation of each kind of door, details of construction, location and extent of hardware blocking, fire ratings, requirements for finishing and other pertinent data.

1. Include requirements for veneer matching.

C. Submit the following

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches for each material and finish. For each wood species and transparent finish, provide set of three samples showing typical range of color and grain to be expected in the finished work.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain flush wood doors through one source from a single manufacturer.

B. Quality Standard: Comply with AWI's "Architectural Woodwork Quality Standards Illustrated"; latest edition "Premium" grade and WDMA "Extra Heavy Duty" Performance Level.

1. Only manufacturers that are certified and listed by AWI to be QCP qualified are acceptable for this project.

2. Provide letter of licensing for Project indicating that doors comply with requirements of grade specified.

C. Fire Rated Wood Doors: Doors complying with Category A, Positive Pressure or Neutral Pressure testing standards per UBC 7-2-1997 and UL 10-C (UBC 7-2-1994 and UL 10B) that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated on Door Schedule, based on testing according to NFPA 252.

1. Conform to prevailing Code requirements to determine which pressure standard (Positive or Neutral) is required.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in plastic bags or cardboard cartons.

C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until building is enclosed, wet work is complete, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form, signed by manufacturer, Installer, and Contractor, in which manufacturer agrees to repair or replace doors that are defective in materials or workmanship, have warped (bow, cup, or twist) in excess of permitted standard noted in Article 2.5 herein, or show telegraphing of core construction in face veneers.

1. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.

2. Warranty shall be in effect during the following period of time from date of Substantial Completion:

    a. Solid Core Flush Wood Doors: Life of installation.

PART 2 PRODUCTS

2.1 SOLID CORE FLUSH WOOD DOORS

A. Provide AWI PC-5 Premium Grade hot pressed 5-ply solid core particleboard doors, 1-3/4" thick, conforming to standards specified herein. Subject to meeting standards specified herein, the following manufacturers are acceptable: Masonite, VT Industries, Mohawk or approved equal.

1. Core shall consist of a formed flat panel consisting of wood particles bonded together with synthetic resins or other added binder, with an average density of 30 to 32 lbs. per cubic foot. The material shall meet or exceed the requirements of ANSI A208.1, Grade 1-LD-2 covering mat formed particleboard with face screw holding of 124 lbs., modulus of rupture of minimum 700 psi and modulus of elasticity of not less than 148,000 psi.

2. Core shall be capable of satisfying this WDMA TM-7 cycle slam test for 1 million slams for surface mounted hardware. Where the manufacturer's core does not meet this criteria, stiles and rails must measure a minimum of 5-1/2" and must be fabricated of hardwood.

    a. Surface mounted hardware must be installed with minimum 1-1/4" screw penetrations using threaded to the head screws; coordinate with Section 087100.

B. Cross Bands: Shall be 1/16" thick hardwood extending full width of door and laid with grain at right angles to face veneers. Cross bands and faces shall be laminated to the core with Type I MF or PVA glue.

C. Stiles, Rails: Stile and rail shall be a minimum of 1-3/8" solid hardwood or structural composite lumber (after trimming) laminated to the core. Stiles and rails must be securely glued to the core with no voids allowed. Stiles and rails must be capable of screw holding of 550 lbs. per WDMA TM-10.

D. Vertical door edge must be capable of screw holding of 550 lbs. per WDMA TM-10; horizontal door edge must be capable of screw holding of 400 lbs. per WDMA TM-10.

E. Doors with transparent finish to match finish of existing doors to be relocated, provide full range of sample for Architect selection. Veneer to conform to AWI, "AA" grade veneer with 3" wide leaf. Minimum veneer thickness shall be not less than 1/50" after sanding.

1. Veneers shall be continuous or end matched at transoms.

F. Doors shall have hinge loading capacity of 500 lbs. per WDMA TM-8.

G. Where glass lites are noted, factory cut openings. Trim openings with solid hardwood moldings of same type of wood as face veneer. Lite openings in 20 minute rated doors shall have manufacturer's 20 minute approved hardwood system.

H. Doors to be field painted shall have MDO face.

2.2 FIRE RATED WOOD DOORS ("B" LABEL)

A. Provide mineral core 1-3/4" thick solid core wood doors conforming to standards specified herein, manufactured by one of the manufacturers noted above. Stile construction on both stiles shall conform to the following:

1. Stile edge screw withdrawals when tested in accordance with ASTM D 1037-78 shall exceed 650 lbs. This applies to both stiles.

2. Stile edge split resistance when tested in accordance with ASTM D 143-52 (78) Modified must exceed 950 lbs. This applies to both stiles.

B. Door to have face finish as specified above in Article 2.1.

1. Where the core is free of urea formaldehyde, provide a layer of veneer over the substrate prior to application of finish veneer to prevent telegraphing of patterns from the adhesive.

C. Blocking: For surface mounted hardware only, provide composite blocking designed to maintain fire resistance of door but with improved screw-holding capability of same thickness as core and with minimum dimensions as follows:

1. 5-inch top rail blocking.

2. 5-inch bottom rail blocking.

3. 1 – 5" x 18" lock block at cylinder or mortise locksets.

4. 2 – 5" x 18" lock blocks at exit devices.

D. Pairs: Provide fire-rated pairs with fire-retardant stiles that are labeled and listed for kinds of applications indicated without formed-steel edges and astragals.

2.3 SHOP FINISH

A. Transparent Finish: Finish in the shop with clear satin catalyzed polyurethane finish conforming to AWI System "Catalyzed Polyurethane Transparent".

B. Opaque Finish: For doors to be field painted, shop prime on all surfaces with one coat of alkyd wood primer applied to a dry film thickness of 1.5 mils.

2.4 FABRICATION

A. Prefit and premachine wood doors at the factory.

B. Comply with the tolerance requirements specified herein. Machine doors for hardware requiring cutting of doors. Comply with final hardware scheduled and door frame shop

drawings, and with hardware templates and other essential information required to ensure proper fit of doors and hardware.

C. Take accurate field measurements of hardware mortises in metal frames to verify dimensions and alignment before proceeding with machining in the factory.

D. Doors shall be factory sized to door opening so that trimming and fitting are not required in the field.

E. Factory fit doors to suit frame-opening sizes indicated, with the following uniform clearances unless otherwise indicated.

1. Three degree bevel or bevel to suit frame sizes indicated, with 3/16" prefit in width, +0/-1/32" tolerances. Prefit top of door 1/8" + 1/16"/-0" and undercut as required by floor condition. Undercut shall not exceed 1/8" from bottom of door to top of finished floor; where threshold occurs undercut shall not exceed 1/8" from bottom of door to top of threshold.

2. Comply with requirements in NFPA 80 for fire-rated doors.

F. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3 unless otherwise noted. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.

1. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before factory machining.

2. Provide concealed intumescent seals at fire-rated pairs of doors meeting the requirements of U.L. 10 C.

G. Openings: Cut and trim openings through doors to comply with applicable requirements of referenced standards for kinds of doors required.

2.5 SOURCE QUALITY CONTROL

A. Once installed, maximum allowable warp, bow, cut or twist in doors shall be 1/16" as measured by the 1/16 inch feeler gauge and a straight-edge extending from corner to corner of the door face at stiles, top and bottom rails and along both diagonals.

PART 3 EXECUTION

3.1 INSTALLATION

A. Refer to Section 062000 for installation of wood doors.

END OF SECTION

SECTION 083113

ACCESS DOORS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the access doors as indicated on the drawings and/or specified herein, including, but not limited to, the following:

1. Frameless recessed panel access doors at drywall ceilings and walls.

2. Framed flush panel access doors at masonry and tile walls.

3. Provide access doors and frames for access from occupied spaces to the following, where indicated or required, and as directed by the trades of Divisions 23 and 26.

   a. All shutoff or balancing valves.
   b. Fire dampers, as required.
   c. Points of duct access.
   d. Pull boxes.
   e. Controls of mechanical and electrical items.
   f. Masonry shafts for pipes and conduits, as required.
   g. Pipe spaces, if required.
   h. Inlets of fans.
   i. Fusible link and splitter damper at filter bank.
   j. Automatic damper and motor.
   k. Equipment not otherwise accessible.

1.3 RELATED SECTIONS

A. Masonry - Section 042000.

B. Drywall - Section 092900.

C. Ceramic tile - Section 093100.

D. Valves and connections - Division 23.

1.4 QUALITY ASSURANCE

A. For actual installation of the work of this Section, use only personnel who are thoroughly familiar with the manufacturer's recommended methods of installation and who are completely trained in the skills required.

B. Fire-Resistance Ratings: Wherever a fire-resistance classification is shown, or for construction where access doors are installed, provide required access door assembly with panel door, frame, hinge and latch from manufacturers listed in Underwriters' Laboratories, Inc. "Classified Building Materials Index" for the rating shown.

1. Provide UL label on each access panel.

2. Provide flush, key operated cylinder lock.

C. Size Variations: Obtain Architect's acceptance of manufacturer's standard size units which may vary slightly from sizes shown or scheduled.

1.5 SUBMITTALS

A. Before any materials of this Section are delivered to the job site, submit complete manufacturer's literature to the Architect. Submit plans and schedules showing size and location of each and every access door for Architect's acceptance prior to installation.

1.6 PRODUCT HANDLING

A. Protection: Use all means necessary to protect the materials of this Section before, during and after installation and to protect the installed work and materials of all other trades.

B. Replacements: In the event of damage, immediately make all repairs and replacements necessary.

PART 2 PRODUCTS

2.1 MATERIALS AND FABRICATION

A. Provide access door assembly manufactured by Milcor Inc, or equal made by Nystrom Inc., Karp Associates, Inc. or approved equal. Assembly shall be an integral unit complete with all parts and ready for installation.

B. Fabricate units of continuous welded steel construction. Grind welds smooth and flush with adjacent surfaces. Provide attachment devices and fasteners of the type required to secure access panels to the types of supports shown.

C. Frames for Masonry and Tile Wall Only (Flush Panel Units)

1. Fabricate frame from sixteen (16) gauge steel. Provide frame with exposed flange not less than one (1) inch wide around perimeter of frame for the following construction:

a. Exposed masonry.
b. Tile finish.

2. For installation in masonry construction, provide frames with adjustable metal masonry anchors.

D. Frameless Units for Drywall Surfaces (Recessed Panel Units): Provide access doors without exposed frames for drywall adhered to recessed panel.

E. Panels: Fabricate from fourteen (14) gauge steel, with concealed spring hinges set to open to 175 degrees. Provide removable pin type hinges of the quantity required to support the access panel sizes used in the work. Finish with manufacturer's factory applied baked enamel prime coat applied over phosphate protective coating on steel.

F. Locking Devices

1. For non-rated access doors, provide flush, screwdriver operated cam locks of number required to hold door in flush, smooth plane when closed.

2. For fire rated doors, provide locks as described in paragraph 1.04, B. herein.

G. Inserts and Anchorage: Furnish inserts and anchoring devices which must be built into masonry for the installation of access panels. Provide setting drawings, templates, instructions, and directions for installation of anchorage devices. Coordinate delivery with other work to avoid delay.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where access doors are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 COORDINATION

A. Coordinate all work with the mechanical trades to insure proper locations and in a timely manner to permit orderly progress of the total work.

B. Set frames accurately in position and securely attach to supports with face panels plumb or level in relation to adjacent finish surfaces.

C. Adjust hardware and panels after installation for proper operation.

D. Remove and replace panels or frames which are warped, bowed, or otherwise damaged.

END OF SECTION

SECTION 08 41 13

ALUMINUM ENTRANCES AND STOREFRONTS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the aluminum entrances and storefronts as indicated on the drawings and/or specified herein, including the following:

1. Exterior entrance and storefront system.

1.3 RELATED SECTIONS

A. Joint Sealers - Section 079200.

B. Finish Hardware - Section 087100.

C. Glass and Glazing - Section 088000.

1.4 QUALITY ASSURANCE

A. Source: For each material type required for work of this Section, provide primary materials which are products of one manufacturer. Provide secondary or accessory materials which are acceptable to manufacturers of primary materials.

B. Installer: A firm with a minimum of three years' experience in type of work required by this Section and which is acceptable to manufacturers of primary materials.

C. Design Criteria: Drawings indicate sizes, member spacings, profiles, and dimensional requirements of work of this Section. Minor deviations will be accepted in order to utilize manufacturer's standard products when, in the Architect's sole judgment, such deviations do not materially detract from the design concept or intended performances.

D. Engineering: Provide services of a Professional Engineer registered in the Puerto Rico to design and certify that work of this Section meets or exceeds performance requirements specified.

1.5 TESTS AND PERFORMANCE REQUIREMENTS

A. Manufacturer's Standard Tests: Provide manufacturer's standard test data showing compliance with specified requirements.

B. Testing and performance data applies to exterior assemblies.

1. Systems shall be tested as required per TAS 201, 202 and 203.

C. Test Sequence: Test sequence is optional, except that air infiltration tests shall precede water resistance tests.

D. Air Infiltration Test: Test unit in accordance with TAS 202, as follows:

1. Static Air Pressure Difference: 6.24 psf for fixed storefront units, and 1.567 psf for doors.

2. Performance: Maximum air leakage shall not exceed Code requirements.

E. Water Leakage Test: Test fixed framing system in accordance with TAS 202.

1. Test Pressure: 15% of the positive design pressure.

2. Performance: No leakage as defined in test method at specified test pressure.

F. Uniform Load Deflection Test: Test units in accordance with TAS 202: "Criteria for Testing Impact & Non-impact Resistant Building Envelope Components Using Uniform Static Air Pressure," at following static air pressure difference (Design Wind Pressure), or loads prescribed by code for this project site, whichever is greater. Apply pressure first to exterior side (positive) and then interior side (negative).

1. Design Wind Pressure: As per Structural Drawings.

2. Test Procedure: Procedure A as specified in TAS 202.

3. Performance: Deflection in each member measured at locations of greatest deflection shall not exceed L/180 at specified Design Wind Pressure.

G. Uniform Load Structural Test: Test units in accordance with TAS 202 at following static air pressure difference. Apply high-pressure load first on one side and then on other side. At conclusion of test there shall be no glass breakage, permanent damage to fasteners, hardware parts, support arms or activating mechanisms.

1. Static Air Pressure: Minimum 1.5 times the Design Wind Pressure.

2. Permanent Deformation in Any Member: Not to exceed 0.2% of member span.

H. Thermal Movement: Provide storefront systems that allow for expansion and contraction of members throughout an ambient temperature range of 120 deg F.

I. Windborne-Debris Impact Resistance: Pass missile-impact and cyclic-pressure tests when tested according to ASTM E 1886 and testing information in ASTM E 1996 for Wind Zone 3.

1. Large-Missile Test: For glazed openings located within 30 feet of grade.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials and products in unopened, factory labeled packages. Store and handle in strict compliance with manufacturer's instructions and recommendations. Store under cover and protect from weather damage.

B. Sequence deliveries to avoid delays, but minimize on-site storage.

C. Hurricane Resistance: Conform to requirements of Miami-Dade County Florida for installation. Assemblies shall be capable of withstanding hurricane force winds up to 150 mph (3 second gust).

D. Windborne-Debris-Impact-Resistance Performance: Pass missile-impact and cyclic-pressure tests according to ASTM E 1996 for project Wind Zone.

1. Large-Missile Test: For glazed openings located within 30 feet of grade.

2. Small-Missile Test: For glazed openings located more than 30 feet above grade.

E. Seismic Loads: Provide entrance and storefront systems, including anchorage, capable of withstanding the effects of earthquake motions calculated according to requirements of authorities having jurisdiction or ASCE 7, "Minimum Design Loads for Buildings and Other Structures," Section 9, "Earthquake Loads," whichever are more stringent.

1.7 SUBMITTALS

A. Product Data: Submit manufacturer's printed product data, specifications, standard details, installation instructions, use limitations and recommendations for each material used. Provide certifications that materials and systems comply with specified requirements.

B. Shop Drawings: Provide large scale shop drawings for fabrication, installation and erection of all parts of work. Provide plans, elevations, and details of anchorages, connections and accessory items. Provide installation templates for work installed by others. Show interfaces and relationships to work of other trades.

C. Field Measurements: Take necessary field measurements before preparation of shop drawings and fabrication. Do not delay progress of job. If field measurements are not possible prior to fabrication, allow for field cutting and fitting.

D. Initial Selection Samples: Submit samples showing complete range of colors, textures, and finishes available for each material used.

E. Verification Samples: Submit representative samples of each material that is to be exposed in completed work. Show full color ranges and finish variations expected. Provide samples having minimum size of 144 sq. in.

F. Calculations: Provide professionally prepared calculations and certification of performance of this work. Indicate how design requirements for loading and other performance criteria have been satisfied; refer to Article 1.4, para. D for further description.

G. Test Reports: Provide certified test reports for specified tests.

H. Provide NOA acceptance letter.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials and products in unopened, factory labeled packages. Store and handle in strict compliance with manufacturer's instructions and recommendations. Store under cover and protect from weather damage.

B. Sequence deliveries to avoid delays; minimize on-site storage.

1.9 WARRANTIES

A. Provide written warranty, signed by manufacturer, agreeing to repair or replace work that exhibits defects in materials or workmanship. "Defects" is defined to include, but not be limited to, leakage of water, abnormal aging or deterioration, abnormal deterioration or fading of

finishes, and failure to perform as required. Include requirement for removal and replacement of covering and connected adjacent work.

1. Warranty Period: Three (3) years from date of Substantial Completion; except finish shall be warranted for a period of fifteen (15) years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS/PRODUCTS

A. Basis-of-Design Products: Provide impact-resistant storefront systems acceptable to the Architect and subject to conformance with drawing details and performance criteria specified herein.

1. Refer to drawings for product selections.

2.2 MATERIALS AND ACCESSORIES

A. Aluminum Members: Provide 6063-T5 alloy and temper as recommended by manufacturer for strength, corrosion resistance, and application of required finish. Comply with ASTM B 221 for extrusions, and ASTM B 209 for sheet/plate. Provide 0.125" thick extrusions for door stiles and storefront framing. Provide 0.050" thick aluminum for glazing moldings.

1. Structural aluminum shapes shall conform to ASTM B 308.

B. Fasteners: Provide non-magnetic stainless steel fasteners, warranted by manufacturer to be non-corrosive and compatible with aluminum components.

C. Concealed Flashing: Dead-soft stainless steel, 26 gauge minimum, or extruded aluminum 0.062" minimum, of an alloy and type selected by manufacturer for compatibility with other components.

D. Brackets and Reinforcements: Non-magnetic stainless steel or hot-dip galvanized steel complying with ASTM A 123.

E. Concrete/Masonry Inserts: Cast-iron, malleable iron, or hot-dip galvanized steel complying with ASTM A 123.

F. Bituminous Coatings: Cold-applied asphalt mastic compounded for 30-mil thickness per coat.

G. Compression Weatherstripping: Manufacturer's standard replaceable stripping of molded neoprene or PVC gaskets complying with ASTM D 2287.

H. Sliding Weatherstripping: Manufacturer's standard replaceable stripping of wool, polypropylene, or nylon woven pile, with nylon fabric or aluminum strip backing.

2.3 HARDWARE

A. Provide hardware units as indicated, scheduled, or required for operation of each door. Refer to Section 087100, Finish Hardware for hardware description.

2.4 FABRICATION

A. Sizes and Profiles: Required sizes for door and frame units, including profile requirements, are indicated on Drawings. Any variable dimensions are indicated, together with maximum and

minimum dimensions required to achieve design requirements and coordination with other work.

B. Prefabrication: To greatest extent possible, complete fabrication, assembly, finishing, hardware application, and other work before shipment to project site. Disassemble components only as necessary for shipment and installation.

1. Preglaze door and frame units to greatest extent possible, in coordination with installation and hardware requirements.

2. Do not drill and tap for surface-mounted hardware items until time of installation at project site.

3. Perform fabrication operations, including cutting, fitting, forming, drilling and grinding of metal work in manner which prevents damage to exposed finish surfaces. For hardware, perform these operations prior to application of finishes.

C. Welding: Comply with recommendations of American Welding Society to avoid discoloration; grind exposed welds smooth and restore mechanical finish.

D. Reinforcing: Install reinforcing as necessary for performance requirements; separate dissimilar metals with bituminous paint or other separator to prevent corrosion.

E. Continuity: Maintain accurate relation of planes and angles, with hairline fit of contacting members.

F. Fasteners: Conceal fasteners.

G. Provide EPDM/vinyl blade gasket weatherstripping in bottom exterior door rail, adjustable for contact with threshold.

H. Provisions shall be made in the framing for minimum edge clearance, nominal edge cover, and nominal pocket width for the thickness and type of glazing installed, and shall be in accordance with the FGMA Glazing Manual.

2.5 STOREFRONT FRAMING

A. General: Provide inside-outside matched resilient flush glazed system with provisions for glass replacement. Shop fabricate and preassemble frame components where possible.

B. Thermal-Break Construction: Fabricate exterior aluminum storefront framing system with integrally concealed, low conductance thermal barrier, located between exterior materials and exposed interior members, in manner which eliminates direct metal-to-metal contact. Provide manufacturer's standard construction which has been in use for similar projects for at least three years.

C. For glass and glazing, refer to Section 088000.

2.6 ALUMINUM DOORS

A. Aluminum entrance doors shall be medium stile, factory-glazed aluminum doors manufactured by same manufacturer as storefront framing.

B. Aluminum entrance doors shall be stile and rail type swing doors. Aluminum shall be extruded aluminum conforming to ASTM B 221, 0.125" thick for door stiles and 0.050" thick for glazing molding.

1. Sections shall be of sizes and profiles indicated; shall present straight, sharply defined lines and arrises; and shall be free from defects impairing strength, durability, and appearance.

2. Fasteners where exposed shall be aluminum, stainless steel, or plated steel conforming to ASTM B 633.

C. Each door shall be factory glazed set in neoprene glazing gasket, refer to Section 088000 for glass.

D. Doors shall meet the following resistance to corner racking when tested by the Dual Moment Load Test.

1. Test section shall consist of a standard top door corner assembly. Side rail section shall be 24" long and top rail section shall be 12" long.

2. Anchor top rail positively to test bench so that corner protrudes 3" beyond bench edge.

3. Anchor a lever arm positively to side rail at a point 19" from inside edge of top rail. Attach weight support pad at a point 19" from inner edge of side rail.

4. Test section shall withstand a load of 235 lbs. on the lever arm before reaching the point of failure, which shall be considered a rotation of the lever arm in excess of 45 deg.

E. Air Infiltration (applies only to single acting offset pivot or butt hung entrances): Comply with Code.

F. For door hardware, refer to Section 087100.

G. Door bottom rail of exterior doors shall have an EPDM blade gasket sweep strip applied with concealed fasteners.

H. Corner construction shall consist of mechanical clip fastening, SIGMA deep penetration and fillet welds. Glazing stops shall be hook-in type with EPDM glazing gaskets.

I. The door weatherstripping on a single-acting, offset-pivot or butt-hung exterior door and frame (single or pairs) shall be thermoplastic elastomer weatherstripping of a tubular shape with a semi-rigid polymeric backing.

J. The door weatherstripping on a double-acting, center-pivoted door and frame (single or pairs) shall be pile cloth. The door bottom rail shall be weatherstripped with an EPDM blade gasket sweep strip applied with concealed fasteners.

K. The meeting stiles on pairs of doors shall be equipped with an adjustable astragal.

2.7 FINISH

A. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.

1. Color: Bronze as selected by Architect.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where aluminum entrances and storefronts are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. Install aluminum entrance doors and storefront framing in openings prepared under other Sections plumb, square, level, in exact alignment with surrounding work, with proper clearances, and securely and positively anchored to building structure, to meet performance requirements specified herein, in accordance with manufacturer's published instructions and approved submittals.

B. Use only skilled mechanics for erection, under supervision of manufacturer's representative.

C. Provide protection against galvanic action. Isolate dissimilar materials with bituminous coating or non-absorptive dielectric tape.

D. Install aluminum entrance doors, storefront frame, and finish hardware. Carefully fit and adjust doors and hardware to frames and weatherstripping. After erection check and adjust operating hardware for smooth and proper operation.

E. Set continuous sill members and flashing in a full sealant bed to provide weathertight construction, unless otherwise indicated. Comply with requirements of Section 079200.

F. Erection Tolerances: Install entrance and storefront systems to comply with the following maximum tolerances.

1. Variation from Plane: Limit variation from plane or location shown to 1/8" in 12 feet; 1/4" over total length.

2. Alignment: Where surfaces abut in line, limit offset from true alignment to 1/16". Where surfaces meet at corners, limit offset from true alignment to 1/32".

3. Diagonal Measurements: Limit difference between diagonal measurements to 1/8".

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Contractor shall engage a qualified independent testing agency to perform testing indicated for storefronts.

B. Test fixed frames for water infiltration per AAMA 501.2; latest edition. Test within the first 10% of work complete, area to be a minimum of 100 SF of wall and including a perimeter where frames adjoin adjacent construction. Interior finishes must not interfere with observation of test area or be removed from test area. Not appropriate for operable doors.

1. This test (AAMA 501.2) shall be performed in the field on new construction.

C. Repair or remove Work that does not meet requirements or that is damaged by testing; replace to conform to specified requirements.

3.4 PROTECTION AND CLEANING

A. Protect finished metal surfaces from damage during fabrication, shipping, storage, and erection, and from then until acceptance by Owner.

B. Clean metal surfaces promptly after installation, exercising care to avoid damage. Remove excess sealant, dirt, and other substances. Lubricate hardware and other moving parts.

C. Replace glass that is broken, cracked or chipped prior to time of final acceptance of Project by Owner.

D. Clean glass surfaces promptly after installation, exercising care to avoid damage to same.

END OF SECTION

SECTION 085213

ALUMINUM-CLAD WOOD WINDOWS AND DOORS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the aluminum-clad wood windows and terrace doors as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Aluminum-clad wood windows, fixed and casement.
2. Aluminum-clad wood French doors.
3. Glass and glazing for windows.
4. Anchors, hardware, weather stripping, trim, attachments, and accessories.

B. Provide window units with dual sealant joints and backer rods. Connect the primary sealant joint to the perimeter air/vapor barrier.

1.3 RELATED SECTIONS

A. Unit Masonry - Section 042000.

B. Carpentry - Section 062000, for wood blocking.

C. Sheet Metal Flashing - Section 076200.

D. Joint Sealers - Section 079200.

E. Finish Hardware - Section 087100.

F. Glass and Glazing - Section 088000.

G. Painting and Finishing - Section 099000, for field finishing of exposed interior window members.

1.4 QUALITY ASSURANCE

A. Standards: Comply with requirements of Window and Door Manufacturers Association (WDMA) Industry Standard for Wood Window Units I.S. 2, except to extent more stringent requirements are indicated.

B. Qualifications

1. Fabricator: Single fabricator regularly engaged for at least ten (10) years fabricating products of the kind and quality required for the Project.

2. Installer: Experienced carpenter contractor who has completed comparable work.

C. Design Criteria

1. Wall Openings: Accommodate allowable building wall construction tolerances and moisture caused brick masonry swelling without stressing or deforming window units or over stressing anchorage.

2. Moisture Changes: Accommodate wood shrinking and swelling caused by ambient condition at the Project without stressing window units, over-stressing anchorage, causing sash to bind, or exceeding air/water entry limits.

1.5 DEFINITIONS

A. Performance grade number, included as part of the AAMA/NWWDA product designation code, is actual design pressure in pounds force per square foot used to determine structural test pressure and water test pressure.

B. Structural test pressure, for uniform load structural test, is equivalent to 150 percent of design pressure.

1.6 PERFORMANCE REQUIREMENTS

A. General: Provide wood windows capable of complying with performance requirements indicated, based on testing manufacturer's windows that are representative of those specified and that are of test size indicated below:

1. Minimum size required by AAMA/WDMA/CSA 101/I.S.1/A440-11.

B. AAMA/NWWDA Performance Requirements: Provide wood windows of the performance class and grade indicated that comply with AAMA/NWWDA 101/I.S.2.

1. Performance Class and Grade: AW-PG60-C.

2. Exception to AAMA/NWWDA 101/I.S.2: In addition to requirements for performance class and performance grade, design fixed glass framing system to limit lateral deflections of glass edges to less than 1/175 of glass-edge length or 3/4 inch, whichever is less, at design pressure based on the following:

a. Testing performed according to AAMA/NWWDA 101/I.S.2 Uniform Load Deflection Test.

C. Wood doors shall conform to HGD-AW40 of AAMA/NWWDA 101/I.S. 2-97.

1.7 SUBMITTALS

A. Product Data: Submit manufacturer's specifications, standard details and recommendations for each type of wood window unit required.

1. Submit verification that windows meet standards specified above in Article 1.4.

B. Shop Drawings: Submit shop drawings of windows, including wall elevations and unit elevations at 1" scale, and half-size section details of every typical composite member, including glazing and operators. Show flashing details as related to dissimilar materials.

1. Section and plan details shall indicate method for anchoring frame to masonry or steel framing. Note all fasteners shall be stainless steel.

2. Shop drawings shall indicate the dual sealant joints with the primary seal connected to the perimeter air/vapor barrier membrane on all details.

C. Samples: Submit corner sections, or other samples acceptable to the Architect, of a typical aluminum-clad window section. Samples shall be of sufficient size to show intended quality of workmanship. Include glazing system, quality of construction, and specified finish.

D. Mock-Ups: Window and door assemblies for typical wall openings shall be provided, complete and ready to install.

E. Certifications

1. Fabricator Qualifications: Not less than ten (10) years prior successful production of units similar to those required. List projects having windows of the kind required for the project. Installations shall have been done to meet job conditions and performance requirements of the kind shown and specified for this Project. Give installation dates, locations, contact names, addresses, and phone numbers for each project.

2. As part of submittal requirements, the window manufacturer shall provide certification and "U" value performance for each window unit size.

3. Test Report: Certified independent testing agency reports to show compliance with specified window and door performance requirements. Tests shall have been made within five (5) years of submission. They shall include test descriptions and results and complete enough product descriptions to show that tested products are representative of those proposed for the project.

a. Independent testing laboratory shall meet criteria of ASTM E 548.

F. Maintenance Instructions: Two copies of manufacturer's Technical Manual with recommendations for routine Owner maintenance of window and door units, hardware and wood finishes, and instructions for removing and replacing sash and glass.

1.8 ALLOWABLE TOLERANCE

A. Glazed Openings: Diagonal dimension of glazed openings shall not differ by more than 1/8". Glazing channels shall not bow more than 1/16" per 4 feet, not exceed 1/32" corner off-set.

B. Erection Tolerances: Not more than 1/8" per 12 linear feet variation from plane of location shown in reviewed shop drawings.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver factory assembled windows and doors in enclosed vans. Bundle and label loose materials as necessary to prevent loss and damage.

B. Store products in a clean, protected, dry, well-ventilated building, on platforms or blocking at least 4" above floor. Stack products so they do not warp, bend or twist. Store windows and doors upright, not flat or leaning, with at least 1/4" air space between units.

C. Handle windows and doors with clean hands or canvas gloves.

1.10 JOB CONDITIONS

A. Connecting Work: Constructed or specified tolerances. Field dimensions agreed upon, prior to fabrication.

B. Reference Points: Benchmarks and other required reference points shall be established.

C. Environmental Conditions: Air temperature during installation shall be at least 40 deg. F. and rising, and the wind light or still. Work areas and materials shall be dry and free of ice and snow.

D. Field Measurements: Verify wood window openings by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating wood windows without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to established dimensions.

1.11 WARRANTY

A. Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace wood windows that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure to meet performance requirements.

b. Structural failures including excessive deflection, water leakage, air infiltration, or condensation.

c. Faulty operation of movable sash and hardware.

d. Deterioration of wood, metals, vinyl, other materials, and finishes beyond normal weathering.

e. Failure of insulating glass.

2. Warranty Period:

a. Doors and Windows: Ten (10) years from date of original purchase.

b. Glazing: Twenty (20) years from date of original purchase.

B. Finish Warranty: Provide manufacturer's standard 20-year warranty on exterior cladding finish; warranted against manufacturing defects resulting in chalk, fade and loss of adhesion (peel) per the American Architectural Manufacturer’s Association (AAMA) Specification 2605-11 Section 8.4 and 8.9 for twenty (20) years from the original date of purchase.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Aluminum windows shall be Double Hung Fixed Window with sash back manufactured by JELD-WEN, Inc. or approved equal.

B. Aluminum doors shall be out-swing doors Custom EPIC Series commercial doors as manufactured by JELD-WEN, Inc. or approved equal.

2.2 FIXED AND CASEMENT WINDOWS

A. Components

1. Primary Components: Wood shall be clear AuraLast Pine. Provide trim, and filler units, sealants, and gaskets.

2. Exterior Aluminum Cladding: Extruded aluminum, ASTM B 221.

3. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or galvanized steel.

B. Window Hardware:

1. Gear-Type Rotary Operators: Complying with AAMA 901 when tested according to ASTM E 405, Method A. Provide operators that function without requiring the removal of interior screens or using screen wickets.

2. Hinges: Manufacturer's standard type for sash weight and size indicated.

3. Single-Handle Locking System: Operates positive-acting arms that pull sash into locked position. Provide one arm on sashes up to 29" tall and two arms on taller sashes.

C. (Confirm windows are fixed to delete) Insect Screens: Factory-installed, 18 by 16 charcoal fiberglass screen mesh in formed aluminum frame with baked-on acrylic coating. Frame Finish: As selected by the Architect to match exterior window frame finish.

D. Glazing: Select quality complying with ASTM C 1036. Insulating glass SIGMA/ IGCC certified to performance level CBA when tested in accordance with ASTM E 774.

1. Glazing: Insulating glass, tempered.

2. Glass Type: Low E coating on #2 surface.

3. Glazing Seal: Dual seal consisting of polyisobutylene as the primary seal and polyurethane as the secondary seal.

4. Refer to Section 088000 for additional requirements.

E. Simulated Divided Lites (SDL): 7/8 inch wide. Internal spacer bars.

F. Aluminum Finishes: Finish designations prefixed by "AA" conform to the system established by the Aluminum Association for designating aluminum finishes.

1. Standard finish is one coat of thermally-cured, proprietary, 100% fluoropolymer resin.

2. Performance characteristics of the standard finish shall comply with AAMA 2605 specifications.

3. Color: As selected by the Architect.

G. Interior Wood Finish: Clear finish.

2.3 ALUMINUM-CLAD OUT-SWING DOORS

A. Wood and cladding, including aluminum finish, shall be as specified for windows.

B. Frame

1. Select woods, water-repellent, preservative-treated in accordance with WDMA I.S.-4.

2. Interior Exposed Surfaces: Douglas fir veneered and edge-banded with no visible fastener holes.

3. Exterior Surfaces: Clad with aluminum at head and jambs.

4. Metal Sill: Solid aluminum, ADA approved, low profile, finish as selected by the Architect.

C. Door Panels

1. Select woods, water-repellent, preservative-treated in accordance with WDMA I.S.-4.

2. Panels: Three-ply construction. Randomly finger-jointed blocks laminated with water-resistant glue.

3. Interior Exposed Surfaces: Douglas fir core veneered with Douglas fir, Douglas fir glass stops.

4. Exterior Surfaces: Clad with aluminum.

5. Corners: Urethane-sealed and secured with metal fasteners.

D. Glazing: Select quality complying with ASTM C 1036. Shall comply with 16 CFR 1201 Safety Standard for Architectural Glazing Materials. Insulating glass SIGMA/IGCC certified to performance level CBA when tested in accordance with ASTM E 774.

1. Glazing Method: Tempered insulating glass.

2. Glass Type: Clear, Low E.

3. Glazing Seal: Silicone bedding, exterior.

E. Finish:

1. Exterior: Aluminum clad. Fluoropolymer modified acrylic topcoat applied over primer. Meets or exceeds AAMA 2605 requirements. Color: As selected by the Architect from manufacturer's full range of standard and custom colors.

2. Interior: Treated bare wood; latex prime coat, white.

F. Hardware - Swing Doors: Bolt on butt hinges, single point roller latch locks, standard pull handles and surface mounted mechanical door closers.

1. Finish: As selected by the Architect.

2. Locking System: As scheduled.

G. Weather Stripping: Head jamb and side jambs to have two sets of bulb weather strip, locking stiles have pile weather strip maintaining contact with door panels.

H. Simulated Divided Lites (SDL): 7/8 inch wide. Internal spacer bars.

2.4 FINISH OF ALUMINUM

A. High-Performance Organic Finish: AA-C12C42R1x (Chemical Finish: Cleaned with inhibited chemicals; Chemical Finish: Acid-chromate-fluoride-phosphate conversion coating; Organic Coating: As specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturer's written instructions.

1. Fluoropolymer Two-Coat System: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2605.

2. Custom color and gloss as selected by the Architect.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine surfaces and conditions where aluminum-clad wood windows and terrace doors are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. Comply with manufacturer's instructions and recommendations for installation of wood window units, hardware, accessories, and other components of work.

B. Set units plumb, level, and true to line, without warp or rack of frames or sash. Provide proper support and anchor securely in place. Refer to Sections 079200 for joint fillers and sealants required for installation.

3.3 ADJUST AND CLEAN

A. Adjust operating sash, leaves and hardware to provide smooth operation with tight, weather-proof closure. Lubricate hardware and moving parts.

B. Clean glass of units promptly after installation. Wash and polish glass of both faces not more than four (4) days prior to date scheduled for final inspection. Comply with glass manufacturer's recommendations for final cleaning and maintenance.

C. Remove and replace glass which is broken, chipped, cracked, abraded or damaged in other ways during construction period, including natural causes, accidents and vandalism.

D. Institute protection required through remainder of construction period, to ensure that wood window units will be without damage or deterioration (other than normal weathering) at time of acceptance.

END OF SECTION

SECTION 085653

BULLET-RESISTANT TRANSACTION WINDOW

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. The Work of this Section includes all labor, materials, equipment, and services necessary to complete the transaction window as shown on the drawings and/or specified herein, including, but not necessarily limited to, the following:

1. Bullet resistant transaction window and bullet-resistant glazing.

1.3 RELATED SECTIONS

A. Joint Sealers - Section 079200.

1.4 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.

1.5 SUBMITTALS

A. Shop Drawings

1. Shop drawings shall show in detail and fully indicate locations and quantities of all the work, the kind, finish, size, section of each unit, overall and detail dimensions, factory and field joint locations, arrangements and details, location and detail of each piece of anchorage, and supporting construction provisions for the work of others.

2. Show all surrounding conditions on elevations and details, including steel, masonry, lintels, and anchorage; all correctly dimensioned.

3. Shop drawings of elevations shall be at scale of 3/4" = 1'-0" or larger. Other shop drawings shall be at scale that is normal to trade, or larger if required by Architect.

4. Contract drawings may not be used (reproduced, enlarged, reduced, etc.) for shop drawings.

5. Fully indicate all requirements regarding the manufacture, finishing, handling, storage, carting sequence and erection of the units.

6. Show joinery techniques, provision for horizontal and vertical expansion, glass and metal thicknesses, and framing member profiles.

7. Identify all materials, including metal alloys, glass types, fasteners, and glazing materials. Identify all shop and field sealants by product name and locate on drawings. Glazing details shall be at full size scale.

8. Show dimensioned position of glass edge relative to metal rabbet.

9. Verify all measurements of windows in the field before commencing fabrication.

10. Any proposed deviations from work shown on the Contract drawings shall be indicated and so identified on shop drawings for Architect's review.

1.6 PRODUCT HANDLING

A. Protection: Use all means necessary to protect the materials of this Section before, during and after installation and to protect the installed work and materials of all other trades.

B. Replacements: In the event of damage, immediately make all repairs and replacements necessary.

PART 2 PRODUCTS

2.1 TRANSACTION WINDOW

A. Furnish each transaction window assembly designed and built in a manner that provides a completely assembled, finished unit, installed in a finished opening. Provide units with circular louvered speak holes and stainless-steel shelf with built-in deal tray, as shown.

B. Provide service window as manufactured by TSS, or approved equal. Ballistic acrylic glazing material shall comply with UL 752 for Ballistic Level per drawings.

C. Unit shall have stainless steel deal tray as manufactured by C. R. Laurence, Bullet Resistance Level to match window, model and dimensions as indicated on drawings.

2.2 WINDOW

A. Design Performance:

1. Through the design, manufacturing techniques and material application the TSS Bullet Resistant Window System shall be of the "non-ricochet" type. This assembly shall provide multiple transaction positions utilizing the window configuration. This design shall employ windows in teller line ballistic glazing to complete the design.

   a. Each transaction position may have a stainless steel dip tray as shown on the drawings.
   b. All vision panels shall be cut to size with all exposed edges polished.
   c. Necessary holes shall be pre drilled and tapped where required.
   d. Stainless Steel assembly screws and acrylic spacers shall be provided.
   e. Frame and channel shall be provided by manufacturer.
   f. Anchoring screws shall be provided by manufacturer.
   g. Provide anchor screws as required to install equipment.

B. Field alterations to the construction of the assembly fabricated under the acceptable standards are not allowed unless approved in writing by the manufacturer and Architect.

C. Standard manufacturing tolerances +/- 1/16" shall be maintained.

D. Materials shall meet or exceed UL 752 requirements.

E. Aluminum sections to be manufactured in accordance with ASTM B209, Extruded aluminum alloy 6063 T5 Anodized to match the existing décor and be free of sharp edges or burrs when in place.

F. Glazing Channel: U-Channel specifically designed for securing transparencies tightly in place. Angles and stops are only acceptable for top attachment. All exposed aluminum edges shall be clean cut and have no burrs. Exposed corners shall be rounded and sanded.

G. Tolerances: All joints and connections shall be tight, providing hairline joints and true alignment of adjacent members

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where bulletproof transaction windows are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. Coordinate as required with other trades to assure proper and adequate provision in the work of those trades for interface with the work of this Section.

B. Install the work of this Section in strict accordance with the original design, requirements of governmental agencies having jurisdiction, and the manufacturer's recommended installation procedures, anchoring all components firmly into position for long life under hard use.

C. Use only skilled installers, with work done in accordance with approved shop drawings and specifications.

D. Install window units into prepared openings in strict accordance with approved shop drawings.

1. Set units plumb, level, and true to line, without warp or rack of frame.

E. Any abraded surface of the stainless-steel finish shall be cleaned and refinished to the approval of the Architect.

3.3 ADJUSTING AND CLEANING

A. After completion of installation, window units shall be inspected, adjusted, and left clean, free of labels, etc.

B. Glass that is broken, damaged, cracked, or permanently stained shall be replaced.

END OF SECTION

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes commercial door hardware for the following:

1. Swinging doors.
2. Sliding doors.
3. Other doors to the extent indicated.

B. Door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.
2. Electromechanical door hardware.
3. Cylinders specified for doors in other sections.

C. Related Sections:

1. Division 08 Section “Hollow Metal Doors and Frames”.
2. Division 08 Section “Flush Wood Doors”.
3. Division 08 Section “Stile and Rail Wood Doors”.
4. Division 08 Section “Sound Control Hollow Metal Door Assemblies”.
5. Division 08 Section “Sound Control Wood Door Assemblies”.
6. Division 08 Section “Aluminum-Framed Entrances and Storefronts”.

D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. ICC/IBC - International Building Code.
3. NFPA 70 - National Electrical Code.
4. NFPA 80 - Fire Doors and Windows.
5. NFPA 101 - Life Safety Code.
6. NFPA 105 - Installation of Smoke Door Assemblies.
7. State Building Codes, Local Amendments.

E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:

1. ANSI/BHMA Certified Product Standards - A156 Series.
2. UL10C - Positive Pressure Fire Tests of Door Assemblies.
3. ANSI/UL 294 - Access Control System Units.
4. UL 305 - Panic Hardware.
5. ANSI/UL 437- Key Locks.

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing, fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
3. Content: Include the following information:

    a. Type, style, function, size, label, hand, and finish of each door hardware item.
    b. Manufacturer of each item.
    c. Fastenings and other pertinent information.
    d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
    e. Explanation of abbreviations, symbols, and codes contained in schedule.
    f. Mounting locations for door hardware.
    g. Door and frame sizes and materials.
    h. Warranty information for each product.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Shop Drawings: Details of electrified access control hardware indicating the following:

1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:

a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
b. Complete (risers, point-to-point) access control system block wiring diagrams.
c. Wiring instructions for each electronic component scheduled herein.

2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.

D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.

E. Informational Submittals:

1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

1.4 CLOSEOUT SUBMITTALS

A. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.

B. Project Record Documents: Provide record documentation of as-built door hardware sets in digital format (.pdf, .docx, .xlsx, .csv) and as required in Division 01, Project Record Documents.

1.5 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).

C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the

manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.

1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.

F. Each unit to bear third party permanent label indicating compliance with the referenced testing standards.

G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:

1. Function of building, purpose of each area and degree of security required.
2. Plans for existing and future key system expansion.
3. Requirements for key control storage and software.
4. Installation of permanent keys, cylinder cores and software.
5. Address and requirements for delivery of keys.

H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.

1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
3. Review sequence of operation narratives for each unique access controlled opening.
4. Review and finalize construction schedule and verify availability of materials.
5. Review the required inspecting, testing, commissioning, and demonstration procedures

I. At completion of installation, provide written documentation that components were applied according to manufacturer's instructions and recommendations and according to approved schedule.

1.6 DELIVERY, STORAGE AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.7 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.8 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.
2. Faulty operation of the hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
4. Electrical component defects and failures within the systems operation.

C. Warranty Period: Unless otherwise indicated, warranty shall be one year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Hardware shall not have any visible manufacturer names on exposed materials, except cylinders, when the door is in a closed position.

2.2 BUTT HINGES

A. Hinges: ANSI/BHMA A156.1 butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity:

   a. Two Hinges: For doors with heights up to 60 inches.
   b. Three Hinges: For doors with heights 61 to 90 inches.
   c. Four Hinges: For doors with heights 91 to 120 inches.
   d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:

   a. Widths up to 3’0”: 4-1/2” standard or heavy weight as specified.
   b. Sizes from 3’1” to 4’0”: 5” standard or heavy weight as specified.

3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:

   a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
   b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.

4. Hinge Options: Comply with the following:

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

5. Manufacturers:

   a. Hager Companies (HA) - BB Series, 5-knuckle.
   b. Ives (IV) - 5BB Series, 5-knuckle.
   c. McKinney (MK) - TA/T4A Series, 5-knuckle.

2.3 CONTINUOUS HINGES

A. Pin and Barrel Continuous Hinges: ANSI/BHMA A156.26 Grade 1-600 pin and barrel continuous hinges with minimum 14 gauge Type 304 stainless steel hinge leaves, concealed

stainless pin, and twin self-lubricated nylon bearings at each knuckle separation. Factory trim hinges to suit door height and prepare for electrical cut-outs.

1. Manufacturers:

   a. Hager Companies (HA).
   b. Markar Products; ASSA ABLOY Architectural Door Accessories (MR).
   c. Pemko (PE).

2.4 POWER TRANSFER DEVICES

A. Electrified Quick Connect Transfer Hinges: Provide electrified transfer hinges with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets with a 1-year warranty. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

   1. Manufacturers:

      a. Hager Companies (HA) - ETW-QC (# wires) Option.
      b. Ives (IV) - Connect.
      c. McKinney (MK) - QC (# wires) Option.

B. Electrified Quick Connect Stainless Steel Continuous Transfer Hinges: Provide electrified transfer stainless steel continuous hinges with electrical transfer access prep accessible without de-mounting door from the frame. Furnish with Molex™ standardized plug connectors with sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

   1. Manufacturers:

      a. Ives (IV) - Connect.
      b. Markar Products; ASSA ABLOY Architectural Door Accessories (MR) - MP-ETAP-EL (# wires) Option.
      c. dormakaba BEST (ST) - C Option.

C. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.

   1. Provide one each of the following tools as part of the base bid contract:

a. McKinney (MK) - Electrical Connecting Kit: QC-R001.
b. McKinney (MK) - Connector Hand Tool: QC-R003.

2. Manufacturers:

a. McKinney (MK) - QC-C Series.
b. Schlage (SC) - Connect.
c. dormakaba BEST (ST) - WH Series.

2.5 DOOR OPERATING TRIM

A. Door Push Plates and Pulls: ANSI/BHMA A156.6 door pushes and pull units of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.

1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
4. Pulls shall be provided with a 10” clearance from the finished floor on the push side to accommodate wheelchair accessibility.
5. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets. When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.
6. Manufacturers:

a. Burns Manufacturing (BU).
b. Ives (IV).
c. Rockwood (RO).

2.6 CYLINDERS AND KEYING

A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.

1. Manufacturers:

a. Match Existing, Field Verify.

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

1. Threaded mortise cylinders with rings and cams to suit hardware application.
2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
3. Bored or cylindrical lock cylinders with tailpieces as required to suit locks.

4. Tubular deadlocks and other auxiliary locks.
5. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
6. Keyway:

C. Keying System: Each type of lock and cylinders to be factory keyed.

1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
3. Existing System: Field verify and key cylinders to match Owner's existing system.

D. Key Quantity: Provide the following minimum number of keys:

1. Change Keys per Cylinder: Two (2)
2. Master Keys (per Master Key Level/Group): Five (5).
3. Construction Keys (where required): Ten (10).

E. Construction Keying: Provide construction master keyed cylinders.

F. Key Registration List (Bitting List):

1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
2. Provide transcript list in writing or electronic file as directed by the Owner.

2.7 MORTISE LOCKS AND LATCHING DEVICES

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

1. Manufacturers:

a. Corbin Russwin Hardware (RU) - ML2000 Series.
b. Sargent Manufacturing (SA) - 8200 Series.
c. Schlage (SC) - L9000 Series.

2.8 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.

3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

B. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Strikes for Bored Locks and Latches: BHMA A156.2.
3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
4. Dustproof Strikes: BHMA A156.16.

2.9 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. Exit devices shall have a five-year warranty.
2. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
3. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer’s catalog and template book for specific requirements.
4. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.
5. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.
6. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.

    a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
    b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.

7. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.
8. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2” wide stiles.
9. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
10. Rail Sizing: Provide exit device rails factory sized for proper door width application.
11. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.

B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed exit devices. Listed manufacturers shall meet all functions and features as specified herein.

1. Electromechanical exit devices shall have the following functions and features:

a. Universal Molex plug-in connectors that have standardized color-coded wiring and are field configurable in fail safe or fail secure and operate from 12vdc to 24vdc regulated.
b. EcoFlex or equivalent technology that reduces energy consumption up to 92% as certified by GreenCircle.
c. Options to be available for request-to-exit or enter signaling, latchbolt and touchbar monitoring.
d. Field configurable electrified trim to fail-safe or fail-secure that operates from 12-24VDC.
e. Five-year limited warranty for electromechanical features.

2. Manufacturers:

a. Corbin Russwin Hardware (RU) - ED4000 / ED5000 Series.
b. Sargent Manufacturing (SA) - 80 Series.
c. Von Duprin (VD) - 35A/98 Series.

2.10 SURFACE DOOR CLOSERS

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

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.
2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.
4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.

B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or

aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.

1. Heavy duty surface mounted door closers shall have a 30-year warranty.

2. Manufacturers:

   a. LCN Closers (LC) - 4040 Series.
   b. Norton Rixson (NO) - 7500 Series.
   c. Sargent Manufacturing (SA) - 351 Series.

2.11 ARCHITECTURAL TRIM

A. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1” LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
3. Where plates are applied to fire rated doors with the top of the plate more than 16” above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer’s catalog and template book for specific requirements for size and applications.
4. Protection Plates: ANSI/BHMA A156.6 protection plates (kick, armor, or mop), fabricated from the following:

   a. Stainless Steel: 300 grade, 050-inch thick.

5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
6. Manufacturers:

   a. Hager Companies (HA).
   b. Ives (IV).
   c. Rockwood (RO).

2.12 DOOR STOPS AND HOLDERS

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

B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.

1. Manufacturers:

    a. Hager Companies (HA).
    b. Ives (IV).
    c. Rockwood (RO).

C. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.

1. Manufacturers:

    a. dormakaba (DO).
    b. Norton Rixson (RF).
    c. Sargent Manufacturing (SA).

2.13 ARCHITECTURAL SEALS

A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.

1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.

1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NFPA 252, Standard Methods of Fire Tests of Door Assemblies.

D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.

E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. Manufacturers:

1. Pemko (PE).
2. Reese Enterprises, Inc. (RE).
3. Zero (ZE).

2.14 ELECTRONIC ACCESSORIES

A. Door Position Switches: Door position magnetic reed contact switches specifically designed for use in commercial door applications. On recessed models the contact and magnetic housing snap-lock into a 1" diameter hole. Surface mounted models include wide gap distance design complete with armored flex cabling. Provide SPDT, N/O switches with optional Rare Earth Magnet installation on steel doors with flush top channels.

1. Manufacturers:

a. Sargent Manufacturing (SA) - 3280 Series.
b. Security Door Controls (SD) - DPS Series.
c. Securitron (SU) - DPS Series.

B. Switching Power Supplies: Provide the least number of power supplies at the appropriate amperage level sufficient to exceed the required total draw for the specified electrified hardware and access control equipment.

1. Power supplies shall meet all functions and features as specified herein.

a. UL listed dual voltage 12 or 24 VDC field selectable continuous output.
b. Tolerates brownout or overvoltage input ± 15% of nominal voltage.
c. Thermal shutdown protection with auto restart.
d. Circuit breaker protection against overcurrent and reverse battery faults.
e. Integrated battery charging circuit to prevent overvoltage on locking devices.
f. Available with a single relay fire trigger or individually triggered relayed outputs.
g. Monitoring options as specified.

2. Manufacturers:

a. Altronix (AS) - Maximal 3.
b. Life Safety Power (LP).
c. Securitron (SU) - AQD Series.

2.15 FABRICATION

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

2.16 FINISHES

A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware

C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.

1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
2. DHI TDH-007-20: Installation Guide for Doors and Hardware.
3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

D. Push Plates and Door Pulls: When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.

E. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

F. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.5 CLEANING AND PROTECTION

A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

B. Clean adjacent surfaces soiled by door hardware installation.

C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.6 DEMONSTRATION

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

3.7 DOOR HARDWARE SETS

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

1. Quantities listed are for each pair of doors, or for each single door.
2. The supplier is responsible for handing and sizing all products.
3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.

B. Manufacturer's Abbreviations:

1. MK - McKinney
2. MR - Markar
3. SA - SARGENT
4. RO - Rockwood
5. RF - Rixson
6. NO - Norton
7. PE - Pemko
8. OT - Other
9. SU - Securitron

Hardware Sets

Set: 1.0

1	Continuous Hinge	FM300 EL ETAP	630	MR
1	Exit Device	LC 55 56 8804	US32D	SA
1	Cylinder	AS REQUIRED x MATCH & EXTEND OWNER'S EXISTING KEY SYSTEM	US32D	
1	Door Pull	RM3310-12 Mtg-Type 12HD	US32D	RO
1	Surface Closer	CPS7500	689	NO
1	Kick Plate	K1050 8" high CSK	US32D	RO
1	Set Weatherstrip	303AS		PE
1	Rain Guard	346C		PE
1	Door Bottom Sweep	3452CNB		PE
1	Threshold	2005AT		PE
1	ElectroLynx Harness	QC-C1500P (@ JAMB)		MK
1	ElectroLynx Harness	QC-C000P x LAR		MK
1	Wiring Diagram	AS REQUIRED		SA
1	Card Reader	FURNISHED IN OTHER SECTION		OT
1	Position Switch	DPS-M-BK		SU
1	Power Supply	AQD AS REQUIRED		SU

OPERATION: DOORS NORMALLY CLOSED AND LOCKED. PRESENTATION OF AUTHORIZED CREDENTIAL SIGNALS LATCH RETRACTION AND ALLOWS INGRESS. EGRESS BY EXIT DEVICE PUSH BAR AT ALL TIMES.

Set: 2.0

1	Continuous Hinge	FM300	630	MR
1	Exit Device	LC 8804	US32D	SA
1	Cylinder	AS REQUIRED x MATCH & EXTEND OWNER'S EXISTING KEY SYSTEM	US32D	
1	Door Pull	RM3310-24 Mtg-Type 12HD	US32D	RO
1	Surface Closer	CPS7500	689	NO
1	Set Weatherstrip	303AS		PE
1	Door Bottom Sweep	315CN		PE
1	Threshold	171A		PE

Set: 3.0

1	Continuous Hinge	FM300	630	MR
1	Storeroom Lock	LC 8204 EJ	US32D	SA
1	Cylinder	AS REQUIRED x MATCH & EXTEND OWNER'S EXISTING KEY SYSTEM	US32D	
1	Surface Closer	CPS7500	689	NO
1	Kick Plate	K1050 8" high CSK	US32D	RO
1	Set Weatherstrip	303AS		PE
1	Rain Guard	346C		PE
1	Door Bottom Sweep	3452CNB		PE
1	Threshold	2005AT		PE

Set: 4.0

1	Continuous Hinge	FM300	630	MR
1	Exit Device	LC 8804	US32D	SA
1	Cylinder	AS REQUIRED x MATCH & EXTEND OWNER'S EXISTING KEY SYSTEM	US32D	
1	Door Pull	RM3310-12 Mtg-Type 12HD	US32D	RO
1	Surface Closer	CPS7500	689	NO
1	Kick Plate	K1050 8" high CSK	US32D	RO
1	Set Weatherstrip	303AS		PE
1	Rain Guard	346C		PE
1	Door Bottom Sweep	3452CNB		PE
1	Threshold	2005AT		PE

Set: 5.0

	Hinge	TA2714	US26D	MK
1	Electric Hinge	TA2714 x QC	US26D	MK
1	Exit Device	12 LC 55 8875 ETJ	US32D	SA
1	Cylinder	AS REQUIRED x MATCH & EXTEND OWNER'S EXISTING KEY SYSTEM	US32D	
1	Surface Closer	7500	689	NO
1	Kick Plate	K1050 8" high CSK	US32D	RO
1	Door Stop	409/441CU	US26D	RO
1	Set Door Seals	S88BL		PE
1	ElectroLynx Harness	QC-C1500P (@ JAMB)		MK
1	ElectroLynx Harness	QC-C000P x LAR		MK
1	Wiring Diagram	AS REQUIRED		SA
1	Card Reader	FURNISHED IN OTHER SECTION		OT
1	Position Switch	DPS-M-BK		SU
1	Power Supply	AQD AS REQUIRED		SU
1	Hardware	SEE NOTE BELOW		OT

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTATION OF AUTHORIZED CREDENTIAL UNLOCKS OUTSIDE LEVER AND ALLOWS INGRESS. EGRESS BY EXIT DEVICE PUSH BAR AT ALL TIMES.

NOTE: DOOR TO BE MONITORED BY BUILDING'S FIRE ALARM SYSTEM.

Set: 6.0

	Hinge	TA2714	US26D	MK
1	Exit Device	12 8815 ETJ	US32D	SA
1	Surface Closer	7500	689	NO
1	Kick Plate	K1050 8" high CSK	US32D	RO
1	Door Stop	409/441CU	US26D	RO
1	Set Door Seals	S88BL		PE

Set: 7.0

	Hinge	TA2714	US26D	MK
1	Electric Hinge	TA2714 x QC	US26D	MK
1	Electrified Lock	LC RX 8271 EJ	US32D	SA
1	Cylinder	AS REQUIRED x MATCH & EXTEND OWNER'S EXISTING KEY SYSTEM	US32D	
1	Surface Closer	7500	689	NO
1	Kick Plate	K1050 8" high CSK	US32D	RO
1	Door Stop	409/441CU	US26D	RO
1	Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE
1	ElectroLynx Harness	QC-C1500P (@ JAMB)		MK
1	ElectroLynx Harness	QC-C000P x LAR		MK
1	Wiring Diagram	AS REQUIRED		SA
1	Card Reader	FURNISHED IN OTHER SECTION		OT
1	Position Switch	DPS-M-BK		SU
1	Power Supply	AQD AS REQUIRED		SU

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTATION OF AUTHORIZED CREDENTIAL UNLOCKS OUTSIDE LEVER AND ALLOWS INGRESS. EGRESS BY INSIDE LEVER AT ALL TIMES.

Set: 8.0

	Hinge	TA2714	US26D	MK
1	Electric Hinge	TA2714 x QC	US26D	MK
1	Electrified Lock	LC RX 8271 EJ	US32D	SA
1	Cylinder	AS REQUIRED x MATCH & EXTEND OWNER'S EXISTING KEY SYSTEM	US32D	
1	Surface Closer	PR7500	689	NO
1	Kick Plate	K1050 8" high CSK	US32D	RO
1	Door Stop	409/441CU	US26D	RO
1	Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE
1	ElectroLynx Harness	QC-C1500P (@ JAMB)		MK
1	ElectroLynx Harness	QC-C000P x LAR		MK
1	Wiring Diagram	AS REQUIRED		SA
1	Card Reader	FURNISHED IN OTHER SECTION		OT
1	Position Switch	DPS-M-BK		SU
1	Power Supply	AQD AS REQUIRED		SU

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTATION OF AUTHORIZED

CREDENTIAL UNLOCKS OUTSIDE LEVER AND ALLOWS INGRESS. EGRESS BY INSIDE LEVER AT ALL TIMES.

Set: 9.0

	Hinge	TA2714	US26D	MK
1	Privacy Lock	LB V21 8265 EJ	US32D	SA
1	Surface Closer	7500	689	NO
1	Kick Plate	K1050 8" high CSK	US32D	RO
1	Door Stop	409/441CU	US26D	RO
1	Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE
1	Hardware	SEE NOTE BELOW		OT

NOTE: DOOR 111 - COORDINATE FLOOR STOP LOCATION WITH ARCHITECT.

Set: 10.0

	Hinge	TA2714	US26D	MK
1	Privacy Lock	LB V21 8265 EJ	US32D	SA
1	Overhead Stop	10 SERIES	630	RF
1	Surface Closer	7500	689	NO
1	Kick Plate	K1050 8" high CSK	US32D	RO
1	Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE

Set: 11.0

	Hinge	TA2714	US26D	MK
1	Office Lock	LC 8205 EJ	US32D	SA
1	Cylinder	AS REQUIRED x MATCH & EXTEND OWNER'S EXISTING KEY SYSTEM	US32D	
1	Door Stop	409/441CU	US26D	RO
1	Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE

Set: 12.0

	Hinge	TA2714	US26D	MK
1	Office Lock	LC 8205 EJ	US32D	SA
1	Cylinder	AS REQUIRED x MATCH & EXTEND OWNER'S EXISTING KEY SYSTEM	US32D	
1	Overhead Stop	10 SERIES	630	RF
1	Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE

Set: 13.0

	Hinge	TA2714	US26D	MK
1	Classroom Lock	LC 8237 EJ	US32D	SA
1	Cylinder	AS REQUIRED x MATCH & EXTEND OWNER'S EXISTING KEY SYSTEM	US32D	
1	Door Stop	409/441CU	US26D	RO
1	Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE

Set: 14.0

	Hinge	TA2714	US26D	MK
1	Storeroom Lock	LC 8204 EJ	US32D	SA
1	Cylinder	AS REQUIRED x MATCH & EXTEND OWNER'S EXISTING KEY SYSTEM	US32D	
1	Door Stop	409/441CU	US26D	RO
1	Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE

Set: 15.0

	Hinge	TA2714	US26D	MK
1	Storeroom Lock	LC 8204 EJ	US32D	SA
1	Cylinder	AS REQUIRED x MATCH & EXTEND OWNER'S EXISTING KEY SYSTEM	US32D	
1	Surface Closer	7500	689	NO
1	Kick Plate	K1050 8" high CSK	US32D	RO
1	Door Stop	409/441CU	US26D	RO
1	Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE

Set: 16.0

	Hinge	TA2714	US26D	MK
1	Storeroom Lock	LC 8204 EJ	US32D	SA
1	Cylinder	AS REQUIRED x MATCH & EXTEND OWNER'S EXISTING KEY SYSTEM	US32D	
1	Surface Closer	PR7500	689	NO
1	Kick Plate	K1050 8" high CSK	US32D	RO
1	Door Stop	409/441CU	US26D	RO
1	Set Door Seals/Silencers	S88BL/608 AS REQUIRED		PE

END OF SECTION 087100

SECTION 088000

GLASS AND GLAZING

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment and services necessary to complete the glass and glazing as shown on the drawings and/or specified herein, including but not limited to glazing of the following:

1. Exterior windows and doors
2. Interior borrowed lites.
3. Interior mirrors, frameless.

1.3 RELATED SECTIONS

A. Hollow metal doors and frames - Section 081113.

B. Aluminum clad windows and doors – Section0 085213.

C. Framed mirrors - Section 102800.

1.4 REFERENCES

A. Comply with the recommendations of the following references unless more stringent requirements are indicated herein.

1. IGMA Publications: IGMA Glazing Manual.
2. AAMA Publications: AAMA TIR-A7 Sloped Glazing Guidelines and Glass Design for Sloped Glazing.
3. LSGA Publications: LSGA Design Guide.
4. SIGMA Publications: TM-3000 Vertical Glazing Guidelines and TB-3001 Sloped Glazing Guidelines.
5. Safety Glass: Products complying with ANSI Z97.1 and testing requirements of 16 CFR Part 1201.
6. Fire-Resistive Glazing Products for Door Assemblies: Products identical to those tested per ASTM E I52, labeled and listed by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

7. Fire-Resistive Glazing Products for Window Assemblies: Products identical to those tested per ASTM E 163, labeled and listed by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

8. 16 CFR 1201, Safety Standards for Architectural Glazing, Sealed Insulating Glass Manufacturing Association.

9. ASTM C 920, Elastomeric Joint Sealant.

10. SAFETY ANSI Z97.1.

11. Fire Resistant ASTM E 152.

12. Insulating Glass Criteria - IGCC International Glass Cert. Council.

1.5 PERFORMANCE REQUIREMENTS

A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Glass Design: Glass thicknesses indicated on drawings and/or specified herein are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites for various size openings in nominal thicknesses indicated, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:

1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300, according to the following requirements:

a. Specified Design Wind Loads: Per Structural Drawings.

2. Probability of Breakage for Vertical Glazing:

a. 8 lites per 1000 for lites set vertically or not more than 15 degrees off vertical and under wind action.
b. 1 lite per 1000 for lites installed 15 degrees from the vertical land and under wind action.
c. Load Duration: 60 seconds or less.

3. Maximum Lateral Deflection: For glass supported on all four edges, provide thickness required that limits center deflection at design wind pressure to 1/100 times the short side length or 0.50", whichever is less.

4. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

a. Temperature Change (Range): 120 deg. F ambient; 180 deg F, material surfaces.

5. Thermal Solar Performance: See Article 2.2 herein.

C. Glass units shall be annealed, heat strengthened, fully tempered or laminated where required to meet wind and/or snow loads and safety glazing requirements, as shown, specified or recommended by the glass fabricator and as required by the prevailing Building Code.

1.6 SUBMITTALS

A. Product Data: Submit manufacturer's printed product data, specifications, standard details, glazing instructions, use limitations and recommendations for each material used. Provide certifications that materials and systems comply with specified requirements, including performance requirements.

B. Submit compatibility and adhesion test reports from sealant manufacturer indicating materials were tested for compatibility and adhesion with glazing sealant, as well as other glazing materials including insulation units.

C. Initial Selection Samples: Submit samples of each glass and glazing material showing complete range of colors, textures, and finishes available for each material used.

1. Submit complete range of samples of standard colors and patterns for ceramic frits at insulating glass.

2. Submit complete range of samples of sandblasted glass showing variations of grits and opacity achieved.

D. Verification Samples: Submit representative samples of each glass and glazing material that is to be exposed in completed work. Show full color ranges and finish variations expected. Provide glass samples having minimum size of 144 sq. in. and 6 in. long samples of sealants and glazing materials; all samples shall bear the name of the manufacturer, brand name, thickness, and quality.

E. Calculations: Provide wind load charts, calculations, thermal stress analysis, and certification of performance of this work. Indicate how design requirements for loading and other performance criteria have been satisfied. Document shall be signed and sealed by a Professional Engineer licensed in the State of South Carolina.

F. Test Reports: Provide certified reports for specified tests.

G. Warranties: Provide written warranties as specified herein.

1.7 QUALITY ASSURANCE

A. Source: For each glass and glazing type required for work of this Section, provide primary materials which are products of one manufacturer. Provide secondary or accessory materials which are acceptable to manufacturers of primary materials.

B. Installer: A firm with a minimum of five years experience in type of work required by this Section and which is acceptable to manufacturers of primary materials; and with a successful record of in-service installations similar in size and scope to this Project.

C. Glass Thickness: Glass thicknesses shown on drawings and/or specified herein are minimum thicknesses. Determine and provide size and thickness of glass products that are certified to meet or exceed performance requirements specified in this Section.

D. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated.

1. GANA Publications: GANA'S "Glazing Manual" and "Laminated Glass Design Guide."

2. IGMA Publications: IGMA TM-3000, "Vertical Glazing Guidelines for Sealed Insulating Glass Units."

E. Heat Strengthened, Tempered and Safety Glazing Products: Comply with testing requirements in 16 CFR 1201 and ANSI Z97.1.

1. Heat Strengthened, Tempered and Safety Glazing Labeling: Where heat strengthened, tempered and safety glazing are indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

2. Where glazing units, including Kind FT glass and laminated glass, are specified in Part 2 articles for glazing lites more than 9 sq. ft. in exposed surface area of one side, provide glazing products that comply with Category II materials, for lites 9 sq. ft. or less in exposed surface area of one side, provide glazing products that comply with Category I or II materials, except for hazardous locations where Category II materials are required by 16 CFR 1201 and regulations of authorities having jurisdiction.

F. Insulating Glass Certification Program: Permanently marked on spacers with appropriate certification label of the following testing and inspecting agency:

1. Insulating Glass Certification Council.

2. Associated Laboratories, Inc.

3. Insulating Glass Manufacturers Alliance.

G. Manufacturer shall be ISO 9001-2000 Certified.

H. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies

1.8 TESTS

A. Preconstruction Sealant Test: Submit samples of materials to be used to glazing sealant manufacturer to determine sealant compatibility. Include samples of glass, gaskets, glazing materials, framing members, and other components and accessories of

glazing work. Test in accordance with ASTM C 794 to verify what type of primers (if any) are required to ensure sealant adhesion to substrates.

1. Submit minimum of nine pieces of each type and finish of framing member, and nine pieces of each type, class, kind, condition, and form of glass, including monolithic, laminated, and insulating glass for adhesion tests.

2. Provide manufacturer's written report and recommendations regarding proper installation.

1.9 PROJECT CONDITIONS

A. Weather: Perform work of this Section only when existing or forecasted weather conditions are within limits established by manufacturers of materials and products used.

B. Temperature Limits: Install sealants only when temperatures are within limits recommended by sealant manufacturer, except, never install sealants when temperatures are below 40 deg. F.

1.10 DELIVERY, STORAGE AND HANDLING

A. Deliver materials and products in unopened, factory labeled packages. Store and handle in strict compliance with manufacturer's instructions and recommendations and GANA Manual.

1. Protect materials from moisture, sunlight, excess heat, sparks and flame.

2. Sequence deliveries to avoid delays, but minimize on-site storage.

1.11 WARRANTIES

A. General: Warranties shall be in addition to, and not a limitation of, other rights the Owner may have under the Contract Documents.

B. Manufacturer's Special Project Warranty on Coated Glass Products: Provide written warranty signed by manufacturer of coated glass agreeing to furnish f.o.b. point of manufacture, within specified warranty period indicated below, replacements for those coated glass units which develop manufacturing defects. Manufacturing defects are defined as peeling, cracking or deterioration in metallic coating due to normal conditions and not due to handling or installation or cleaning practices contrary to glass manufacturer's published instructions.

1. Warranty Period: Manufacturer's standard but not less than five (5) years after date of substantial completion.

C. Manufacturer's Special Project Warranty on Insulating Glass: Provide written warranty signed by manufacturer of insulating glass agreeing to furnish f.o.b. point of manufacture, freight allowed project site, within specified warranty period indicated below, replacements for those insulating glass units developing manufacturing defects. Manufacturing defects are defined as failure of the hermetic seal of air space (beyond that due to glass breakage) as evidenced by intrusion of dirt or moisture, internal condensation or fogging, deterioration of protected internal glass coatings, if any, and other visual indications of seal failure or performance; provided the manufacturer's

instructions for handling, installing, protecting and maintaining units have been complied with during the warranty period.

1. Warranty Period: Manufacturer's standard but not less than ten (10) years after date of substantial completion.

D. Manufacturer's Special Project Warranty on Laminated Glass: Manufacturer's standard form, made out to Owner and signed by laminated glass manufacturer agreeing to replace laminated glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty period five (5) years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS/FABRICATORS

A. All glass and glazing used at the exterior of the Project shall be manufactured by the same manufacturer. The same manufacturer and the same furnace shall be used for all tempered and heat strengthened glass used throughout the project. Acceptable manufacturers include the following:

1. Vitro Architectural Glass

2. Guardian Industries.

3. Pilkington.

4. AGC.

5. Viracon.

2.2 GLASS MATERIALS AND PRODUCTS

A. Clear Float Glass: ASTM C 1036, Type I (Transparent, Flat), Class 1 (Clear), Quality q3, minimum 1/4" thick.

B. Clear Tempered Glass: ASTM C 1048, Condition A (Uncoated), Type I (Transparent, Flat), Class 1 (Clear), Quality q3, Kind FT, minimum 1/4" thick. Tempered glass must be certified by SGCC to meet applicable standards. Tempered glass shall also conform to the following:

1. Length and Width: For 2.9 mm to 6.0 mm; +/-1.6 mm.

2. Diagonal: +/- 3.0 mm.

3. Edgework: Belt seaming or diamond wheels. 1.5 mm seam of upper and lower glass edges. No sharp edges.

4. Corners: No more than 3.0 mm from square.

5. Float Glass Defects: Must meet the requirements of ASTM C 1036. The most common defects are scratches, stones gaseous bubbles and edge chips. Tables in the glass standards have limits for size/quantity of defects.

6. Tempered glass shall have a minimum surface compression of 10,000 psi.

7. Tempered glass to be heat-treated by horizontal (roller hearth) process with inherent roller-wave distortion parallel to the bottom edge of the glass when installed.

8. Flatness Tolerances

    a. Roller-Wave or Ripple: The deviation from flatness at any peak shall be targeted not exceed 0.003" as measured per peak to valley for 1/4" (6mm) thick glass.
    b. Bow and Warp: The bow and warp tolerances shall not exceed 1/32" per linear foot.
    c. Fully tempered glass shall be heat soaked to EN 14179-1:2005-European Heat Soaking Standard.

C. Low 'E' Coated Glass: Provide high-performance, clear, metallic coating, equal to Solarban 70 on #2 surface providing following performance

1. Thermal

    a. Winter U-factor (Btu/h·ft2·F): 0.28
    b. Winter U-factor (W/m2·K): 1.60
    c. Solar Heat Gain Coefficient: 0.27
    d. Shading Coefficient: 0.31
    e. Light to Solar Gain: 2.35

2. Optical

    a. Visible Light Transmittance: 64%
    b. Visible Light Reflectance (outside): 13%
    c. Visible Light Reflectance (inside): 14%
    d. Total Solar Transmittance: 23%
    e. Total Solar Reflectance (outside): 40%
    f. Ultraviolet Transmittance: <1%

D. Laminated Safety Glass: Provide two glass panes of equal thickness, laminated together with a polyvinyl butyl interlayer, conform to ASTM C 1172, and as follows:

1. Interlayer Color: Clear.

2. Interlayer Material: Provide Sentry Glass Plus by Dupont, Kuraray America, 0.030" thick at vertical applications, and 0.060" thick at sloped or horizontal applications. Use ionoplast-type (SGP) interlayer where laminated Glass edges will be exposed to direct wetting or relative humidity (RH) conditions greater than 60%.

3. Minimum thickness of 1/4".

E. Patterned Glass: Provide ceramic frit patterned glass in custom colors and patterns as selected by the Architect, minimum thickness of 1/4". Ceramic frit glass shall meet requirements specified herein for ceramic frit spandrel glass.

F. Insulating Glass: Insulated glass composition shall consist of 1/4" clear exterior lite of float (or tempered, where required) glass with Low E coating on No. 2 face, 1/2" air space and 1/4" clear interior lite of laminated with pvb interlayer Saflex 0.030" glass. Provide factory assembled units of organically sealed panes of glass enclosing a hermetically sealed dehydrated air space, complying with ASTM E 2190, and as follows:

1. Sealing System: Dual Seal.

2. Primary Sealant: Polyisobutylene.

3. Secondary Sealant: Silicone, General Electric IGS 3204 or IGS 3100, or Dow Corning 982.

    a. For structurally glazed IG units, secondary seal shall conform to ASTM C 1249.

4. Primary and secondary seals shall not contain voids and must be continuously bonded to the glass structure.

5. Spacer: Clear finish aluminum with welded, soldered, or bent corners, hollow tube types, filled with low nitrogen absorption desicant.

6. Desiccant: Molecular sieve, silica gel, or blend of both.

7. Air Space Thickness: 1/2".

8. Glass Thickness: 1/4" minimum.

9. Units shall be certified for compliance with seal classification "CBA" by the Insulating Glass Certification Council (IGCC) or by IGMA, and tested in accordance with the above ASTM Test Methods.

10. Insulating glass shall conform to the following tolerances:

    a. Length and Width: + 3.0 mm/ -2.0 mm.
    b. Diagonal: +/- 3.0 mm.
    c. Thickness: As agreed +/- 1.0 mm.
    d. Edge-Deletion of Coating: Minimum 8 mm wide. Width of deletion must be more than the width of the secondary seal. Silver layer(s) must be completely removed. Appearance must be uniform.
    e. Primary PIB Seal: Must be complete with no breaks. Appearance must be uniform. PIB bead must overlap coating. No visible bright line when glass is viewed in transmission. The width of the PIB bead shall be 4.0 mm + 3.0/ - 1.5 mm.
    f. Secondary Seal: Nominal 6 mm + 3.0/ - 1.5 mm. The minimum width of the secondary silicone seal for IG units that are glazed structurally must be determined according to ASTM C 1249. The secondary seal must be uniformly applied without bubbles, cavities or gaps. Avoid excess sealant that will need to be trimmed off later.

11. Additional requirements and properties for primary and secondary insulating glass seals and spacers:

    a. All glass units shall comply with IGMA Guidelines which limits the dimension of the visible edge seal encroachment into the vision area to be no greater than the "sightline infringement of 3mm (0.12").
    b. Insulating glass unit hermetic seal to consist of butyl primary and silicone secondary seals with bent, welded, or soldered interpane spacer corners; keyed corners are not acceptable unless also soldered or welded. Spacers shall be aluminum or stainless steel. Locate spacer joint at the top or sides of the units, but in no instances at the sill. Design units to minimize the number of spacer joints. Provide solid keys, embedded in butyl sealant on all four sides, at spacer joints.
    c. Hermetic seals must be continuous and intimately bonded to both lites of glass. Provide primary seal of uniform depth with a nominal width of 1/8 to 3/16 in. Hermetic seals shall not be contaminated with debris, fingerprints, or other foreign matter and shall not contain voids or air pockets that decrease the width of the seal below the minimum widths listed in these Specifications, or that breach the seal. The width of the primary seal shall not be less than 1/16 in., and the total cumulative length of the primary seal between 1/16 in. and 1/8 in. shall be less than 12 in. in any one insulating glass unit. The primary seal shall not have a reduced thickness at the corners. An increased thickness of the primary seal at the corners is acceptable.
    d. Provide secondary seal of uniform depth with a nominal width of 1/4 in. Provide a total width of the primary and secondary seal of 1/2 in. Units shall meet SIGMA 65-7-2, latest edition. Units shall not contain breather or capillary tubes or similar penetrations.

G. Ballistic Glass: Per Drawings.

H. Frameless Mirrors: 1/4", Quality q2, clear float glass with silver, copper, and organic coating, and as follows:

    1. Edges: Uniformly ground and polished.

2.3 GLAZING MATERIALS AND PRODUCTS

A. General: Provide sealants and gaskets with performance characteristics suitable for applications indicated. Ensure compatibility of glazing sealants with insulating glass sealants, with laminated glass interlayers, and with any other surfaces in contact.

B. General Glazing and Cap Bead Sealant: Provide sealant with maximum Shore A hardness of 50. Provide one of the following:

    1. Dow Corning 795.

    2. General Electric Silglaze N 2500 or Contractors SCS-1000.

    3. Tremco Spectrem 2.

C. Weather Seal Sealant: Provide non-acid curing sealant with movement range ± 50%, ASTM C 719. Provide one of the following:

1. Dow Corning 795.

2. General Electric Silpruf.

3. Tremco Spectrem 2.

D. Backer Rod: Closed cell non-gassing polyethylene rod with rod diameter 25% wider than joint width.

E. Dense Elastomeric Compression Seal Gaskets: Provide molded or extruded neoprene or EPDM gaskets, Shore A hardness of 75±5 for hollow profile, and 60±5 for solid profiles, ASTM C 864.

F. Cellular, Elastomeric Preformed Gaskets: Provide extruded or molded closed cell, integral-skinned neoprene, Shore A 40±5, and 20% to 35% compression, ASTM C 509; Type II.

G. Preformed Glazing Tape: Provide solvent-free butyl-polyisobutylene rubber with 100% solids content complying with ASTM C1281 AAMA A 800 with integral continuous EPDM shim. Provide preformed glazing tape in extruded tape form. Provide Tremco "Polyshim II" or approved equal.

H. Setting Blocks: Provide 100% or silicone blocks with Shore A hardness of 80-90. Provide products certified by manufacturer to be compatible with silicone sealants. Length to be not less than 4". Width for setting blocks to be 1/16" more than glass thickness and high enough to provide the lite recommended by glass manufacturer. When thickness of setting block exceeds 3/4" the glass manufacturer must be consulted for sizes and configuration. In a vented system, setting block shall be designed so as to not restrict the flow of water within the glazing rabbet to the weep holes.

1. Shims: For shims used with setting blocks, provide same materials, hardness, length and width as setting blocks.

2. Structural Silicone Glazing: Provide silicone setting blocks where structural silicone occurs at sills and at insulating units with silicone edge seals.

I. Edge Blocks: Provide neoprene or silicone as required for compatibility with glazing sealants. Provide blocks with Shore A hardness of 55±5.

J. Spacers: Elastomeric blocks or continuous extrusions with a Shore A durometer hardness required by glass manufacturer to maintain glass lites in place.

K. Miscellaneous Glazing Materials: Provide sealant backer rods, primers, cleaners, and sealers of type recommended by glass and sealant manufacturers.

L. Mirror Adhesive: Palmer's "Mirro-Mastic", or approved equal; mastic must be compatible with mirror backing.

1. Clips: No. 4 finish Type 304 stainless steel.

2.4 FABRICATION OF GLASS AND OTHER GLAZING PRODUCTS

A. Fabricate glass and other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing standard, to comply with system performance requirements.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites in a manner that produces square edges with slight kerfs at junctions with indoor and outdoor faces.

C. Grind smooth and polish exposed glass edges.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine framing glazing, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.

2. Presence and functioning of weep system.

3. Minimum required face or edge clearances.

4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

3.3 GENERAL GLAZING STANDARDS

A. Install products using the recommendations from the manufacturer of glass, sealants, gaskets and other glazing materials, except where more stringent requirements are indicated, including those in the "GANA Glazing Manual".

B. Verify that Insulating Glass (IG) Unit secondary seal is compatible with glazing sealants.

C. Install glass in prepared glazing channels and other framing members.

D. Install setting blocks in rabbets as recommended by referenced glazing standards in GANA Glazing Manual" and "IGMA Glazing Guidelines".

E. Provide bite on glass, minimum edge and face clearances and glazing material tolerances recommended by "GANA Glazing Manual".

F. Provide weep system as recommended by "GANA Glazing Manual".

G. Set glass lites in each series with uniform pattern, draw, bow and similar characteristics.

H. Distribute the weight of glass unit along the edge rather than the corner.

I. Comply with manufacturers and referenced industry standards on expansion joint and anchors; accommodating thermal movement; glass openings; use of setting blocks, edge, face, and bite clearances; use of glass spacers; edge blocks and installation of weep systems.

J. Protect glass edge damage during handling and installation.

K. Prevent glass from contact with contaminating substances that result from construction operations, such as weld spatter, fireproofing or plaster.

L. Remove and replace glass that is broken, chipped cracked or damaged in any way.

3.4 GLAZING

A. Glazing channel dimensions, as indicated on Shop Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.

B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.

D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead. Install setting blocks at the one greater points of each lite along the horizontal mullion.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide spacers for glass lites where the length plus width is larger than 50 inches as follows:

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.

2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

I. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

J. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

K. Flush Glazing

1. If the butt joint in the metal framing is in the vertical direction, the glazier shall run the tape initially on the head and sill members going directly over this joint. Should the butt joint in the metal framing run horizontally, tapes must first be applied to the jambs so that it crosses over the joint.

2. Each tape section shall butt the adjoining tape and be united with a tool to eliminate any opening.

3. Do not overlap the adjoining length of tape or rubber shim as this will prevent full contact around the perimeter of glass.

L. Off-Set Glazing

1. Where the glazing legs are off-set, the difference in the rabbet width shall be compensated by employing different glazing tapes with different diameter shims. The difference in shim shall be equal to the size of the off-set. The thinner tape shall be positioned first on the glazing leg closest to the interior. The thicker tape shall be cut to the exact length of the dimension between the applied tapes, and installed on the outermost glazing leg.

2. Immediately prior to setting glass, paper backing shall be removed. Apply a toe bead of sealant 6" in each direction, from each corner.

3. Locate setting blocks in the sill member at quarter points, or if necessary to within 6" of each corner. Setting blocks must be set equal distance from center line of the glass and high enough to provide the recommended bite and edge clearances.

4. Set edge block according to glass manufacturer’s recommendations.

5. Set Glass: The glass shall be pressed firmly against the tape to achieve full contact.

6. In a vented system, apply a heel bead (air seal) of sealant around the perimeter of glass, between the sole of the I.G. unit and the base of the rabbet of the metal framing developing a positive bond to the unit and to the metal framing. The bead of the sealant shall be deep enough so that it will partially fill the channel to a depth of 1/4" between the glass edge and the base of the metal framing rabbet.

7. Interior stops shall be set, and glazing tape spline for the appropriate face clearance shall be rolled into place, compressing the glass to the shim within the glazing tape.

3.5 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Where framing joints are vertical, cover these joints by applying tapes to heads and sills first and then to jambs. Where framing joints are horizontal, cover these joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until just before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant as recommended by glass manufacturer or glass frame manufacturer.

G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape where noted on approved shop drawings.

3.6 GASKET GLAZING (DRY)

A. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with stretch allowance during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Install gaskets so they protrude past face of glazing stops.

3.7 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

1. Exterior glazing gasket shall be set a minimum of 1/8” below exterior glazing stop to create a channel for sealant installation.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.8 FRAMELESS MIRRORS

A. Apply mastic to back of mirror "pats" spaced 4 pats/sq. ft.; adjust mirror so that it is plumb and in place to avoid distortion of reflecting images. Allow 1/8" space between back of mirror and wall surface.

1. Apply "pats" using Palmer Electric Applicator.

B. Apply stainless steel clips at mirror top and bottom; securely clip to substrate using non-corrosive anchors. At drywall back-up anchors must be secured to studs or steel wallplate spanning from stud to stud.

3.9 PROTECTION AND CLEANING

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove them immediately as recommended by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for build-up of dirt, scum, alkaline deposits, or stains; remove as recommended by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged in any way, including natural causes, accidents, and vandalism, during construction period.

E. Clean excess sealant or compound from glass and framing members immediately after application, using solvents or cleaners recommended by manufacturers.

F. Glass to be cleaned according to:

1. GANA Glass Information Bulletin GANA 01-0300 – “Proper Procedure for Cleaning Architectural Glass Products”.

2. GANA Glass Informational Bulletin GANA TD-02-0402 – “Heat Treated Glass Surfaces are Different”.

G. Do not use razor blades, scrapers or metal tools to clean glass.

END OF SECTION

SECTION 092900

GYPSUM DRYWALL

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the gypsum drywall as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Gypsum board work for partitions, ceilings, column enclosures, furring, and elsewhere where gypsum drywall work is shown on drawings.
2. Metal supports for gypsum drywall construction.
3. Acoustical insulation for gypsum drywall work.
4. Sealant for gypsum drywall work.
5. Concealed metal reinforcing for attachment of railings, toilet partitions and other items supported on drywall partitions and walls.
6. Taping and finishing of drywall joints.
7. Installing rings and frames in drywall surfaces for grilles, registers and lighting fixtures.
8. Bracing and connections.
9. Security mesh.

1.3 RELATED SECTIONS

A. Thermal insulation - Section 072100.

B. Hollow metal door frames - Section 081113.

C. Access doors - Section 083113.

D. Painting - Section 099000.

E. Elevators - Division 14.

F. Rings for grilles, registers and light fixtures - Division 23 and 26.

1.4 QUALITY ASSURANCE

A. The following standards, as well as other standards which may be referred to in this Section, shall apply to the work of this Section:

1. The Gypsum Construction Handbook, latest edition, USG.

2. Construction Guide, latest edition, National Gypsum.

3. ASTM A 568 "Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements For"

4. ASTM C 475 "Standard Specification for Joint Treatment Materials for Gypsum Wallboard Construction"

5. ASTM C 645 "Standard Specification for Non-Structural Steel Framing Members"

6. ASTM C 754 "Standard Specification for Installation of Steel Framing Members to Receive Screw Attached Gypsum Panel Products"

7. ASTM C 840 "Standard Specification for Application and Finishing of Gypsum Board"

8. ASTM C 919 "Standard Specification for Use of Sealants in Acoustical Applications"

9. ASTM C 954 "Standard Specification for Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases to Steel Studs From 0.033 in. to 0.112 in. in Thickness"

10. ASTM C 1002 "Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Board"

11. ASTM C 1177 "Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing"

12. ASTM C 1178 "Standard Specification for Glass Mat Water Resistant Gypsum Backing Board"

13. ASTM C 1278 "Standard Specification for Fiber-Reinforced Gypsum Panel"

14. ASTM C 1396 "Standard Specification for Gypsum Board"

15. ASTM D 3273 "Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber"

B. Allowable Tolerances: 1/32" offsets between planes of board faces, and 1/16" in 8'-0" for plumb, level, warp and bow.

C. System Design Load

1. Provide standard drywall wall assemblies designed and tested by manufacturer to withstand a lateral load of 5 lbs. per sq. ft. for the maximum wall height required, and with deflection limited to L/240 of partition height.

2. Provide drywall ceiling assemblies designed, fabricated and installed to have a deflection not to exceed L/360.

D. Fire-Resistance Rating: Where gypsum drywall with fire resistance ratings are indicated, provide materials and installations which are identical with those of applicable assemblies tested per ASTM E 119 by fire testing laboratories, or to design designations in UL "Fire Resistance Directory" or in listing of other testing agencies acceptable to authorities having jurisdiction, and compliant with UL Test #2079; criteria for cycle movement for all field height wall sections requiring allowance for vertical deflection within framing details.

E. Installer: Firm with not less than 5 years of successful experience in the installation of specified materials.

F. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Steel Framing Industry Association (SFIA) or be a part of a similar organization that provides verifiable code compliance program.

1.5 SUBMITTALS

A. Submit shop drawing for each drywall partition, furring and ceiling system showing size and gauges of framing members, hanger and anchorage devices, wallboard types, insulation, sealant, methods of assembly and fastening, control joints indicating column lines, corner details, joint finishing and relationship of drywall work to adjacent work.

B. Samples: Each material specified herein, 12" x 12", or 12" long, or in manufacturer's container, as applicable for type of material submitted.

C. Manufacturer's Literature: Submit technical and installation instructions for each drywall partition, furring and ceiling system specified herein, and for each fire-rated and sound-rated gypsum board assembly. Submit other data as required to show compliance with these specifications, including data for mold resistant joint compound.

D. Test Reports: This Contractor shall submit test report, obtained by drywall manufacturer, indicating conformance of drywall assemblies to required fire ratings and sound ratings.

E. Evaluation Reports: Submit evaluation reports certified under an independent third party inspection program administered by an agency accredited by IAS to ICC-ES AC98, IAS Accreditation Criteria for Inspection Agencies.

1.6 PRODUCT HANDLING AND PROTECTION

A. Deliver, store and handle drywall work materials to prevent damage. Deliver materials in their original, unopened containers or bundles, and store where protected from moisture, damage and from exposure to the elements. Store wallboard in flat stacks.

B. Protect wallboard from becoming wet.

C. Protect metal framing from corrosion, deformation, and other damage during delivery, storage, and handling as required by AISI's "Code of Standard Practice".

1.7 ENVIRONMENTAL CONDITIONS

A. Provide and maintain minimum temperature of fifty-five (55) degrees F. and adequate ventilation to eliminate excessive moisture within the building in the area of the drywall work for at least twenty-four (24) hours, prior to, during and after installation of drywall work. Installation shall not start until windows are glazed and doors are installed, unless openings are temporarily closed. Space above suspended ceilings shall be vented sufficiently to prevent temperature and pressure build up.

1.8 JOB MOCK-UP

A. At a suitable location, where directed by the Architect, lay up a portion of a finished wall and ceiling demonstrating the quality of work, including finishing, to be obtained under this Section. Omit drywall boards in locations as directed by the Architect to show stud spacing and attachments; after acceptance, complete assembly.

B. Adjust the finishing techniques as required to achieve the finish required by the Architect as described in this Section of these specifications.

C. Upon approval of the mock-up, the mock-up may be left in place as a portion of the finished work of this Section.

D. All drywall work shall be equal in quality to approved mock-up.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers for Gypsum Drywall Panels and Accessories: U.S. Gypsum Co., Georgia Pacific, CertainTeed Corporation, Certainteed, or National Gypsum Co. meeting specification requirements are acceptable.

1. All drywall products must be manufactured in North America.

B. Acceptable Manufacturers for Metal Supports of Drywall Assemblies: Unless otherwise noted, provide products manufactured by ClarkDietrich, Super Stud Building Products, Marino/Ware, or approved equal.

2.2 METAL SUPPORTS

A. Metal Floor and Ceiling Runners

1. Drywall Track: Formed from 0.0312 inch (20 U.S. Std. gauge) (minimum unless otherwise noted or required by performance requirements) cold formed steel, width to suit shaped metal studs. Use 20 ga. top runners with 1-1/4" minimum flanges.

2. Deflection track or head of wall connections at rated partitions shall conform to UL #2079 for cycle movement. Provide positive mechanical connection of framing to structure, allowing for vertical movement within connections. Minimum of 0.0312 (20 ga.) cold formed steel for clips, 25 ga. cold formed steel for deflection track.

a. Product: ClarkDietrich; [BlazeFrame DSL] [MaxTrak] Slotted Deflection Track As manufactured by the Steel Network, VertiClip or VertiTrack or equal made by Metal-Lite Inc.
b. FireTrak (including stud clips) by FireTrak Corp. or equal made by Metal-Lite Inc.

3. Shaft Wall "J" Type Runner: Formed from 0.0329 inch (20 U.S. Std. gauge) galvanized steel, 1" x 2-1/2" or 4" wide (to suit detail) x 2-1/4" (for shaft wall).

B. Metal Studs, Framing and Furring

1. C-Shaped Studs: Channel type with holes for passage of conduit formed from minimum 0.0312 inch (20 U.S. Std. gauge) (unless heavier gauge is required to meet deflection limits) cold formed steel, width as shown on drawings.

2. Furring Channels: Hat shaped, formed from galvanized steel, 25 U.S. Std. gauge.

a. Product: ClarkDietrich; Furring Channel, or comparable product.

3. "C-H," "CT," or "I" Type Stud: 1-1/2" x 2-1/2", 4" or 6" wide (to suit detail) galvanized steel. Use for shaft wall construction; gauge and size as required to meet deflection limits given herein.

a. Product: ClarkDietrich; CT Stud, or a comparable product.

4. Double "E" Type Stud or "J" Track with Holding Tabs: 1" x 2-1/2", 4" or 6" wide (to suit detail) galvanized steel. Use for shaft wall construction; gauge and size as required to meet deflection limits given herein.

a. Product: ClarkDietrich; J-Tabbed Track, or a comparable product.

5. Continuous 16 gauge x 8" wide steel wall plate screwed to studs as required for support of railings, toilet partitions and other items supported on drywall partitions and walls.

C. Suspended Ceiling and Fascia Supports

1. Main Runners: 1-1/2" steel channels, cold rolled at 0.475 lbs. per ft., rust-inhibitive paint finish.

2. Furring Members: Screw-type hat-shaped furring channels of 25 ga. zinc-coated steel; comply with ASTM C 645.

3. Hangers: Galvanized, 1" x 3/16" flat steel slats capable of supporting 5x calculated load supported.

4. Hanger Anchorages: Provide inserts, clips, bolts, screws and other devices applicable to the required method of structural anchorage for ceiling hangers. Size devices for 5x calculated load supported.

5. Furring Anchorages: 16 ga. galvanized wire ties, manufacturer's standard clips, bolts or screws as recommended by furring manufacturer.

D. Protective Coating: All cold-formed steel members shall have coating conforming to AISI S220; ASTM A 653, G60 or coating with equivalent corrosion resistance of ASTM A653/A653M, G60. Galvannealed products are not acceptable

2.3 GYPSUM WALLBOARD TYPES

A. Gypsum Wallboard: 1/2" thick and 5/8" thick as indicated on drawings, "Sheetrock" by USG, "Gold Bond" by National Gypsum, or "Regular Gypsum" by CertainTeed Corp., 48" wide, in maximum lengths available to minimize end-to-end butt joints.

B. Water-Resistant Backing Board for Tile Finish: 5/8" thick, "DUROCK Glass Mat Tile Backerboard" by USG, "Dens-Shield Tile Backer Board" by Georgia Pacific, or "GlasRoc Tile Backer" by CertainTeed Corp. Cover joints with a pressure sensitive woven glass fiber tape equal to Durock Brand Tile Backer Tape.

C. Moisture/Mold-Resistant Gypsum Wallboard at locations listed below, unless otherwise shown on drawings: 1/2" thick and 5/8" thick as indicated on drawings, "Mold Tough" or "Mold Tough Firecode X" by U.S. Gypsum, "DensArmor Plus" by Georgia Pacific, "Mold Defense" and/or "GlasRoc Interior"or "GlasRoc Type X" by Certainteed, or "Gold Bond EXP Interior Extreme Gypsum Board" by National Gypsum, 48" wide, in maximum lengths available to minimize end-to-end butt joints. Board must have a rating of 10 per ASTM D 3273 with a core that meets ASTM C 1396, Section 6 or ASTM C 1658.

1. Areas in toilet rooms, lockers, janitor's closets not scheduled to receive ceramic tile, or where fire rating is required.

2. Interior faces of exterior walls of basements, cellars and other below grade rooms.

3. Walls and ceilings of spaces containing condensers, water tanks, water pumps and pressure reduction valves.

4. Walls and ceilings of laundry rooms.

5. Portions of walls within 2 feet of kitchen sinks to a height of 4 feet above the floor.

6. Portions of walls within 2 feet of kitchen stoves to a height of 4 feet above the floor.

7. Walls of bathrooms that are not solely water closet compartments, other than walls specifically required to be cement board.

8. Walls and ceilings in service sink closets.

9. Portion of walls within 2 feet of mop sinks or service sinks to a height of 4 feet above the floor.

10. All perimeter walls and wet shafts.

2.4 ACCESSORIES

A. Acoustical Insulation: Paper-less, non-combustible, semi-rigid mineral fiber mat, 2" thick, in walls (unless otherwise indicated), 3 lb./cu. ft. maximum density; Thermafiber "Thermafiber SAFB FF," Rockwool "Rockwool AFBevo" or approved equal.

B. Fasteners for Wallboard: USG Brand Screws; Type S Bugle Head for fastening wallboard to lighter gauge interior metal framing (up to 20 ga.). Type S-12 Bugle Head for fastening wallboard to heavier gauge interior metal framing (20 ga. to 12 ga.); Type S and Type S-12 Pan Head for attaching metal studs to door frames and runners; and Type G Bugle Head for fastening wallboard to wallboard. Lengths specified below under "Part 3 - Execution" Articles and as recommended by drywall manufacturer.

1. For Portland cement base boards, fasteners shall be equal to Durock Steel Screws by U.S. Gypsum.

C. Laminating Adhesive: "Sheetrock Brand Joint Compound."

D. Metal Trim - Corner Beads: For 90 degree External Corners - ClarkDietrich; 103 Deluxe Cornerbead or "Dur-A-Bead" No. 103, 30 U.S. Std. ga. galvanized steel, 1-1/4" x 1-1/4", for 90 degree external corners.

E. Metal Trim - Edge Beads: "Sheetrock Brand Paper Faced Metal Bead and Trim."

F. Partition/Concrete Ceiling Trim: Trim-Tex Super Seal Tear Away or approved equal.

G. Metal Trim Treatment Materials and Joint Treatment Materials for Gypsum Drywall Boards: Paper tape for joint reinforcing; Setting Type (Durabond 90) or Lightweight Setting Type Joint Compound for taping and topping; and Ready Mix Compound for finishing.

1. For mold-resistant drywall, water resistant drywall, and tile backer board, use alkali resistant glass mesh tape with setting joint compound that is rated 10 when tested in accordance with ASTM D 3273 and evaluated in accordance with ASTM D 3274. Acceptable joint compound is "Rapid Set One Pass" made by CTS Cement Manufacturing Corp. or approved equal meeting standards noted herein.

H. Control Joints: ClarkDietrich; #093 Control Joint or No. 0.093, USG. Within fire rated partitions provide FAS-093X

I. Acoustical Sealant: USG "Acoustical Sealant" or "Tremco Acoustical Caulking" of Tremco Mfg. Co., Masterseal NP520 by BASF or approved equal.

J. Neoprene Gaskets: Conform to ASTM D 1056.

K. Security Mesh: Clark Dietrich Barrier Mesh for Security (BM75), 9 gauge, Type II, Class 1 attached with barrier mesh clip or approved equal.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where gypsum drywall is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. General

1. Install drywall work in accordance with drywall manufacturer's printed instructions and as indicated on drawings and specified herein.

2. All metal framing for drywall partitions shall extend from floor to underside of structural deck above. Provide for vertical deflection with positive mechanical connections of framing members to structure.

3. Provide concealed reinforcement, 16 ga. thick by eight (8) inches wide or as detailed or as recommended by manufacturer, for attachment of railings, toilet partitions, and other items to be supported on the partitions which cannot be attached to the metal framing members. Concealed reinforcement shall span between metal studs and be attached thereto using two (2) self-tapping pan head screws at each stud.

a. Back of drywall shall be scored or notched to prevent bulging out where reinforcement plate occurs.

B. Acoustical Assemblies: Install acoustically-rated assemblies to achieve a minimum STC as noted on drawings, in accordance with test results obtained and published by the drywall manufacturer, for the drywall assembly type indicated on the drawings.

C. Sealant

1. Install continuous acoustical sealant bead at top and bottom edges of wallboard where indicated or required for sound rating as wallboard is installed, and between metal trim edge beads and abutting construction.

2. Install acoustical sealant in 1/8" wide vertical control joints within the length of the wall or partitions, and in all other joints, specified below under "Control Joints." Install bead of acoustical sealant around electric switch and outlet boxes, piping, ducts, and around any other penetration in the wallboard; place sealant bead between penetrations and edge of wallboard.

3. Where sealant is exposed to view, protect adjacent surfaces from damage and from sealant material, and tool sealant flush with and in same plane as wallboard surface. Sealant beads shall be 1/4" to 3/8" diameter.

D. Wallboard Application

1. Do not install wallboard panels until steel door frames are in place; coordinate work with Section 081113, "Steel Doors and Frames."

2. See drawings for all board types. Use fire-rated wallboard for fire-rated assemblies. Use water-resistant wallboard where indicated on drawings and where wallboard would be subject to moisture. Install water-resistant wallboard in full, large sheets (no scraps) to limit number of butt joints.

3. Apply wallboard with long dimension parallel to stud framing members, and with abutting edges occurring over stud flanges.

4. Install wallboard for partitions from floor to underside of structure above and secure rigidly in place by screw attachment, unless otherwise indicated.

5. Provide "Thermafiber" safing insulation meeting standards of Section 078413 at flutes of metal deck where partitions carry up to bottom of metal deck.

6. Neatly cut wallboard to fit around outlets, switch boxes, framed openings, piping, ducts, and other items which penetrate wallboard; fill gaps with acoustic sealant.

7. Where wallboard is to be applied to curved surfaces, dampen wallboard on back side as required to obtain required curve. Finish surface shall present smooth, even curve without fluting or other imperfections.

8. Screw fasten wallboard with power-driven electric screw driver, screw heads to slightly depress surface of wallboard without cutting paper, screws not closer than 3/8" from ends and edges of wallboard.

9. Where studs are doubled-up, screw fasten wallboard to both studs in a staggered pattern.

E. Metal Trim: Install and mechanically secure in accordance with manufacturer's instructions; and finish with three (3) coats of joint compound, feathered and finish sanded smooth with adjacent wallboard surface, in accordance with manufacturer's instructions.

1. Corner Beads: Install specified corner beads in single lengths at all external corners, unless corner lengths exceed standard stock lengths.

2. Edge Beads: Install specified edge beads in single lengths at all terminating edges of wallboard exposed to view, where edges abut dissimilar materials, where edges would be exposed to view, and elsewhere where shown on drawings. Where indicated on drawings, seal joint between metal edge bead and adjoining surface with specified gasket, 1/8" wide minimum and set back 1/8" from face of wallboard, unless other size and profile indicated on drawings.

3. Casing beads shall be set in long lengths, neatly butted at joints. Provide casing beads at juncture of board and vertical surfaces and at exposed perimeters.

F. Control Joint Locations: Gypsum board surfaces shall be isolated with control joints where:

1. Ceiling abuts a structural element, dissimilar wall or other vertical penetration.

2. Construction changes within the plane of the partition or ceiling.

3. Shown on approved shop drawings.

4. Ceiling dimensions exceed thirty (30) feet in either direction.

5. Wings of "L," "U," and "T" shaped ceiling areas are joined.

6. Expansion or control joints occur in the structural elements of the building.

7. Shaftwall runs exceed 30' without interruption.

8. Partition or furring abuts a structural element or dissimilar wall or ceiling.

9. Partition or furring runs exceed 30' without interruption.

10. Where control joints are required, ceiling height door frames may be used as control joints. Less than ceiling height frames shall have control joints extending to the ceiling from both corners.

G. Joint Treatment and Spackling

1. Joints between face wallboards in the same plane, joints at internal corners of intersecting partitions and joints at internal corners of intersections between ceilings and walls or partitions shall be filled with joint compound.

2. Screw heads and other depressions shall be filled with joint compound. Joint compound shall be applied in three (3) coats, feathered and finish surface sanded smooth with adjacent wallboard surface, in accordance with manufacturer's instructions. Treatment of joints and screw heads with joint compound is also required where wallboard will be covered by finish materials which require a smooth surface, such as vinyl wall coverings.

H. Security Mesh: Barrier Mesh shall be attached to framing members using specified clips through recommended threaded fasteners. Install no less than 12" on-center vertically on framing members

3.3 FURRED WALLS AND PARTITIONS

A. Use specified metal furring channels. Run metal furring channel framing members vertically, space sixteen (16) inches o.c. maximum. Fasten furring channels to concrete or masonry surfaces with power-driven fasteners or concrete stub nails spaced sixteen (16) inches o.c. maximum through alternate wing flanges (staggered) of furring channel. Furring channels shall be shimmed as necessary to provide a plumb and level backing for wallboard. At inside of exterior walls, an asphalt felt protection strip shall be installed between each furring channel and the wall. Furring channel and splices shall be provided by nesting channels at least eight (8) inches and securely anchoring to concrete or masonry with two (2) fasteners in each wing.

B. Wallboard Installation: Same as specified under Article 3.4 - "Metal Stud Partitions."

3.4 METAL STUD PARTITIONS

A. Unless otherwise noted, steel framing members shall be installed in accordance with ASTM C 754.

B. Runner Installation: Use channel type. Align accurately at floor according to partition layout. Anchor runners securely sixteen (16) inches o.c. maximum with power-driven

anchors to floor slab, with power-driven anchors to structural slab above. See "Stud Installation" below for runners over heads of metal door frames. Where required, carefully remove sprayed-on fireproofing to allow partition to be properly installed.

C. Stud Installation

1. Use channel type, positioned vertically in runners, spaced as noted on drawings, but not more than sixteen (16) inches o.c.

2. Anchor studs to floor runners with screw fasteners. Provide snap-in or slotted hole slip joint bolt connections of studs to ceiling runners leaving space for movement. Anchor studs at partition intersections, partition corners and where partition abuts other construction to floor and ceiling runners with sheet metal screws through each stud flange and runner flange.

3. Connection at ceiling runner for non-rated partitions shall be snap-in or slotted hole slip joint bolt connection that shall allow for movement. Seal studs abutting other construction with 1/8" thick neoprene gasket continuously between stud and abutting construction.

4. Connections for fire rated partitions at ceiling runners shall conform to UL Design #2079.

5. Install metal stud horizontal bracing wherever vertical studs are cut or wallboard is cut for passage of pipes, ducts or other penetrations, and anchor horizontal bracing to vertical studs with sheet metal screws.

6. At jambs of door frames and borrowed light frames, install doubled-up studs (not back to back) from floor to underside of structural deck, and securely anchor studs to jamb anchors of frames and to runners with screws. Provide cross braces from hollow metal frames to underside of slab.

7. Over heads of door frames, install cut-to-length section of runner with flanges slit and web bent to allow flanges to overlap adjacent vertical studs, and securely anchor runner to adjacent vertical studs with sheet metal screws. Install cut-to-length vertical studs from runner (over heads of door frame) to ceiling runner sixteen (16) inches maximum o.c. and at vertical joints of wallboard, and securely anchor studs to runners with sheet metal screws.

8. At control joints, in field of partition, install double-up studs (back to back) from floor to ceiling runner, with 1/4" thick continuous compressible gasket between studs. When necessary, splice studs with eight (8) inches minimum nested laps and attach flanges together with two (2) sheet metal screws in each flange. All screws shall be self-tapping sheet metal screws.

D. Runners and Studs at Chase Wall: As specified above for "Runners" and "Studs" and as specified herein. Chase walls shall have either a single or double row of floor and ceiling runners with metal studs sixteen (16) inches o.c. maximum and positioned vertically in the runners so that the studs are opposite each other in pairs with the flanges pointing in the same direction. Anchor all studs to runner flanges with sheet metal screws through each stud flange and runner flange following requirements of paragraph 3.4, B. Provide cross bracing between the rows of studs by attaching runner

channels or studs set full width of chase attached to vertical studs with one self-tapping screw at each end. Space cross bracing not over thirty-six (36) inches o.c. vertically.

E. Wallboard Installation - Single Layer Application (Screw Attached)

1. Install wallboard with long dimension parallel to framing member and with abutting edge joints over web of framing member. Install wallboard with long dimension perpendicular to framing members above and below openings in drywall extending to second stud at each side of opening. Joints on opposite sides of wall shall be arranged so as to occur on different studs.

2. Boards shall be fastened securely to metal studs with screws as specified. Where a free end occurs between studs, back blocking shall be required. Center abutting ends over studs. Correct work as necessary so that faces of boards are flush, smooth, true.

3. Wallboard screws shall be applied with an electric screw gun. Screws shall be driven not less than 3/8" from ends or edges of board to provide uniform dimple not over 1/32" deep. Screws shall be spaced twelve (12) inches o.c. in the field of the board and 8" o.c. staggered along the abutting edges.

4. All ends and edges of wallboard shall occur over screwing members (studs or furring channels). Boards shall be brought into contact but shall not be forced into place. Where ends or edges abut, they shall be staggered. Joints on opposite sides of a partition shall be so arranged as to occur on different studs.

5. At locations where piping receptacles, conduit, switches, etc., penetrate drywall partitions, provide non-drying sealant and an approved sealant stop at cut board locations inside partition.

F. Wallboard Installation - Double-Layer Application

1. General: See drawings for wallboard partition types required.

2. First Layer (Screw Attached): Install as described above for single layer application.

3. Second Layer (Screw Attached): Screw attach second layer, unless laminating method of attachment indicated on drawings or necessary to obtain required sound rating or fire rating. Install wallboard vertically with vertical joints offset thirty-two (32) inches from first layer joints and staggered on opposite sides of wall. Attach wallboard with 1-5/8" screws sixteen (16) inches o.c. along vertical joints and sixteen (16) inches o.c. in the field of the wallboard. Screw through first layer into metal framing members.

4. Second Layer (Laminated): Install wallboard vertically. Stagger joints of second layer from first layer joints. Laminate second layer with specified laminating adhesive in beads or strips running continuously from floor to ceiling in accordance with manufacturer's instructions. After laminating, screw wallboard to framing members with 1-5/8" screws, spaced twelve (12) inches o.c. around perimeter of wallboard.

G. Wallboard Installation - Laminated Application: Where laminated wallboard is indicated, use specified laminating adhesive, install wallboard vertically and maintain tolerances as specified for screw attached wallboard.

H. Insulation Installation: Install where indicated on drawings. Place blanket tightly between studs.

I. Deflection of Structure Above: To allow for possible deflection of structure above partitions, provide top runners for non-rated partitions with 1-1/4" minimum flanges and do not screw studs or drywall to top runner. Where positive anchorage of studs to top runner is required, anchorage device shall be by means of slotted hole (in clip connection with screw attachment to web of steel through bushings located in slots of clips), or other anchorage device approved by Architect.

J. Control Joints

1. Leave a 1/2" continuous opening between gypsum boards for insertion of surface mounted joint.

2. Back by double framing members.

3. Attach control joint to face layer with 9/16" galvanized staples six (6) inches o.c. at both flanges along entire length of joint.

4. Provide two (2) inch wide gypsum panel strip or other adequate seal behind control joint in fire rated partitions and partitions with safing insulation.

3.5 DRYWALL FASCIAS AND CEILINGS

A. Furnish and install inserts, hanger clips and similar devices in coordination with other work.

B. Secure hangers to inserts and clips. Clamp or bolt hangers to main runners.

C. Space main runners 4'-0" o.c. and space hangers 4'-0" o.c. along runners, except as otherwise shown.

D. Level main runners to a tolerance of 1/4" in 12'-0", measured both lengthwise on each runner and transversely between parallel runners.

E. Metal Furring Channels: Space sixteen (16) inches o.c. maximum. Attach to 1-1/2" main runner channels with furring channel clips (on alternate sides of main runner channels). Furring channels shall not be let into or come in contact with abutting masonry walls. End splices shall be provided by nesting furring channels no less than eight (8) inches and securely wire tying. At any openings that interrupt the furring channels, install additional cross reinforcing to restore lateral stability.

F. Mechanical accessories, hangers, splices, runner channels and other members used in suspension system shall be of metal, zinc coated, or coated with rust inhibitive paint, of suitable design and of adequate strength to support units securely without sagging, and such as to bring unit faces to finished indicated lines and levels.

1. Provide special furring where ducts are over two (2) feet wide.

G. Apply board with its long dimension at right angles to channels. Locate board butt joints over center of furring channels. Attach board with one (1) inch self-drilling drywall screws twelve (12) inches o.c. in field of board at each furring channel; eight (8) inches o.c. at butt joints located not less than 3/8" from edges.

3.6 SHAFT WALLS

A. Runner Installation: Use "J" metal runners at floor and ceiling, with the short leg toward finish side of wall. Securely attach runners to structural supports with power-driven fasteners at both ends and twenty-four (24) inches o.c.

B. Shaft Wall Liner: Cut shaft wall liner panels one (1) inch less from floor to ceiling height and erect vertically between J-runners.

C. C-H Studs: Cut metal studs 3/8" to not more than 1/2" less than floor to ceiling height and install between shaft wall liner panels so that panels are fitted snugly into the one (1) inch wide "H," "T," or "I" portion of the stud. Space studs twenty-four (24) inches o.c., unless otherwise indicated on drawings. Install full-length steel E-Studs or J-runners vertically at T-intersections, corners, door jambs, and columns. Install full length E-Studs or J-runners over shaft wall liner both sides of closure panels. Frame openings cut within a liner panel with J-Runner around perimeter. For openings, frame with vertical E-Stud or J-runner at edges, horizontal runner at head and sill, and reinforcing as shown on the drawings. Suitably frame all openings to maintain structural support for wall. Install floor-to-ceiling steel E-Studs or J-runners each side of elevator door frames to act as strut-studs. Attach strut-stud to floor and ceiling runners with two (2) 3/8" Type S screws, space twelve (12) inches o.c. Over metal doors, install a cut to length section of runner and attach to strut-studs with clip angles and 3/8" Type S Screws space twelve (12) inches o.c.

D. Wallboard Installation - Double Layer Installation: Erect gypsum wallboard base layer vertically or horizontally to meet fire rating on one side of studs with end joints staggered. Fasten base layer panels to studs with one (1) inch Type S screws twenty-four (24) inches o.c. Caulk perimeter of base layer panels. Apply gypsum wallboard face layer vertically over base layer with joints staggered and attached with 1-5/8" Type S screws staggered from those in base, spaced eight (8) inches o.c. and driven into studs.

E. Wallboard Installation (Where Both Sides of Shaft Wall are Finished): Apply gypsum wallboard face layers vertically both sides of studs. Stagger joints on opposite partition sides. Fasten panels with one (1) inch or two (2) inches Type S screws spaced eight (8) inches o.c. in field and along edges into studs.

F. Cants: Provide one (1) inch thick shaft wall liner, cut to suit condition, at beams and other projections wider than two (2) inches in elevator shafts. Cants shall slope seventy-five (75) degrees from the horizontal. Screw attach shaft wall liner to the vertical metal studs.

G. Support elevator hoistway door frames independently of drywall shaft framing system, or reinforce system in accordance with system manufacturer's instructions.

H. Where handrails are indicated for direct attachment to drywall shaft system, provide not less than a sixteen (16) ga. x eight (8) inches wide galvanized steel reinforcement

strip, accurately positioned and secured to studs and concealed behind not less than one 1/2" thick course of gypsum board in the system.

I. Integrate stair hanger rods with drywall shaft system by locating cavity of system as required to enclose rods.

J. Horizontal Shaftwall Duct and Ceiling Assemblies: Provide I-stud cavity shaftwall system for horizontal duct protection consisting of I-studs 24" o.c. with 1" fire-rated shaft liner panels inserted in the stud tabs, and three layers of 1/2" firecode C gypsum board attached to the stud flanges opposite the shaft liner panels.

3.7 ERECTION AT COLUMN ENCLOSURES

A. Metal furring supports shall be provided under work of this Section, and shall be cut to lengths as necessary for tight fit such that spacing is not more than sixteen (16) inches o.c.

B. Board shall be fastened securely to supports with screws as specified. Place boards in position with minimum number of joints. Where free ends occur between supports, back-blocking or furring shall be required. Center abutting ends over supports. Correct work as necessary so that faces of boards are flush, smooth and true. Provide clips or cross furring for attachment as required.

C. All layers shall be screw attached to furring.

D. When column finish called for on drawings to be in the same plane as drywall finish layer, maintain even, level plane.

3.8 FINISHING

A. Taping: A thin, uniform layer of compound shall be applied to all joints and angles to be reinforced. Reinforcing tape shall be applied immediately, centered over the joint, seated into the compound. A skim coat shall follow immediately, but shall not function as a fill or second coat. Tape shall be properly folded and embedded in all angles to provide a true angle.

B. Filling: After initial coat of compound has hardened, additional compound shall be applied, filling the board taper flush with the surface. The fill coat shall cover the tape and feather out slightly beyond the tape. On joints with no taper, the fill coat shall cover the tape and feather out at least four (4) inches on either side of the tape. No fill coat is necessary on interior angles.

C. After compound has hardened, a finishing coat of compound shall be spread evenly over and extending slightly beyond the fill coat on all joints and feathered to a smooth, uniform finish. Over tapered edges, the finished joint shall not protrude beyond the plane of the surface. All taped angles shall receive a finish coat to cover the tape and taping compound, and provide a true angle. Where necessary, sanding shall be done between coats and following the final application of compound to provide a smooth surface, ready for painting.

D. Fastener Depressions: Compound shall be applied to all fastener depressions followed, when hardened by at least two (2) coats of compound, leaving all depressions level with the plane of the surface.

E. Finishing Beads and Trim: Compound shall be applied to all bead and trim and shall be feathered out from the ground to the plane of the surface. When hardened, this shall be followed by two (2) coats of compound each extending slightly beyond the previous coat. The finish coat shall be feathered from the ground to the plane of the surface and sanded as necessary to provide a flat, smooth surface ready for decoration.

F. Except as otherwise noted, level of finish for surface exposed to view shall conform to Level 4 of ASTM C 840 and GA-214 of the Gypsum Association.

1. For drywall boards with fiberglass facing, provide Level 5 finish of ASTM C 840 and GA-214.

G. Drywall construction with defects of such character which will mar appearance of finished work, or which is otherwise defective, will be rejected and shall be removed and replaced at no expense to the Owner.

3.9 CLEANING AND ADJUSTMENT

A. At the completion of installation of the work, all rubbish shall be removed from the building leaving floors broom clean. Excess material, scaffolding, tools and other equipment shall be removed from the building.

B. Work shall be left in clean condition ready for painting or wall covering. All work shall be as approved by Architect.

C. Cutting and Repairing: Include all cutting, fitting and repairing of the work included herein in connection with all mechanical trades and all other trades which come in conjunction with any part of the work, and leave all work complete and perfect after all trades have completed their work.

3.10 PROTECTION OF WORK

A. Installer shall advise Contractor of required procedures for protecting drywall work from damage and deterioration during remainder of construction period.

END OF SECTION

SECTION 093000

CERAMIC TILE

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the ceramic tile as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Ceramic mosaic floor tile.
2. Ceramic glazed wall tile and matching base.
3. Stone saddles.
4. Setting beds, grout and sealant.
5. Waterproofing membrane.

1.3 RELATED SECTIONS

A. Concrete - Section 033000.

B. Masonry - Section 042000.

C. Gypsum drywall - Section 092900.

1.4 REFERENCES

A. ANSI A108 Series/A118 Series - American National Standards for Installation of Ceramic Tile.

B. ANSI A136.1 - American National Standards for Organic Adhesives for Installation of Ceramic Tile.

C. ASTM C 144 - Standard Specification for Aggregate for Masonry Mortar.

D. ASTM C 150 - Standard Specification for Portland Cement.

E. TCNA - Handbook for Ceramic, Glass and Stone Tile Installation; Tile Council of North America, latest 2021 Edition.

F. ISO 13007 - International Standards Organization; classification for Grout and Adhesives.

G. LFT Tile – Large Format Tile, tile 15” or larger in any one direction.

1.5 QUALITY ASSURANCE

A. Qualifications of Installers: For cutting, installing and grouting of ceramic tile, use only thoroughly trained and experienced journeyman tile setters who are completely familiar with the requirements of this work, and the recommendations contained in the referenced standards, and the installers are Certified Ceramic Tile Installer (CTI) through the Ceramic Tile Education Foundation (CTEF) or Tile Installer Thin Set Standards (ITS) verification through the University of Ceramic Tile and Stone.

B. Codes and Standards: In addition to complying with all pertinent codes and regulations, comply with the following:

1. Manufacture all tile in accordance with Standard Grade Requirements of ANSI A-137.1.

2. Install all ceramic tile in accordance with the recommendations contained in Handbook for Ceramic, Glass and Stone Tile Installation of the Tile Council of North America, Inc., latest edition noted herein and ANSI A108/A118/A136.

3. Stone tiles shall conform to the requirements of ASTM C1242.

C. Flooring surfaces shall have a minimum wet DCOF AcuTest value of 0.42 and tested per ANSI A326.3 Dynamic Coefficient of Friction of Hard Surface Flooring Materials.

1.6 SUBMITTALS

A. Samples

1. Before any ceramic tile is delivered to the job site, submit to the Architect sample panels, approx. 12" x 12", mounted on hardboard back-up with selected grout color for each color and pattern of ceramic tile and grout specified.

2. Submit 6" length of stone saddles.

3. Submit 12" x 12" samples of waterproofing membrane.

B. Master Grade Certificates: Prior to opening ceramic tile containers, submit to the Architect a Master Grade Certificate, signed by an officer of the firm manufacturing the ceramic tile used, and issued when the shipment is made, stating the grade, kind of tile, identification marks for tile containers, and the name and location of the project.

C. Mock-ups

1. At an area on the site where approved by the Architect, provide a mock-up ceramic tile installation.

    a. Make the mock-up approximately 3’-0” x 3’-0” in dimension.

    b. Provide one mock-up for each type, class, and color of installation required under this Section.

    c. The mock-ups may be used as part of the Work, and may be included in the finished Work, when so approved by the Architect.

    d. Revise as necessary to secure the Architect's approval.

2. The mock-ups, when approved by the Architect, will be used as datum for comparison with the remainder of the work of this Section for the purposes of acceptance or rejection.

3. If the mock-up panels are not permitted to be part of the finished Work, completely demolish and remove them from the job site upon completion and acceptance of the work of this Section.

1.7 PRODUCT HANDLING

A. Delivery and Storage

1. Deliver all materials of this Section to the job site in their original unopened containers with all labels intact and legible at time of use.

2. Store all materials under cover in a manner to prevent damage and contamination; store only the specified materials at the job site.

B. Protection: Use all means necessary to protect the materials of this Section before, during and after installation and to protect the installed work and materials of all other trades.

C. Replacements: In the event of damage, immediately make all repairs and replacements necessary.

1.8 PROJECT CONDITIONS

A. Maintain environmental conditions and protect work during and after installation to comply with referenced standards and manufacturer's printed recommendations.

B. Vent temporary heaters to exterior to prevent damage to tile work from carbon dioxide buildup.

C. Maintain temperatures at not less than 50 deg. F. in tiled areas during installation and for 7 days after completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Tile: Obtain tile of each type and color or finish from single source or producer.

1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.

1. Obtain setting and grouting materials, except for unmodified Portland cement and aggregate, from single manufacturer.

2. Obtain waterproof/crack isolation membrane, except for sheet products, from manufacturer of setting and grouting materials.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer:

1. Stone thresholds.

2. Waterproof membrane.

3. Metal edge strips.

2.2 TILE

A. Refer to finish schedule on drawings.

2.3 TRIM AND SPECIAL SHAPES

A. Provide external and internal corners, trim shapes at openings, and all other trim and special shapes to match the tile specified herein, as required by field conditions and drawing details.

2.4 STONE SADDLES

A. Provide sound stone saddles as selected by the Architect, minimum 3/4" thick, with an abrasive hardness of not less than 10.0, when tested in accordance with ASTM C 241. Cut saddle to fit jamb profile, honed finish.

2.5 METAL TRIM

A. Anodized aluminum of profiles indicated on drawings by Schluter or approved equal.

2.6 SURFACE PREPARATION (PROPOSED ADDITION)

A. Self-Leveling Underlayment for rapid leveling of concrete, Portland cement mortar bed, plywood, and existing stone or ceramic tile floors to achieve flatness. Meeting minimum compressive strength of 4400 psi and application from feather edge to 1-1/2" or per manufacturer's recommendation.

1. Laticrete NXT Level Plus and NXT Primer
2. Mapei UltraPlan 1 Plus and Primer
3. SikaLevel 325
4. Bostik SL-100 and Universal Primer Pro
5. Custom Tech T-150

2.7 MORTAR BED, BOND COAT AND GROUT

A. Portland Cement: ASTM C 150, Type I.

B. Hydrated Lime: ASTM C 207, Type S.

C. Sand: ASTM C 144, clean and graded natural sand.

D. Reinforcing for Mud Set Systems: 2" x 2" x 16/16 ga. welded wire mesh.

E. Latex Modified Mortar Bed

1. Laticrete 3701 Fortified Mortar Bed
2. MAPEI, "4 to 1 Mud Bed Mix" with "Planicrete AC"
3. Pro Spec, Floor Mud with B-710 SBR Acrylic Additive.
4. SikaLevel 050 Rapid Slope
5. Bostik, Mud in a Bag with 425 latex admixture
6. Custom Building Products Thick Bed Mortar and Thin-set Mortar Admix

F. Latex – Portland Cement Bond Coat, complying with ANSI A118.15 and ISO 13007, C2ES1P1 with minimum compressive strength of 400 psi.

1. Laticrete, 254 Platinum
2. MAPEI, Keraflex Super.
3. Pro Spec – Permalastic System consisting of Permalastic Dryset Mortar and Permalastic Admixture

4. SikaTile 350 Flex Set

5. Custom Building Products Pro-Lite Premium Mortar.

G. Improved Modified Cement Mortars, complying with ANSI 118.15 and ISO 13007, CSES1P1.

(Also for use with LFT Tile and Stone Tile)

1. Laticrete, MultiMax Lite

2. Mapei; Keraflex Super.

3. SikaTile 475 LHT Premium Set or SikaTile 500 LHT Lite (above products are lightweight and non-lightweight)

4. Bostik, BAM

5. Custom Building Products Mega-Lite Ultimate LHT Mortar.

H. Wall and Base Tile

1. Over glass mat water resistant gypsum backer board use a Latex Portland cement mortar bond coat, Laticrete TriLite, MAPEI, Keraflex Super or Ultralite Mortar, Customs Pro-Lite, SikaTile 475 LHT Premium Set and for non-LHT SikaTile 350 Flex Set or equal by Pro Spec, conforming to ANSI A118.15, ISO 13007-C2ES1P1, and TCNA Detail W-245.

I. Floor Tile and Stone Saddle - Waterproof Setting Bed: Set floor tile and stone saddle using thin set latex Portland cement bond coat, Basis of Design, Laticrete 254 Platinum, MAPEI, Keraflex Super, Customs Pro-Lite, SikaTile 350 Flex Set, Bostik Big Tile & Stone conforming to ANSI A118.15, ISO 13007-C2ES1P1, and waterproofing membrane conforming to TCNA Detail F-122/122A.

1. For installation of (LFT and Stone Tile), Improved Modified Cement Mortars and medium bed, Basis of Design, Laticrete MultiMax Lite, MAPEI, Ultraflex LFT Customs Mega-Lite, SikaTile 475 LHT Premium Set, Bostik BAM, conforming to ANSI 118.15, ISO 13007-C2ES1P1.

J. Uncoupling membrane at all locations: Ditra by Schluter or approved equal.

K. Floor over plywood: ¼" Cement board and setting bed complying with TCNC F-144, provide membrane.

L. Water: Clean, fresh and suitable for drinking.

M. Grout complying with A118.7; and ISO 13007, CG2WAF: For grouting ceramic tile, provide a commercial Portland cement grout "Laticrete PermaColor or Laticrete PermaColor Select", SikaTile 815 Secure Grout or "Ultracolor Plus FA" (additive not

required) made by MAPEI; "Prism Ultimate Grout" made by Custom Building Products (additive not required), (addition not required) Bostik Hydroment Vivid; color as selected by the Architect.

N. Physical Properties: The setting beds and grouts must meet the following physical requirements:

1. Compressive Strength – 3000 psi min.

2. Shear Bond Strength – 500 psi min.

3. Service Rating (ASTM C 627) – Extra Heavy Duty.

O. Sealer: Seal all grout joints and all unglazed tile using "StoneTech Heavy Duty Sealer" by Laticrete, "Sealer's Choice 15 Gold" by Aqua Mix Inc or "Ultracare Penetrating Plus Stone, Tile, and Grout Sealer" by MAPEI. Merkrete Grout Sealer

P. Temporary Protective Coating: Either product indicated below that is applied in the tile manufacturer's factory and formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products; and easily removable after grouting is completed without damaging grout or tile.

1. Petroleum paraffin wax, applied hot, fully refined and odorless, containing at least 0.5 percent oil with a melting point of 120 to 140 deg. F. per ASTM D 87.

2. Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulated and recommended for use as temporary protective coating for tile.

Q. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, equal to "StoneTech Stone & Tile Cleaner" by Laticrete, "Concentrated Stone & Tile Cleaner" made by Aqua-Mix, "Ultracare Concentrated Tile & Grout Cleaner" by MAPEI, Aqua Mix Heavy Duty Grout N Tile Cleaner, or approved equal, specifically approved for materials and installations indicated by tile and grout manufacturers.

2.8 SEALANT

A. Joint Backing: Preformed, compressible, resilient, non-extruding, non-staining strips of foam neoprene, foam polyethylene, or other material recommended by sealant manufacturer.

B. Bond Breaker: Polyethylene tape, 3 mils thick or other material recommended by sealant manufacturer.

C. Sealant Primer: Colorless, non-staining, or type to suit substrate surface, as recommended by sealant manufacturer.

D. Sealant: One-part silicone based sanitary sealant, conforming to ASTM C 920, Type S, Grade NS, Class 25. Sealant hardness upon full cure shall be between 20-30 Shore "A" Durometer. Color of sealant to blend with or match adjacent materials, and as selected by the Architect. Sealant shall be equivalent to 1700 Sanitary Sealant made by General Electric or approved equal.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where ceramic tile is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 CONDITION OF SURFACES

A. Allowable Variations in Substrate Levels

1. Floors: + 1/8" in 10'-0" distance and 1/4" total max. variation from levels shown.

B. Grind or fill concrete and masonry substrates as required to comply with allowable variations.

C. Concrete substrates must meet ANSI A108.01 tolerances and surface textures in preparation for tile work; coordinate with concrete trades.

3.3 PREPARATION

A. Coordinate the following with Section 033000:

1. Steel trowel and fine broom finish concrete slabs that are to receive ceramic tile. Cure concrete slabs that are to receive tile before tile application. Do not use liquid curing compounds or other coatings that may prevent bonding of tile setting materials to slabs. Slab shall be dry at time of tile installation.

2. Tile floors with floor drains must have a slope to direction of 1/4” per foot; coordinate this with concrete trades.

B. Etch concrete substrate as may be required to remove curing compounds or other substances that would interfere with proper bond of setting bed. Rinse with water to remove all traces of treatment. Surface must meet finish requirements as noted in ANSI 108.01.

C. Blending: for tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved samples. If not factory blended, either return to manufacturer or blend tiles at project site before installing.

D. Field Applied Temporary Protective Coating: Pre-coat tile with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.4 JOINTS IN TILE WORK

A. Joint Widths: 1/16" wide in ceramic tile.

B. Alignment: Wall, base and floor joints shall align through the field and trim. Direction and location of all joints as directed by Architect.

C. Movement Joints: Conform to TCNA Detail EJ171. Locate where movement joints are in back-up material. Provide movement joint at joints between mop receptors and ceramic tile. Provide movement joint at all vertical internal joints of wall tile. Movement joints 1/8" wide in ceramic tile. Fill all movement joints with specified backing and sealant. Use bond breaker where sufficient space for joint backing does not exist.

1. Provide sealant between ceramic tile and plumbing fixtures, mirrors, pipes, countertops and other dissimilar materials penetrating or adjacent to ceramic tile.

3.5 INSTALLATION

A. Comply with the following installation standards

1. Wall tile over cement board or glass mat backer board using dry set mortar with latex additive - ANSI A118.15 and ISO 13007, C2ES1P1.

2. Floor tile over waterproofing membrane.- A118.15, and ISO 13007, C2ES1P1.

B. Backs of tile must be cleaned before installation.

C. All setting beds and/or adhesives shall provide for an average contact area of not less than 95% coverage.

D. Allowable Variations in Finished Work: Do not exceed the following deviations from level and plumb, and from elevations, locations, slopes and alignment shown.

1. Floors: 1/8" in 10'-0" run, any direction; +/- 1/8" at any location; 1/32" offset at any location.

2. Walls: 1/8" in 8'-0" run, any direction; 1/8" at any location; offset at any location, 1/32".

3. Joints: +/- 1/32" joint width variation of any location; 1/16" in 3'-0" run deviation from plumb and true.

E. Waterproofing Membrane

1. Install the membrane in strict accordance with manufacturer's written recommendations.

2. Upon completion of work, test horizontal membrane for leaks by flood testing per ASTM D 5957. Inspect for leakage. Make necessary adjustments to stop all leakage and retest until watertight. If membrane is not covered by another surface immediately, provide protection until membrane is covered.

F. Handle, store, mix and apply setting and grouting materials in compliance with the manufacturer's instructions.

G. Extend tile work into recesses and under equipment and fixtures, to form a complete covering without interruptions. Terminate work neatly at obstructions, edges and corners without disruption of pattern or joint alignment.

H. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight, aligned joints. Fit tile closely to electrical outlets, piping and fixtures so that plates, collars, or covers overlap tile.

I. Lay tile in grid pattern. Align joints when adjoining tiles on floor, base, walls and trim are the same size. Lay out tile work and center tile fields both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths.

3.6 INSTALLATION OF STONE SADDLES

A. Install stone saddles cut to profiles and sizes shown, accurately fitted to jambs, coped at stops, set in full bed of mortar herein specified, and with grouted edge joints as specified for floor tile.

3.7 CLEANING AND PROTECTION

A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove grout residue from tile as soon as possible.

2. Clean grout smears and haze from tile according to tile and grout manufacturer’s written instructions but no sooner than 10 days after installation. Use cleaners only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning to insure removal of all cleaning material.

3. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.

B. Protect installed tile work with Kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. Apply coat of sealer to all grout joints and all unglazed tile.

C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

D. Before final inspection, remove protective coverings from tile surfaces.

E. Leave finished installation clean and free of cracked, chipped, broken, unbonded or otherwise defective tile work.

END OF SECTION

SECTION 095113

ACOUSTIC PANEL CEILINGS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment and services necessary to complete the acoustic panel ceilings as shown on the drawings and/or specified herein, including but not limited to, the following:

1. Acoustical panel units.

2. Exposed "T" suspension system, including hangers and inserts.

3. Provisions for the installation of lighting fixtures, diffusers, grilles and similar items provided under other Sections.

4. Cutting, drilling, scribing and fitting as required for electro-mechanical penetrations.

5. Perimeter and column moldings, trim and accessories for acoustical ceilings.

1.3 RELATED SECTIONS

A. Metal deck - Section 053100.

B. Drywall ceilings - Section 092900.

C. Diffusers, grilles and related frames - Division 23.

D. Lighting fixtures - Division 26.

1.4 QUALITY ASSURANCE

A. Codes and Standards: In addition to complying with all pertinent codes and regulations, comply with all pertinent recommendations published by the Ceilings and Interior Systems Construction Association (CISCA).

B. Qualifications of Installers

1. The suspended ceiling subcontractor shall have a record of successful installation of similar ceilings acceptable to Architect and shall be currently approved by the manufacturer of the ceiling suspension system.

2. For the actual fabrication and installation of all components of the system, use only personnel who are thoroughly trained and experienced in the skills required and completely familiar with the requirements established for this work.

C. The work is subject to the following standards:

1. ASTM C 635 "Standard Specification for Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings," American Society for Testing and Materials.

2. ASTM C 636 "Standard Recommended Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels," American Society for Testing and Materials.

D. In addition to suspension system specified, provide seismic struts and seismic clips to meet seismic standards as required by prevailing Codes and Ordinances.

1.5 SUBMITTALS

A. Shop Drawings: Submit completely dimensioned ceiling layouts for all areas where acoustical ceilings are required, showing:

1. Any deviations from Architect's reflected ceiling plan layouts, especially lighting fixture and dimensions. Also indicate if any light fixtures will not fit into Architect's ceiling layout due to dimensional restrictions of field conditions.

2. Direction and spacing of suspension members and location of hangers for carrying suspension members.

3. Direction, sizes and types of acoustical units, showing suspension grid members, and starting point for each individual ceiling area.

4. Moldings at perimeter of ceiling, at columns and elsewhere as required due to penetrations or exposure at edge of ceiling tiles.

5. Location and direction of lights, air diffusers, air slots, and similar items in the ceiling plane.

6. Details of construction and installation at all conditions.

7. Materials, gauges, thickness and finishes.

B. Samples and Product Literature: Submit the following samples and related manufacturer's descriptive literature.

1. Twelve (12) inch long sample of each components of suspension systems, including moldings.

2. Acoustical units — full size.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination or other causes.

B. Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical ceiling units carefully to avoid chipping edges or damaging units in any way.

1.7 PROJECT CONDITIONS

A. Do not install acoustical ceilings until wet-work in space is completed and nominally dry, work above ceilings has been completed, and ambient conditions of temperature and humidity will be continuously maintained at values near those indicated for final occupancy.

1.8 COORDINATION

A. Coordinate layout and installation of acoustical ceiling units and suspension system components with other work supported by or penetrating through ceilings, including light fixtures, HVAC equipment, fire suppression system components, and partition system.

1.9 EXTRA STOCK

A. Extra Stock: Deliver stock of maintenance material to Owner. Furnish maintenance material matching products installed, packaged with protective covering for storage and identified with appropriate labels.

1. Acoustical Ceiling Units: Furnish quantity of full size units equal to 2.0% of amount installed.

PART 2 PRODUCTS

2.1 ACOUSTICAL UNITS

A. See finish schedule.

2.2 SUSPENSION SYSTEM

A. Provide exposed "T" suspension system, steel, with low sheen white baked enamel finish per finish schedule exposed tee 2-way grid system made by Armstrong World Industries, or equal made by USG Interiors, Inc. or Chicago Metallic Corp.

B. The suspension system shall support the ceiling assembly shown on the drawings and specified herein, with a maximum deflection of 1/360 of the span, in accordance with ASTM C 635.

C. Provide min. 12 ga. galvanized wire hangers, soft annealed steel conforming to ASTM A 641, prestretched, Class 1 zinc coating, soft temper, size so that stress at 3 times hanger design load (ASTM C 635, Table 1, Direct Hung) will be less than yield stress of wire.

D. Provide ceiling clips and inserts to receive hangers, type as recommended by suspension system manufacturer, sizes for pull-out resistance of not less than five (5) times the hanger design load, as indicated in ASTM C 635.

E. Suspension systems shall conform to ASTM C 635, intermediate duty.

F. Provide manufacturer’s standard wall moldings with off-white baked enamel finish to match suspension systems. For circular penetrations of ceilings, provide edge moldings fabricated to diameter required to fit penetration exactly.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas where acoustic panel ceilings are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected to permit proper installation of the layout.

3.2 PREPARATION

A. Coordination: Furnish layouts for inserts, clips, or other supports required to be installed by other trades for support of acoustical ceilings.

B. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less-than-half width units at borders, and comply with reflected ceiling plans.

3.3 INSTALLATION

A. Codes and Standards: Install materials in accordance with manufacturer’s printed instructions, and to comply with governing regulations and industry standards.

B. Install suspension systems to comply with ASTM C 636, with wire hangers supported only from building structural members. Locate hangers not more than 6" from each end and spaced 4'-0" along direct-hung runner, leveling to tolerance of 1/8" in 12'-0".

C. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eye-screws, or other devices which are secure and appropriate for substrate, and which will not deteriorate or fail with age or elevated temperatures.

D. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum which are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal force by bracing, reinforcing, countersplaying or other equally effective means.

E. Install edge moldings at edges of each acoustical ceiling area, and at locations where edge of acoustical units would otherwise be exposed after completion of the work.

1. Secure moldings to building construction by fastening through vertical leg. Space holes not more than 3" from each end and not more than sixteen (16) inches o.c. between end holes. Fasten tight against vertical surfaces.

2. Level moldings with ceiling suspension system, to a level tolerance of 1/8" in 12'-0".

F. Install acoustical units in coordination with suspension system, with edges concealed by support of suspension members. Scribe and cut panels to fit accurately at borders and at penetrations.

G. Install hold-down clips in toilet areas, and in areas where required by governing regulations; space 2'-0" o.c. on all cross tees.

H. Light fixtures or other ceiling apparatus shall not be supported from main beams or cross tees if their weight causes the total load to exceed the deflection capability of the ceiling suspension system. In such cases the load shall be supported by supplemental hangers furnished and installed by this Section of work.

I. Where fixture or ceiling apparatus installation causes eccentric loading on runners, provide stabilizer bars to prevent rotation.

3.4 ADJUST AND CLEAN

A. Clean exposed surfaces of acoustical ceilings, including trim, edge molding, and suspension members; comply with manufacturer's instructions for cleaning and touch-up of minor finish damage. Remove and replace work which cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

SECTION 096500

RESILIENT TILE FLOORING

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the resilient tile flooring, as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Vinyl composition tile.

2. Vinyl base.

3. Transition strips.

4. Accessories.

1.3 RELATED SECTIONS

A. Concrete slab - Section 033000.

B. Gypsum board partitions - Section 092900.

C. Carpeting - Section 096800.

1.4 QUALITY ASSURANCE

A. Qualifications of Installers: Use only personnel who are thoroughly trained and experienced in the skills required and completely familiar with the requirements established for this work.

1.5 SUBMITTALS

A. Manufacturer's Data: For information only, submit manufacturer's technical information and installation instructions for type of resilient tile.

B. Samples

1. Submit full-size sample tiles for each type and color required, representative of the expected range of color and pattern variation. Sample submittals will be reviewed

for color, texture and pattern only. Compliance with all other requirements is the exclusive responsibility of the Contractor.

2. Submit six (6) inch long samples of base and strips.

C. Submit manufacturer's warranty as noted herein.

1.6 DELIVERY AND STORAGE

A. Deliver materials to the project site in the manufacturer's original unopened containers, clearly marked to indicate pattern, gauge, lot number and sequence of materials.

B. Carefully handle all materials and store in original containers at not less than seventy (70) degrees F. for at least forty-eight (48) hours before start of installation.

1.7 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F. or more than 95 deg F., in spaces to receive floor tile during the following time periods:

1. 48 hours before installation.

2. During installation.

3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F. or more than 95 deg F.

C. Close spaces to traffic during floor tile installation.

D. Close spaces to traffic for 48 hours after floor tile installation.

E. Install floor tile after other finishing operations, including painting, have been completed.

1.8 WARRANTY

A. Provide manufacturers 5 year limited warranty.

PART 2 - PRODUCTS

2.2 TILE

A. Provide 12" x 12" x 1/8" thick vinyl composition tile conforming to ASTM F 1066, Class 2, in colors as selected by the Architect, equal to "Iliad " made by AHF Contract or "Standard Excelon" made by Armstrong, or "Azrock VCT" made by Johnsonite Tarkett, or approved equal. Provide tile units with uniformly distributed color and pattern

throughout the thickness of tile. Variations in shades and off-pattern matches between containers are not acceptable.

2.3 BASE

A. Provide four (4) inches high, 1/8" thick, continuous vinyl, top set cove base with pre-formed internal and external corner pieces, color as selected by the Architect. For areas to receive carpet, provide flat base, no cove. Base shall conform to ASTM F 1861, Type TV, Group 1 as manufactured by Roppe, Johnsonite, Armstrong, or approved equal.

2.4 ACCESSORIES

A. Adhesives: Waterproof, stabilized type, as recommended by the tile manufacturer for the type of service indicated based on a RH of 90%.

B. Concrete Slab Primer: Non-staining type recommended by the tile manufacturer.

C. Leveling Compound: Novoplan 2 made by Mapei, Ardex K-15 or approved equal.

D. Edging Strips: 1/8" thick, homogeneous vinyl or rubber composition, tapered or bullnose edge, color as selected by the Architect from manufacturer's standards.

E. Finish

1. Cleaner shall be equal to "Super Shine All" made by Hillyard Chemical Co., or approved equal.

2. Wax shall be equal to "Super Hil-Brite" made by Hillyard Chemical Co., or approved equal.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where resilient tile flooring is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 CONDITION OF SURFACES

A. Allowable Variations in Substrate Levels (Floors): ± 1/8" in 10'-0" distance and 1/4" total maximum variation from levels shown.

B. Grind or fill concrete substrates as required to comply with allowable variation.

3.3 PREPARATION

A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.

2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.

3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.

4. Moisture Testing: Proceed with installation only after substrates pass testing according to floor tile manufacturer's written recommendations, but not less stringent than the following:

a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb. of water/1000 sq. ft. in 24 hours.

b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a maximum **75** percent relative humidity level.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install floor tiles until they are the same temperature as the space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.4 INSTALLATION

A. Install tile only after all finishing operations, including painting, have been completed and permanent heating system is operating. Moisture content of concrete slabs,

building air temperature and relative humidity must be within limits recommended by tile manufacturer.

B. Place tile units with adhesive cement in strict compliance with the manufacturer's recommendations. Butt tile units tightly to vertical surfaces, thresholds, nosings and edgings. Scribe around obstructions and to produce neat joints, laid tight, even and in straight, parallel lines. Extend tile units into toe spaces, door reveals, and into closet and similar openings.

C. Maintain reference markers, holes, or openings that are in place or plainly marked for future cutting by repeating on the finish tile as marked in the subfloor. Use chalk or other non-permanent marking devices.

D. Lay tile from center marks established with principal walls, discounting minor off-sets, so that tile at opposite edges of the room are of equal width. Adjust as necessary to avoid use of cut widths less than 1/2 tile at room perimeters. Lay tile square to room axis, unless otherwise shown.

E. Match tiles for color and pattern by using tile from cartons in the same sequence as manufactured and packaged. Cut tile neatly to and around all fixtures. Broken, cracked, chipped or deformed tile is not acceptable.

F. Tightly cement tile to sub-base without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks through tile, or other surface imperfections.

G. Lay tile with grain in all tile running in the same direction.

H. Place resilient edge strips tightly butted to tile and secure with adhesive. Provide edging strips at all unprotected edges of tile, unless otherwise shown.

I. Bases: In all spaces where base is indicated, install bases tight to walls, partitions, columns, built-in cabinets, etc., without gaps at top or bulges at bottom, with tight joints and flush edges, with molded corner pieces at internal and external corners. Provide end stops adjacent to flush type door frames and where base does not terminate against an adjacent surface. Keep base in full contact with walls until adhesive sets.

3.5 CLEANING AND PROTECTION

A. Remove any excess adhesive or other surface blemishes from tile, using neutral type cleaners as recommended by the tile manufacturer. Protect installed flooring from damage by use of heavy Kraft paper or other covering.

B. Finishing: After completion of the project and just prior to the final inspection of the work, thoroughly clean tile floors and accessories. Apply two (2) coats of wax and buff using materials as specified herein.

END OF SECTION

SECTION 096513

RESILIENT BASE AND ACCESSORIES

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the resilient base and accessories, as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Rubber base.

2. Accessories.

1.3 RELATED SECTIONS

A. Gypsum Drywall - Section 092900.

B. Resilient Tile Flooring - Section 096519.

C. Carpeting - Section 096800.

1.4 QUALITY ASSURANCE

A. Qualifications of Installers: Use only personnel who are thoroughly trained and experienced in the skills required and completely familiar with the requirements established for this work.

1.5 SUBMITTALS

A. Manufacturer's Data: For information only, submit manufacturer's technical information and installation instructions for type of resilient base.

B. Samples: Submit six (6) inch long samples of base.

1.6 DELIVERY AND STORAGE

A. Deliver materials to the project site in the manufacturer's original unopened containers, clearly marked to indicate pattern, gauge, lot number and sequence of materials.

B. Carefully handle all materials and store in original containers at not less than seventy (70) degrees F. for at least forty-eight (48) hours before start of installation.

1.7 JOB CONDITIONS

A. Continuously heat spaces to receive base to a temperature of seventy (70) degrees F. for at least forty-eight (48) hours prior to installation, whenever project conditions are such that heating is required. Maintain seventy (70) degrees F. temperature continuously during and after installation as recommended by the manufacturer, but for not less than forty-eight (48) hours. Maintain a temperature of not less than fifty-five (55) degrees F. in areas where work is completed.

PART 2 PRODUCTS

2.1 RUBBER BASE

A. Rubber Cove Base: Provide 4" high by 1/8" thick continuous rubber base with preformed internal and external corner pieces; color as indicated on Finish Schedule. Base shall conform to ASTM F 1861, Type TS, Group 1. Provide "BaseWorks" as manufactured by Johnsonite, or comparable product by Mohawk.

B. Rubber Block Base: Provide 2 1/2" high by 3/8" thick rubber base.... Provide "Mandalay 2 1/2" of the "Millwork Wall Base System" as manufactured by Johnsonite. Color to match wall; Final Selection by Architect.

2.2 ACCESSORIES

A. Adhesives: Waterproof, stabilized type, as recommended by the manufacturer for the type of service indicated.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where resilient base is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. In all spaces where base is indicated, install bases tight to walls, partitions, columns, built-in cabinets, etc., without gaps at top or bulges at bottom, with tight joints and flush edges, with molded corner pieces at internal and external corners. Provide end stops adjacent to flush type door frames and where base does not terminate against an adjacent surface. Keep base in full contact with walls until adhesive sets.

3.3 CLEANING AND PROTECTION

A. Remove any excess adhesive or other surface blemishes from base using neutral type cleaners as recommended by the manufacturer.

END OF SECTION

SECTION 096723

EPOXY RESIN COMPOSITION FLOORING

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 WORK INCLUDED

A. Work of this Section includes all labor, materials, equipment and services necessary to complete the epoxy resin composition flooring and base as scheduled on the drawings and/or specified herein.

1.3 RELATED SECTIONS

A. Cast-in-Place Concrete - Section 033000.

B. Floor drains - Division 22.

1.4 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product Data: Submit manufacturer's technical data application instructions and general recommendations for the epoxy resin composition flooring specified herein.

C. Samples for initial selection purposes in form of manufacturer's color charts showing full range of colors and finishes available.

1. Submit 3" x 3" samples of color chips from color chart selection designated by the Architect.

D. Material certificates signed by manufacturer certifying that the epoxy resin composition flooring complies with requirements specified herein.

E. Maintenance Instructions: Submit manufacturer's written instructions for recommended maintenance practices.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer or applicator who has specialized in installing resinous flooring types similar to that required for this Project and who is acceptable to manufacturer of primary materials.

B. Single-Source Responsibility: Obtain epoxy resin composition flooring materials, including primers, resins, hardening agents, and finish or sealing coats, from a single manufacturer.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in original packages and containers with seals unbroken and bearing manufacturer's labels containing brand name and directions for storage and mixing with other components.

B. Store materials to comply with manufacturer's directions to prevent deterioration from moisture, heat, cold, direct sunlight, or other detrimental effects.

1.7 PROJECT CONDITIONS

A. Environmental Conditions: Comply with epoxy resin composition flooring manufacturer's directions for maintenance of substrate temperature, moisture, ventilation, and other conditions required to execute and protect Work.

B. Lighting: Permanent lighting will be in place and working before installing resinous flooring.

PART 2 PRODUCTS

2.1 MATERIALS

A. Troweled epoxy resin composition flooring shall be Dex-O-Tex Cheminert "K" with Posi-Tred "O" top finish as manufactured by Crossfield Products Corp.; Compton, CA; Roselle Park, NJ; Hinsdale, IL; Moss Point, MS; or Sherwin Williams (G-P) TPM #115-U4 Upgraded Trowelled Mortar System, or approved equal.

2.2 PROPERTIES

A. Colors: As indicated, or if not otherwise indicated, as selected by Architect from manufacturer's standard colors.

B. Physical Properties: Provide flooring system that meet or exceed the listed minimum physical property requirements when tested according to the referenced standard test method in parentheses.

1. Compressive Strength (ASTM C 579): 11,000 psi.

2. Tensile Strength (ASTM C 307): 1643 psi.

3. Flexural Strength (ASTM C 580): 4,300 psi.

4. Flexural Modulus of Elasticity (ASTM C 580): 2.0×10^6 psi.

5. Water Absorption (MIL D-3134): 0.3 percent max.

6. Surface Hardness (ASTM D-2240): 85.5 Durometer "D".

7. Abrasion Resistance (ASTM D-1044): 0.0 gr.

8. Indentation (MIL-D-3134): 0.024" max.

9. Impact Resistance (Gardner Impact Tester): No chipping, cracking, or delamination and not more than 0.014".

10. Adhesion (A.C.I. Comm. No. 403): 400 psi.

11. Electrical Conductivity (NFPA 56A): Di-electric.

12. Critical Radiant Flux (ASTM E-648): Greater than 1.07 watts/cm^2.

13. Co-efficient of Friction - Rubber Shoe Surface (MIL-D-3134 Test Procedure)

Profiles	Static Friction Saltwater Solution on Surface	Static Friction Oil on Surface	Sliding Friction Saltwater Solution on Surface	Sliding Friction Oil on Surface
Fine Profile	0.95	0.75	0.89	0.44
Medium Profile	1.03	0.75	0.95	0.45
Coarse Profile	1.09	0.85	1.00	0.56
Very Coarse Profile	1.24	0.78	1.04	0.59

2.3 SUPPLEMENTAL MATERIALS

A. Joint Sealant: Type recommended or produced by manufacturer of epoxy resin composition flooring system for type of service and joint condition indicated.

B. Waterproofing Membrane: Type recommended or produced by manufacturer of epoxy resin composition flooring system for type of service and floor condition indicated.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where the epoxy resin composition flooring is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected by the Contractor in a manner acceptable to the Architect.

B. Coordinate work with other trades to insure that concrete substrate has been "wet" cured only.

3.2 PREPARATION

A. Substrate: Perform preparation and cleaning procedures according to flooring manufacturer's instructions for particular substrate conditions involved, and as specified. Provide clean, dry, and neutral substrate for flooring application.

B. Concrete Surfaces: Shot-blast, acid etch, or power scarify as required to obtain optimum bond of flooring to concrete. Remove sufficient material to provide a sound surface free of laitance, glaze, efflorescence, and any curing compounds or form release agents. Remove grease, oil, and other penetrating contaminants. Repair damaged and deteriorated concrete to acceptable condition. Leave surface free of dust, dirt, laitance, and efflorescence.

C. Materials: Mix resin and hardener, add colorant and aggregate when required, and prepare materials according to flooring system manufacturer's instructions.

3.3 APPLICATION

A. General: Apply each component of epoxy resin composition flooring system according to manufacturer's directions to produce a uniform monolithic wearing surface of thickness indicated.

B. Bond Coat: Apply bond coat over prepared substrate at manufacturer's recommended spreading rate. Coordinate applying bond coat with topping mix to ensure optimum adhesion between flooring materials and substrate.

C. Body Coat: Over freshly applied primer, trowel apply epoxy mortar mix at 1/4-inch thickness. Hand or power trowel and grout with epoxy to fill voids. When cured, sand, if necessary, to remove trowel marks and roughness.

D. Finish or Sealing Coats: After body coat has cured sufficiently, apply finish or sealing coats of type recommended by flooring manufacturer to produce finish matching approved sample and in number of coats and spreading rates recommended by manufacturer.

1. Final finish coat shall be in color and skid retardant profile as approved by the Architect.

2. Finish floor shall be 1/4" thick, uniform in color and free of travel marks.

E. Cove Base: Apply cove base mix to wall surfaces at locations shown to form cove base height of 4 inches unless otherwise indicated. Round interior and external corners. Follow manufacturer's printed instructions and details including taping, mixing, priming, troweling, sanding, and top-coating of cove base.

F. Joints: Where substrate is interrupted by expansion or control joints, provide joint in flooring to comply with details indicated or, if not otherwise indicated, as recommended by flooring manufacturer.

1. Apply joint sealant materials to comply with resinous flooring manufacturer's recommendations.

3.4 CURING, PROTECTION AND CLEANING

A. Cure epoxy resin composition flooring materials according to manufacturer's directions, taking care to prevent contamination during application stages and before completing curing process. Close application area for a minimum of 24 hours.

B. Protect epoxy resin composition flooring materials from damage and wear during construction operation. Where temporary covering is required for this purpose, comply with manufacturer's recommendations for protective materials and application method.

C. Cleaning: Remove temporary covering and clean epoxy resin composition flooring just before final inspections. Use cleaning materials and procedures recommended by flooring manufacturer.

END OF SECTION

SECTION 096813

CARPET TILE

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor materials, equipment and services necessary to complete the carpet tile as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Carpet tile.

2. Adhesive.

1.3 RELATED SECTIONS

A. Concrete sub-floor – Section 033000.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Firm with not less than five (5) years of experience in installation of commercial carpeting of type, quantity and installation methods similar to work of this Section.

B. General Terminology/ Information Standard: Refer to current edition of "Carpet Specifier's Handbook" by The Carpet and Rug Institute; for definitions of terminology not otherwise defined herein, and for general recommendations and information.

C. Carpet used on Project must be from same dye lot for each carpet type.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's complete technical product data for each type of carpet, cushion and accessory item required.

B. Samples: Submit full size samples of carpet tile and six (6) inches long samples of each type exposed edge stripping.

C. Certification: Submit manufacturer's certification stating that carpet materials furnished comply with specified requirements.

1. Include listing of mill register numbers for carpet furnished.

2. Include supporting certified laboratory test data indicating that carpet meets or exceeds specified test requirements.

D. Maintenance Data: Submit manufacturer's printed maintenance recommendations, including methods and frequency recommended for maintaining carpet in optimum conditions under anticipated traffic and use conditions.

1.6 EXTRA STOCK

A. Produce and deliver to project at least five (5) percent overrun on calculated yardage. Provide required overrun exclusive of carpet needed for proper installation, waste and usable scraps.

1.7 PRODUCT DELIVERY AND STORAGE

A. Deliver carpeting materials in original mill protective wrapping with mill register numbers and tags attached. Store inside, in well ventilated area, protected from weather, moisture and soiling.

1.8 WARRANTY

A. Provide special project warranty, signed by Contractor and Manufacturer (Carpet Mill), agreeing to repair or replace defective materials and workmanship of carpeting work during two (2) year warranty period following substantial completion. Attach copies of product warranty.

PART 2 PRODUCTS

2.1 CARPET TILE

A. Provide 18" x 18" 10 oz./sq. yd. carpet tile Model "New Ground" and "Major Frequency: Once Vibration" manufactured by Milliken or approved equal. Design and color as scheduled on the drawings.

2.2 ACCESSORIES

A. Adhesive for Carpet Tile: Provide release type adhesive as recommended by the carpet tile manufacturer for use with carpet tile specified. Provide adhesive which complies with flame spread rating required for the carpet installation.

B. Miscellaneous Materials: Provide the types of adhesives and tape, and other accessory items recommended by the carpet manufacturer and Installer for the conditions of installation and use.

C. Leveling Compound: Latex/Portland cement flash patching and leveling compound equal to No. DSP-520 made by H.B. Fuller or No. 226 with 3701 admixture made by Laticrete or equal made by Mapei, or approved equal.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where carpet tile is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 PRE-INSTALLATION REQUIREMENTS

A. Floor shall be clean and free of cracks and protrusions. Any gaps or cracks more than 1/16" wide to be filled in with latex leveling compound. Protrusions must be sanded down smooth, the floor cleanly swept and vacuumed if necessary to remove all dust and grit.

B. Floor temperature shall be 65 deg., at least 24 hrs. prior to installation; and 48 hrs. after carpet is installed.

C. Conduct a moisture test. The presence of moisture in the concrete floor will interfere with the curing and subsequent performance of the adhesive. Conduct the test as follows:

1. Drive a concrete nail a half inch into the floor. Then remove the nail.

2. Place a small amount of anhydrous calcium chloride or calcium sulphate crystals over the hole.

3. Cover the crystals and the hole with a piece of flat glass and seal the edges with waterproof tape or putty. Since concrete pourings vary, repeat the test every 1500 sq. ft.

4. Leave in place 72 hrs. Any color change in the crystals indicates the presence of moisture. Do not apply carpet until slab is free of moisture and meets with approval of carpet adhesive manufacturer.

D. Sequence carpeting with other work so as to minimize possibility of damage and soiling of carpet during remainder of construction period.

3.3 INSTALLATION

A. General

1. Comply with manufacturer's instructions and recommendations. Maintain direction of pattern and texture, including lay of pile.

2. Adhere all tiles with a full spread of adhesive. Dry-fit cut tiles and apply adhesive to tile back after tile has been cut.

3. Tiles shall be installed in a monolithic corner to corner manner following arrows printed on back of each tile indicating pile direction. Tiles shall be installed to achieve patterns as directed by the Architect.

4. Vinyl reducer strips shall be used along any necessary open edges so as to maintain the fixed perimeter.

3.4 CLEANING UP

A. Upon completion of the carpeting installation in each area, visually inspect all carpet installed in that area and immediately remove all dirt, soil, and foreign substance from the exposed face; inspect all adjacent surfaces and remove all marks and stains caused by the carpet installation: remove all packaging materials, carpet scraps, and other debris from the carpet installation to the area of the job site set aside for its storage.

3.5 PROTECTION

A. In all areas, provide a temporary non-staining paper pathway in the direction of traffic.

END OF SECTION

SECTION 098413

ACOUSTICAL WALL PANELS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment and services necessary to complete the acoustic wall panels as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Vertical Slat Acoustical Wall Panels.

1.3 RELATED SECTIONS

A. Carpentry - Section 062000.

B. Gypsum Drywall - Section 092900.

C. Wall Coverings - Section 097200.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualification: At least 5 years' experience fabricating and installing comparable work, employing skilled mechanics under competent supervision for all phases of the Work.

1.5 SUBMITTALS

A. Shop Drawings/Product Data

1. Base drawings on field measurements.

2. Show dimensioned wall elevations with seam and joint locations, cutout sizes and locations, anchor locations, relation to adjacent work; large scale joint and mounting details; materials type, weight/thickness, design, color; and other data necessary to fabricate and install work and coordinate work with affected trades.

B. Samples: Two 12" x 12" (minimum) panels in selected finish, showing seam, edge and cutout conditions.

C. Certification

1. Acoustical Performance: Certified reports of acoustical performance tests conducted and/or witnessed by a recognized, independent, testing agency. Tests shall have been done by specified methods or recognized equivalent. Sound absorption tests shall be not more than three years old. Reports on earlier tests

are acceptable if it can be established to the Architect's satisfaction, that they are valid indications of compliance with Project requirements.

2. Fire Hazard: Evidence of compliance with regulatory agency and specifications requirements.

D. Cleaning and Maintenance Instructions: Recommendations for maintenance and cleaning per Section 017300 requirements. Identify cleaning/spotting products generically or by trade name.

E. Manufacturer Qualifications: List comparable installations with 3-year (minimum) service histories. Describe installations and give owner/building manager names and addresses.

1.6 REFERENCES

A. ASTM C 423 "Test for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method."

B. ASTM E 84 "Test for Surface Burning Characteristics of Building Materials."

1.7 DELIVERY, STORAGE AND HANDLING

A. Allow materials to become acclimated to Project conditions before installation, if necessary to prevent sag and distortion during service life.

1.8 PROJECT CONDITIONS

A. Work areas shall be at or near ambient occupancy temperature and relative humidity.

B. Painting, dust-raising activities, and work that introduces dampness shall be completed.

PART 2 PRODUCTS

2.1 GENERAL

A. Fabricate panels to sizes and configurations indicated; attach facing materials to cores to produce installed panels with visible surfaces fully covered and free from waves in fabric weave, wrinkles, sages, blisters, seams, adhesive or other foreign matter.

1. Fabricate back-mounted panels in factory to exact sizes required to fit wall surfaces based on field measurements of completed substrates indicated to receive acoustical wall panels.

2. Where radius corners are indicated, attach facing material so there are no seams or gathering of material.

B. Adhesives shall comply with project sustainability requirements.

C. Dimensional Tolerances of Finished Units: Overall height and width of panels plus or minus 1/16".

D. Sound Absorption Performance: Provide acoustical wall panels with minimum noise reduction coefficients (NRC) indicated, as determined by testing per ASTM C 423 for mounting type specified under individual product requirements.

E. Colors, Textures, and Patterns: Where manufacturer's standard material is indicated, provide acoustical wall panels faced with manufacturer's material complying with the following requirements:

2.2 MANUFACTURERS

A. Basis of Design:

1. AT-1: Artizin Slat Acoustical Wall Panels or approved equal.

B. Alternate Manufacturers: Subject to compliance with requirements, products by the following may be considered:

1. Sound Seal – Acoustical Wall Panels.

2. Acoustical Solutions, Inc.

3. Armstrong World Industries.

C. Substitutions: As permitted by Division 01.

2.3 PANEL TYPES

A. AT-1: Artizin Slat Acoustical Wall Panel.

1. Product: Artizin Vertical Slat Wood Acoustical Panel or approved equal.

2. Pattern: Vertical Slats and image as scheduled.

3. Material: 9mm ArtFelt.

4. Color: Per finish schedule on the drawings.

5. NRC: 0.60 minimum.

6. Mounting: Z-clips

2.4 ACCESSORIES

A. Edge Trim: Provide aluminum or manufacturer’s standard painted edge trim where indicated.

B. Mounting Hardware: Provide Z-clips, mechanical brackets, adhesives, and other accessories recommended by manufacturer for complete installation.

C. Backing Materials: Provide acoustic backing or infill to achieve specified NRC ratings.

D. Fire-Resistant Backing: Comply with NYC Building code and fire-resistance requirements.

2.5 SOURCE QUALITY CONTROL

A. Provide each type of panel and the associated accessories for a complete installation from a single source and single manufacturer.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where acoustic wall panels are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. General: Install acoustical wall panels in locations indicated with vertical surfaces and edges plumb, top edges level and in alignment with other panels, scribed to fit adjoining work accurately at borders and at penetrations. Comply with panel manufacturer's printed instructions for installation of panels using type of mounting accessories indicated or, if none indicated, as recommended by manufacturer.

B. Construction Tolerances

1. Variation from Plumb and Level: +/- 1/16".

2. Variation of Joints from Hairline: Not more than 1/16".

C. Back-Mounted, Edge Reinforced Acoustical Wall Panels:

1. Anchoring to Drywall: Anchor clips to unreinforced gypsum board with toggle or Molly anchors. Anchor clips to metal drywall framing with tapping sheet metal screws.

2. Panels shall be pressed against wall and slid down engaging 'Z' clips into wall brackets.

D. Remove and replace panels that are damaged and are unacceptable to the Architect.

3.3 ADJUSTING AND CLEANING

A. Correct non-complying and damaged/defective Work. Replace work that cannot be satisfactorily repaired.

B. Restretch and reinstall sagging and distorted fabric and correct other defects that occurred during normal service.

C. Carefully and thoroughly clean completed work by vacuuming and/or other means. Remove soil, stains, loose threads.

D. Protect work from soiling and other damage.

END OF SECTION

SECTION 099000

PAINTING AND FINISHING

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the painting and finishing as shown on the drawings and/or specified herein, including, but not limited to, the following:

1. Prime painting unprimed surfaces to be painted under this Section.
2. Painting all items furnished with a prime coat of paint, including touching up of or repairing of abraded, damaged or rusted prime coats applied by others.
3. Painting all ferrous metal (except stainless steel) exposed to view.
4. Painting all galvanized ferrous metals exposed to view.
5. Painting gypsum drywall exposed to view.
6. Painting of wood exposed to view, except items which are specified to be painted or finished under other Sections of these specifications. Back painting of all wood in contact with concrete, masonry or other moisture areas.
7. Painting pipes, pipe coverings, conduit, ducts, insulation, hangers, supports and other mechanical and electrical items and equipment exposed to view.
8. Painting surfaces above, behind or below grilles, gratings, diffusers, louvers, lighting fixtures, and the like, which are exposed to view through these items.
9. Incidental painting and touching up as required to produce proper finish for painted surfaces, including touching up of factory finished items.
10. Painting of any surface not specifically mentioned to be painted herein or on drawings, but for which painting is obviously necessary to complete the job, or work which comes within the intent of these specifications, shall be included as though specified.

1.3 RELATED SECTIONS

A. Shop priming is required on some, but not all of the items scheduled to be field painted. Refer to other Sections of work for complete description.

B. Shop Coat on Machinery and Equipment: Refer to the Sections under which various items of manufactured equipment with factory applied shop prime coats are furnished,

including, but not necessarily limited to, the following Sections. All items of equipment furnished with prime coat finish shall be finish painted under this Section.

1. Plumbing - Division 22.

2. Heating, ventilation and air conditioning - Division 23.

C. Color Coding of Mechanical Piping and Electrical Conduits - Divisions 22 and 26.

1. This Color Coding consists of an adhesive tape system and is in addition to painting of piping and conduits under this Section, as specified above.

1.4 MATERIALS AND EQUIPMENT NOT TO BE PAINTED

A. Items of equipment furnished with complete factory finish, except for items specified to be given a finish coat under this Section.

B. Factory-finished toilet partitions.

C. Factory-finished acoustical tile.

D. Non-ferrous metals, except for items specified and/or indicated to be painted.

E. Finished hardware, excepting hardware that is factory primed.

F. Surfaces not to be painted shall be left completely free of droppings and accidentally applied materials resulting from the work of this Section.

1.5 QUALITY ASSURANCE

A. Job Mock-Up

1. In addition to the samples specified herein to be submitted for approval, apply in the field, at their final location, each type and color of approved paint materials, applied 10 feet wide, floor to ceiling of wall surfaces, before proceeding with the remainder of the work, for approval by the Architect. Paint mock-ups to include door and frame assembly.

2. These applications when approved will establish the quality and workmanship for the work of this Section.

3. Repaint individual areas which are not approved, as determined by the Architect, until approval is received. Assume at least two paint mock-ups of each color and gloss for approval.

B. Qualification of Painters: Use only qualified painters for the mixing and application of paint on exposed surfaces.

C. Paint Coordination: Provide finish coats which are compatible with the prime paints used. Review other Sections of these specifications in which prime paints are to be provided to ensure compatibility of the total coatings system for the various substrates. Upon request from other subcontractors, furnish information on the characteristics of the finish materials proposed to be used, to ensure that compatible prime coats are used. Provide barrier coats over incompatible primers or remove and re-prime as

required. Notify the Architect in writing of any anticipated problems using the coating systems as specified with substrates primed by others.

D. All paints must conform to the Volatile Organic Compounds (VOC) standards of prevailing codes and ordinances.

1.6 SUBMITTALS

A. Materials List

1. Before any paint materials are delivered to the job site, submit to the Architect a complete list of all materials proposed to be furnished and installed under this portion of the work.

2. This shall in no way be construed as permitting substitution of materials for those specified or accepted for this work by the Architect.

B. Samples

1. Accompanying the materials list, submit to the Architect copies of the full range of colors available in each of the proposed products.

2. Upon direction of the Architect, prepare and deliver to the Architect two (2) identical sets of Samples of each of the selected colors and glosses painted onto 8-1/2" x 11" x 1/4" thick material; whenever possible, the material for Samples shall be the same material as that on which the coating will be applied in the work.

C. Manufacturer's Recommendations: In each case where material proposed is not the material specified or specifically described as an acceptable alternate in this Section of these specifications, submit for the Architect's review the current recommended method of application published by the manufacturer of the proposed material.

D. Close out Submittal

1. Coating Maintenance Manual: Upon conclusion of the project, the Contractor or plant manufacturer/supplier shall furnish a coating maintenance manual such as Sherwin Williams "Custodian Project Color and Product Information" report or equal. Manual shall include an Area Summary with finish schedule, Area Detail designating where each product/color/finish was used, product data pages, MSDS, care and cleaning instructions, touch-up procedures, and color samples of each color and finish used.

1.7 PRODUCT HANDLING

A. Deliver all paint materials to the job site in their original unopened containers with all labels intact and legible at time of use.

B. Protection

1. Store only the approved materials at the job site, and store only in a suitable and designated area restricted to the storage of paint materials and related equipment.

2. Use all means necessary to ensure the safe storage and use of paint materials and the prompt and safe disposal of waste.

3. Use all means necessary to protect paint materials before, during and after application and to protect the installed work and materials of all other trades.

C. Replacements: In the event of damage, immediately make all repairs and replacements necessary.

1.8 EXTRA STOCK

A. Upon completion of this portion of the Work, deliver to the Owner an extra stock of paint equaling approximately ten (10) percent of each color and gloss used and each coating material used, with all such extra stock tightly sealed in clearly labeled containers.

1.9 JOB CONDITIONS

A. Apply water-based paints only when the temperature of surfaces to be painted and the surrounding air temperatures are between 50 degrees F. and 90 degrees F., unless otherwise permitted by the paint manufacturer's printed instructions.

B. Apply solvent-thinned paints only when the temperature of surfaces to be painted and the surrounding air temperatures are between 45 degrees F. and 95 degrees F. unless otherwise permitted by the paint manufacturer's printed instructions.

C. Do not apply paint in snow, rain, fog or mist; or when the relative humidity exceeds eighty-five (85) percent; or to damp or wet surfaces; unless otherwise permitted by the paint manufacturer's printed instructions.

D. Painting may be continued during inclement weather only if the areas and surfaces to be painted are enclosed and heated within the temperature limits specified by the paint manufacturer during application and drying periods.

PART 2 PRODUCTS

2.1 PAINT MANUFACTURERS

A. Except as otherwise noted, provide the painting products listed for all required painting made by one of the manufacturers listed in the paint schedule (Section 2.4). These companies are Benjamin Moore, PPG Paints (PPG), and Sherwin Williams (S-W). Comply with number of coats and required minimum mil thicknesses as specified herein.

2.2 MATERIALS

A. Provide undercoat paint produced by the same manufacturer as the finish coats. Use only thinners approved by the paint manufacturer and use only to recommended limits.

B. Colors and Glosses: All colors and glosses shall be as selected by the Architect. Certain colors will require paint manufacturer to prepare special factory mixes to match colors selected by the Architect. Color schedule (with gloss) shall be furnished by the Architect.

C. Coloring Pigment: Products of or furnished by the manufacturer of the paint or enamel approved for the work.

D. Linseed Oil: Raw or boiled, as required, of approved manufacture, per ASTM D 234 and D 260, respectively.

E. Turpentine: Pure distilled gum spirits of turpentine, per ASTM D 13.

F. Shellac: Pure gum shellac (white or orange) cut in pure denatured alcohol using not less than four (4) lbs. of gum per gallon of alcohol.

G. Driers, Putty, Spackling Compound, Patching Plaster, etc.: Best quality, of approved manufacture.

H. Heat Resistant Paint: Where required, use heat resistant paint when applying paint to heating lines and equipment.

2.3 GENERAL STANDARDS

A. The various surfaces shall be painted or finished as specified below in Article 2.4. However, the Architect reserves the right to change the finishes within the range of flat, semi-gloss or gloss, without additional cost to the Owner.

B. All paints, varnishes, enamels, lacquers, stains and similar materials must be delivered in the original containers with the seals unbroken and label intact and with the manufacturer's instructions printed thereon.

C. All painting materials shall bear identifying labels on the containers with the manufacturer's instructions printed thereon.

D. Paint shall not be badly settled, caked or thickened in the container, shall be readily dispersed with a paddle to a smooth consistency and shall have excellent application properties.

E. Paint shall arrive on the job color-mixed except for tinting of under-coats and possible thinning.

F. All thinning and tinting materials shall be as recommended by the manufacturer for the particular material thinned or tinted.

G. It shall be the responsibility of the Contractor to see that all mixed colors match the color selection made by the Architect prior to application of the coating.

2.4 SCHEDULE OF FINISHES

A. High Performance Coating on Exterior Galvanized Ferrous Metals

First Coat:	"Amerlock 600 Epoxy Series by PPG, "Series 27WB Typoxy" by Tnemec; "Epoxy Mastic Coating V 160" by Benjamin Moore Corotech or "Recoatable Epoxy Primer 867-45" by Sherwin Williams.
Second Coat:	"Pittthane Ultra 95-812 (Gloss)" or "High Build 95-8800 (Semi-Gloss)" by PPG; "Series 1080 (gloss) Endura-Shield WB" or "Series 1081 (semi-gloss) Endura-Shield WB" by Tnemec; "Acrylic Aliphatic Urethane V 500 (Gloss)" or "V 510 (Semi-Gloss)" by Benjamin Moore Corotech or "Hi-Solids Urethane B65-300/350" by Sherwin Williams.

B. High Performance Coating on Exterior Non-Galvanized Ferrous Metals

Prime Coat: "Amercoat 68HS Epoxy Zinc-Rich Primer" by PPG; "Series 94-H_2O Hydro-Zinc" by Tnemec; "Organic Zinc Rich Primer V 170" by Benjamin Moore Corotech or "Zinc Clad II Plus Inorganic Zinc Rich Coating B69V212" by Sherwin Williams.

Second Coat: "Amerlock 600 Epoxy" by PPG; "Series 27WB Typoxy" by Tnemec; "Epoxy Mastic Coating V 160" by Benjamin Moore Corotech or "Macropoxy 646 Fast Cure Epoxy B58-600" by Sherwin Williams.

Third Coat: "Pitthane Ultra 95-812 (Gloss)" or "High Build 95-8800 (Semi-Gloss)" by PPG; "Series 1070V (gloss) Fluoronar" or "Series 1071V (semi-gloss) Fluoronar" by Tnemec; "Acrylic Aliphatic Urethane V 500 (Gloss)" or "V 510 (Semi-Gloss)" by Benjamin Moore Corotech or "Hi-Solids Polyurethane B65-300/350" by Sherwin Williams.

C. Interior Ferrous Metal

Satin Finish/Latex

Primer: Benj. Moore Ultra Spec HP Acrylic Metal Primer (HP04)
PPG Pitt Tech Plus DTM Acrylic Primer 4020 PF
S-W Pro-Industrial Pro-Cryl Universal Primer B66-3100 Series

First Coat: Benj. Moore Ultra Spec-HP DTM Acrylic Low Luster (HP25)
PPG Pitt-Tech WB EP DTM Acrylic Satin 90-1710
S-W Pro Industrial Acrylic Eg-Shel, B66-660 Series

Second Coat: Benj. Moore Ultra Spec-HP DTM Acrylic Low Luster (HP25)
PPG Pitt-Tech WB EP DTM Acrylic Satin 90-1710
S-W Pro Industrial Acrylic Eg-Shel, B66-660 Series
a. Total DFT not less than: 3.9 mils

Semi-Gloss Finish/Latex

Primer: Benj. Moore Ultra Spec-HP Acrylic Metal Primer (HP04)
PPG Devflex 4020 PF DTM Primer/Flat Finish
S-W Pro-Industrial Pro-Cryl Universal Primer B66-3100 Series

First Coat: Benj. Moore Ultra Spec HP DTM Acrylic Semi-Gloss (HP29)
PPG Pitt-Tech WB EP DTM Acrylic Semi-Gloss 90-1610
S-W Pro Industrial Acrylic Semi-Gloss, B66-650 Series

Second Coat: Benj. Moore Ultra Spec HP DTM Acrylic Semi-Gloss (HP29)
PPG Pitt-Tech WB EP DTM Acrylic Semi-Gloss 90-1610
S-W Pro Industrial Acrylic Semi-Gloss, B66-650 Series
a. Total DFT not less than: 4.0 mils

D. Interior Drywall

Flat Finish/Vinyl Acrylic Latex

Primer: Benj. Moore Ultra Spec 500 Interior Latex Primer (N534)
PPG Speedhide Zero Interior Latex Primer 6-4900XI
S-W ProMar 200 Zero VOC Interior Latex Primer, B28-2600

First Coat: Benj. Moore Ultra Spec 500 Latex Flat (N536)
PPG Speedhide Zero Interior Latex Flat 6-5110
S-W ProMar 200 Zero VOC Interior Latex Flat, B30-12600 Series

Second Coat: Benj. Moore Ultra Spec 500 Latex Flat (N536)
PPG Speedhide Zero Interior Latex Flat 6-5110
S-W ProMar 200 Zero VOC Interior Latex Flat, B30-12600 Series

a. Total DFT not less than: 3.6 mils

Eggshell Finish/ Scuff Resistant Latex
Primer: Benjamin Moore Ultra Spec 500 Interior Latex Primer (N534)
First Coat: Benjamin Moore Ultra Spec Scuff-X Latex Eggshell (485)
Second Coat: Benjamin Moore Ultra Spec Scuff-X Latex Eggshell (485)

Eggshell Finish/Vinyl Acrylic Latex
Primer: Benj. Moore Ultra Spec 500 Interior Latex Primer (N534)
PPG Speedhide Zero Interior Latex Primer 6-4900XI
S-W ProMar 200 Zero VOC Interior Latex Primer, B28-2600
First Coat: Benj. Moore Ultra Spec 500 Interior Latex Eggshell (N538)
PPG Speedhide Zero Interior Latex Eggshell 6-5310
S-W ProMar 200 Zero VOC Interior Latex Eg-Shel, B20-1900 Series
Second Coat: Benj. Moore Ultra Spec 500 Interior Latex Eggshell (N538)
PPG Speedhide Zero Interior Latex Eggshell 6-5310
S-W ProMar 200 Zero VOC Interior Latex Eg-Shel, B20-1900 Series
a. Total DFT not less than: 3.8 mils

Matte Finish/Scuff and Stain Resistant Acrylic Latex
Primer: PPG Speedhide Zero Interior Latex Primer 6-4900XI
First Coat PPG UltraLast Interior Latex Paint + Primer Matte 13-210
Second Coat PPG UltraLast Interior Latex Paint + Primer Matte 13-210

Eggshell Finish/Scuff and Stain Resistant Acrylic Latex
Primer: PPG Speedhide Zero Interior Latex Primer 6-4900XI
First Coat PPG UltraLast Interior Latex Paint + Primer Eggshell 13-310
Second Coat PPG UltraLast Interior Latex Paint + Primer Eggshell 13-310

Semi-Gloss Finish/Scuff and Stain Resistant Acrylic Latex
Primer: PPG Speedhide Zero Interior Latex Primer 6-4900XI
First Coat PPG UltraLast Interior Latex Paint + Primer Semi-Gloss 13-510
Second Coat PPG UltraLast Interior Latex Paint + Primer Semi-Gloss 13-510

2.5 EXISTING SURFACES TO BE PAINTED

A. Existing surfaces shall be painted in accordance with schedule given in Article 2.4 herein except that first or prime coat may be eliminated where existing paint is sound. Where existing paint must be removed down to base material, provide first or prime coat as specified.

2.6 PIPING AND MECHANICAL EQUIPMENT EXPOSED TO VIEW

A. Paint all exposed piping, conduits, ductwork and mechanical and electrical equipment. Use heat resisting paint when applied to heating lines and equipment. The Contractor is cautioned not to paint or otherwise disturb moving parts in the mechanical systems. Mask or otherwise protect all parts as required to prevent damage.

B. Exposed Uncovered Ductwork, Piping, Hangers and Equipment: Latex Enamel Undercoater and one (1) coat Acrylic Latex Flat.

C. Exposed Covered Piping, Duct Work and Equipment: Primer/Sealer and one (1) coat Acrylic Latex Flat.

D. Panel Boards, Grilles and Exposed Surfaces of Electrical Equipment: Latex Enamel Undercoater and two (2) coats Latex Semi-Gloss.

E. Equipment or Apparatus with Factory-Applied Paint: Refinish any damaged surfaces to match original finish. Do not paint over name plates and labels.

F. All surfaces of insulation and all other work to be painted shall be wiped or washed clean before any painting is started.

G. All conduit, boxes, distribution boxes, light and power panels, hangers, clamps, etc., are included where painting is required.

H. All items of Mechanical and Electrical trades which are furnished painted under their respective Contracts shall be carefully coordinated with the work of this Section so as to leave no doubt as to what items are scheduled to be painted under this Section.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where painting and finishing are to be applied and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 GENERAL WORKMANSHIP REQUIREMENTS

A. Only skilled mechanics shall be employed. Application may be by brush or roller. Spray application only upon acceptance from the Architect in writing.

B. The Contractor shall furnish the Architect a schedule showing when he expects to have completed the respective coats of paint for the various areas and surfaces. This schedule shall be kept current as the job progresses.

C. The Contractor shall protect his work at all times, and shall protect all adjacent work and materials by suitable covering or other method during progress of his work. Upon completion of the work, he shall remove all paint and varnish spots from floors, glass and other surfaces. He shall remove from the premises all rubbish and accumulated materials of whatever nature not caused by others and shall leave his part of the work in clean, orderly and acceptable condition.

D. Remove and protect hardware, accessories, device plates, lighting fixtures, and factory finished work, and similar items, or provide ample in place protection. Upon completion of each space, carefully replace all removed items by workmen skilled in the trades involved.

E. Remove electrical panel box covers and doors before painting walls. Paint separately and re-install after all paint is dry.

F. All materials shall be applied under adequate illumination, evenly spread and flowed on smoothly to avoid runs, sags, holidays, brush marks, air bubbles and excessive roller stipple.

G. Coverage and hide shall be complete. When color, stain, dirt or undercoats show through final coat of paint, the surface shall be covered by additional coats until the paint film is of uniform finish, color, appearance and coverage, at no additional cost to the Owner.

H. All coats shall be dry to manufacturer's recommendations before applying succeeding coats.

I. Do not apply paint behind frameless mirrors that use mastic for adhering to wall surface.

3.3 PREPARATION OF SURFACES

A. Existing Surfaces: Clean existing surfaces requiring paint or finishing, remove all loose and flaking paint or finish and sand surface smooth as required to receive new paint or finish. No "telegraphing" of lines, ridges, flakes, etc., through new surfacing is permitted. Where this occurs, Contractor shall be required to sand smooth and re-finish until surface meets with Architect's approval.

B. General

1. The Contractor shall be held wholly responsible for the finished appearance and satisfactory completion of painting work. Properly prepare all surfaces to receive paint, which includes cleaning, sanding, and touching-up of all prime coats applied under other Sections of the work. Broom clean all spaces before painting is started. All surfaces to be painted or finished shall be perfectly dry, clean and smooth.

2. Perform all preparation and cleaning procedures in strict accordance with the paint manufacturer's instructions and as herein specified, for each particular substrate condition.

3. Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease with clean cloths and cleaning solvents prior to mechanical cleaning. Program the cleaning and painting so that dust and other contaminants from the cleaning process will not fall in wet, newly painted surfaces.

C. Metal Surfaces

1. Weld Fluxes: Remove weld fluxes, splatters, and alkali contaminants from metal surfaces in an approved manner and leave surface ready to receive painting.

2. Bare Metal: Thoroughly clean off all foreign matter such as grease, rust, scale and dirt before priming coat is applied. Clean surfaces, where solder flux has been used, with benzene. Clean surfaces by flushing with mineral spirits. For aluminum surfaces, wipe down with an oil free solvent prior to application of any pre-treatment.

a. Bare metal to receive high performance coating specified herein must be blast cleaned SSPC SP-6 prior to application if field applied primer;

coordinate with steel trades furnishing ferrous metals to receive this coating to ensure that this cleaning method is followed.

3. Shop Primed Metal: Clean off foreign matter as specified for "Bare Metal." Prime bare, rusted, abraded and marred surfaces with approved primer after proper cleaning of surfaces. Sandpaper all rough surfaces smooth.

4. Galvanized Metal: Prepare surface as per the requirements of ASTM D 6386.

5. Metal Filler: Fill dents, cracks, hollow places, open joints and other irregularities in metal work to be painted with an approved metal filler suitable for the purpose and meeting the requirements of the related Section of work; after setting, sand to a smooth, hard finish, flush with adjoining surface.

D. Gypsum Drywall Surfaces: Scrape off all projections and splatters, spackles all holes or depressions, including taped and spackled joints, sand smooth. Conform to standards established in Section 092900, "Gypsum Drywall."

E. Wood Surfaces: Sand to remove all roughness, loose edges, slivers, or splinters and then brush to remove dust. Wash off grease or dirt with an approved cleaner. Fill all cracks, splits, nail holes, screw holes, and surface defects with putty after the priming coat has been applied. Putty shall be brought up flush with the surface and sanded smooth and touched-up with primer when dry.

F. Block Masonry Surfaces: Thoroughly clean off all grit, grease, dirt mortar drippings or splatters, and other foreign matter. Remove nibs or projections from masonry surfaces. Fill cracks, holes or voids not filled under the "Masonry" Section, with Portland cement grout, and bag surface so that it has approximately the same texture as the adjacent masonry surface.

G. Testing for Moisture Content: Contractor shall test all plaster, masonry, and drywall surfaces for moisture content using a reliable electronic moisture meter. Contractor shall also test latex type fillers for moisture content before application of top coats of paint. Do not apply any paint or sealer to any surface or to latex type filler where the moisture content exceeds seven (7) percent as measured by the electronic moisture meter.

H. Touch-Up: Prime paint all patched portions in addition to all other specified coats.

3.4 MATERIALS PREPARATION

A. Mix and prepare painting materials in strict accordance with the manufacturer’s directions.

B. Store materials not in actual use in tightly covered containers. Maintain containers used in storage, mixing, and application of paint in a clean condition, free of foreign materials and residue.

C. Stir all materials before application to produce a mixture of uniform density, and as required during the application of the materials. Do not stir any film which may form on the surface into the material. Remove the film and, if necessary, strain the material before using.

D. Tint each undercoat a lighter shade to facilitate identification of each coat where multiple coats of the same material are to be applied. Tint undercoats to match the color of the finish coat but provide sufficient difference in shade of undercoats to distinguish each separate coat.

3.5 APPLICATION

A. General

1. Apply paint by brush or roller in accordance with the manufacturer's directions. Use brushes best suited for the type of material being applied. Use rollers of carpet, velvet back, or high pile sheep's wool as recommended by the paint manufacturer for material and texture required.

2. The number of coats and paint film thickness required is the same regardless of the application method. Do not apply succeeding coats until the previous coat has completely dried. Sand between each enamel or varnish coat application with fine sandpaper, or rub surfaces with pumice stone, where required to produce an even, smooth surface in accordance with the coating manufacturer's directions.

3. Apply additional coats when undercoats, stains, or other conditions show through the final coat of paint, until the paint film is of uniform finish, color and appearance. Give special attention to ensure that all surfaces, including edges, corners, crevices, welds, and exposed fasteners receive a film thickness equivalent to that of flat surfaces.

4. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Paint surfaces behind permanently fixed equipment or furniture with prime coat only.

   a. "Exposed surfaces" is defined as those areas visible when permanent or built-in fixtures, convector covers, covers for finned tube radiation, grilles, etc., are in place in areas scheduled to be painted.

5. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, non-specular black paint, before final installation of equipment.

6. Paint the back sides of access panels, removable or hinged covers to match the exposed surfaces.

7. Finish doors on tops, bottoms, and side edges the same as the faces, unless otherwise indicated.

8. Enamel finish applied to wood or metal shall be sanded with fine sandpaper and then cleaned between coats to produce an even surface.

9. Paste wood filler applied on open grained wood after beginning to flatten, shall be wiped across the grain of the wood, then with a circular motion, to secure a smooth, filled, clean surface with filler remaining in open grain only. After overnight dry, sand surface with the grain until smooth before applying specified coat.

B. Scheduling Painting

1. Apply the first coat material to surfaces that have been cleaned, pre-treated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

2. Allow sufficient time between successive coatings to permit proper drying. Do not re-coat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and the application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

C. Prime Coats: Re-coat primed and sealed walls and ceilings where there is evidence of suction spots or unsealed areas in first coat, to assure a finish coat with no burn-through or other defects due to insufficient sealing.

D. Pigmented (Opaque) Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance and coverage.

E. "Touching-Up" of Factory Finishes: Unless otherwise specified or shown, materials with a factory finish shall not be painted at the project site. To "touch-up," the Contractor shall use the factory finished material manufacturer's recommended paint materials to repair abraded, chipped, or otherwise defective surfaces.

3.6 PROTECTION

A. Protect work of other trades, whether to be painted or not, against damage by the painting and finishing work. Leave all such work undamaged. Correct any damages by cleaning, repairing or replacing, and repainting, as acceptable to the Architect.

B. Provide "Wet Paint" signs as required to protect newly painted finishes. Remove temporary protective wrappings provided by others for protection of their work after completion of painting operations.

3.7 CLEAN UP

A. During the progress of the work, remove from the site all discarded paint materials, rubbish, cans and rags at the end of each work day.

B. Upon completion of painting work, clean window glass and other paint spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.

C. At the completion of work of other trades, touch-up and restore all damaged or defaced painted surfaces.

END OF SECTION

SECTION 101100

VISUAL DISPLAY SURFACES

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment and services necessary to complete the visual display surfaces as shown on the drawings and/or specified herein, including but not necessarily limited to the following:

1. Glass marker boards.

2. Frames and trim.

1.3 RELATED SECTIONS

A. Drywall - Section 092900.

1.4 QUALITY ASSURANCE

A. Qualifications of Installers: For installation of whiteboards and tackboards, use only personnel who are thoroughly trained and experienced in the skills involved and who are completely familiar with the manufacturer's recommended methods of installation.

B. Installation Methods: The recommended installation methods of the manufacturer shall become the basis for acceptance or rejection of actual installation methods used in the work.

C. Manufacturer: Furnish all whiteboards and tackboards by one manufacturer for entire project.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's technical data and installation instructions for each material and component part, including data substantiating that materials comply with requirements.

B. Shop Drawings: Submit for each type of whiteboard and tackboard. Include sections of typical trim members and dimensioned elevations. Show anchors, grounds, reinforcement, accessories, and installation details.

C. Samples: Submit full range of color samples for each type of whiteboard, tackboard, trim and accessories required. Provide 12" square samples of sheet materials and 12" lengths of trim members for color verification after selections have been made.

1.6 SPECIAL PROJECT WARRANTY

A. Warranty on Porcelain Enamel Whiteboards: Provide written warranty, signed by manufacturer, agreeing to replace, within warranty period of twenty-five (25) years porcelain enamel whiteboards which do not retain original writing and erasing qualities, defined to include surfaces which become slick and shiny, or exhibit crazing, cracking or flaking; provide manufacturer's instructions for handling, installing, protecting and maintaining whiteboards have been adhered to during the warranty period. Replacement is limited to material replacement only and does not include labor for removal and reinstallation.

1.7 PRODUCT HANDLING

A. Protection: Use all means necessary to protect the materials of this Section before, during and after installation and to protect the installed work and materials of all other trades.

B. Replacements: In the event of damage, immediately make all repairs and replacements necessary.

PART 2 PRODUCTS

2.1 GLASS MARKER BOARDS

A. Provide Factory assembled fixed units consisting of a low lead, low iron glass, 5/16” nominal thickness, frameless glass marker board Model# 300.45 as manufactured by 3Form or approved equal. Provide manufacturer’s metal Z-clip hanging system components.

1. Glass finish as scheduled on drawings.

2. Color to be selected from manufacturer’s standard color line.

3. Sizes as shown on the Architectural Elevation Drawings.

2.2 ACCESSORIES

A. Provide clips, anchors and fasteners required for complete installation.

B. For each wall mounted glass marker board provide Clarus box tray eraser and marker holder, with required mounting hardware, or equivalent from alternate glass board manufacturer.

2.3 FABRICATION

A. Assembly: Provide factory-assembled whiteboard and tackboard units unless field-assembled units indicated.

B. Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, balanced around center of board, as acceptable to Architect.

1. Provide manufacturer's standard vertical joint system between abutting sections of whiteboard.

2. Provide mullion trim at joints between whiteboard and tackboards.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where whiteboards and tackboards are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. Deliver factory-built whiteboard and tackboard units completely assembled in one piece without joints, whenever possible. Where dimensions exceed panel size, provide 2 or more pieces of equal length as acceptable to the Architect. When overall dimensions require delivery in separate units, prefit at factory, disassembled for delivery, and make final joints at site. Use splines at joints to maintain surface alignment.

B. Install units in locations and mounting heights as shown on drawings and in accordance with manufacturer's instructions, keeping perimeter lines straight, plumb and level. Provide all grounds, clips, backing materials, adhesives, brackets, anchors, trim and accessories for complete installation.

C. Coordinate job-assembled units with grounds, trim and accessories. Join all parts with neat, precision fit.

3.3 ADJUST AND CLEAN

A. Verify accessories required for each unit properly installed and operating units properly functioning.

B. Clean units in accordance with manufacturer's instructions, breaking in only as recommended.

END OF SECTION

SECTION 101400

SIGNAGE

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the signage as shown on the drawings and/or specified herein, including the following:

1. Interior panel signs.

1.3 RELATED SECTIONS

A. Exit signs - Division 26.

1.4 QUALITY ASSURANCE

A. For actual installation of signage, use only personnel who are thoroughly familiar with the manufacturer's recommended methods of installation and who are completely trained in the required skills.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's technical data and installation instructions for each type of signage required.

B. Samples: Submit samples of each type of signage showing finishes, colors, surface textures and qualities of manufacture and design of each sign component including graphics.

C. Shop Drawings: Submit shop drawings for fabrication and erection of signage. Include plans, elevations, and large scale details of sign wording and lettering layout. Show anchorage and accessory items. Furnish location template drawings for items supported or anchored to permanent construction.

1.6 PRODUCT HANDLING

A. Protection: Use all means necessary to protect the materials of this Section before, during, and after installation, and to protect the installed work and materials of all other trades.

B. Replacements: In the event of damage, immediately make all repairs and replacements necessary.

PART 2 PRODUCTS

2.1 INTERIOR PANEL SIGNS

A. Fire egress, floor, and other signs required by Code shall be as follows:

1. Interior Panel Signs: Provide smooth sign panel surfaces constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch measured diagonally from corner to corner, manufactured from manufacturer's standard acrylic sheet, unframed. Comply with requirements indicated for finishes, colors, designs, shapes, sizes, and details of construction (as selected by the Architect).

2. Engraved Copy: Machine engrave letters, numbers, symbols, and other graphic devices into panel sign on face indicated to produce precisely formed copy, incised to uniform depth. Fill engraved copy with enamel.

3. Tactile Characters: Characters and Grade 2 Braille raised 1/32 inch above surfaces, in contrasting color.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where signage is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. Install units and components at the locations directed by the Architect, securely mounted with concealed theft-resistant fasteners. Attach to substrates in accordance with the manufacturer's instructions.

B. Install level, plumb, and at the proper height. Cooperate with other trades for installation of sign units to finish surfaces. Repair or replace damaged units as directed by the Architect.

END OF SECTION

SECTION 102600

CORNER GUARDS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment and services necessary to complete corner guards as shown on the drawings and/or specified herein.

1.3 RELATED SECTIONS

A. Masonry – Section 042000.

B. Gypsum drywall – Section 092900

1.4 QUALITY ASSURANCE

A. Cover materials shall be classified in accordance with ASTM E 84 as to flame spread and smoke development and shall be classified as self-extinguishing in accordance with ASTM D 635.

1.5 SUBMITTALS

A. Samples: Two (2) samples of wall guards and corner guards each 12" long shall be delivered to the Architect.

B. Shop Drawings: Submit shop drawings for wall and corner guards showing all anchorage devices.

PART 2 PRODUCTS

2.1 MATERIALS

A. Corner guards shall be surface mounted, Model SSM-25N manufactured by C/S Group size as indicated on the drawings, with 0.078" thick continuous extruded vinyl cover.

B. Color of vinyl corner guards shall be as selected by the Architect.

C. Vinyl covers shall be rated Class "I" as to flame spread and smoke development.

D. Similar wall and corner guards as manufactured by Brown Manufacturing Co. or InPro. are acceptable.

E. Appropriate end caps, bolts, and other required fitting shall be provided.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where wall and corner guards are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. Corner guards shall be set in alignment with the corner bead of the gypsum wallboard substrate.

3.3 ADJUST AND CLEAN

A. Clean surfaces promptly after installation, exercise care to avoid damage to surfaces.

B. Protect wall and corner guards from damage until acceptance of work.

END OF SECTION

SECTION 102800

TOILET ACCESSORIES

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the toilet accessories as shown on the drawings and/or specified herein.

1.3 RELATED SECTIONS

A. Gypsum board partitions - Section 092900.

B. Ceramic tile - Section 093000.

1.4 QUALITY ASSURANCE

A. Inserts and Anchorages: Furnish inserts and anchoring devices which must be set in concrete or built into masonry; coordinate delivery with other work to avoid delay.

B. Accessory Locations: Coordinate accessory locations with other work to avoid interference and to assure proper operation and servicing of accessory units. Accessories shall be installed at heights in compliance with prevailing Handicapped Code.

C. Products: Unless otherwise noted, provide products of same manufacturer for each type of unit and for units exposed in same areas.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's technical data, catalogue cuts and installation instructions for each toilet accessory.

B. Setting Drawings: Provide setting drawings, templates, instructions, and directions for installation of anchorage devices in other work

C. Submit schedule of accessories indicating quantity and location of each item.

1.6 PRODUCT HANDLING

A. Deliver accessories to the site ready for use in the manufacturer’s original and unopened containers and packaging, bearing labels as to type or material, manufacturer’s name and brand name. Delivered materials shall be identical to approved samples.

PART 2 PRODUCTS

2.1 MATERIALS

A. Stainless Steel: AISI Type 302/304, with polished No. 4 finish, 22 gauge minimum, unless otherwise indicated.

B. Brass: ASTM B 19 flat products; ASTM B 16, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.

C. Galvanized Steel Sheet: ASTM A 653, G60.

D. Chromium Plating: Nickel and chromium electro-deposited on base metal, ASTM B 456, Type SC 2.

E. Mirrors: ASTM C 1503, mirror glazing quality, clear glass mirrors, nominal 1/4" thick.

2.2 FASTENING DEVICES

A. Exposed Fasteners: Theftproof type, chrome plated, or stainless steel; match finishes on which they are being used.

B. Concealed Fasteners: Galvanized (ASTM A 123) or cadmium plated.

C. No exposed fastening devices permitted on exposed frames.

D. For metal stud drywall partitions, provide ten (10) gauge galvanized sheet concealed anchor plates for securing surface mounted accessories.

2.3 FABRICATION

A. General: Stamped names or labels on exposed faces of toilet accessory units are not permitted. Unobtrusive labels on surfaces not exposed to view are acceptable. Where locks are required for a particular type of toilet accessory, provide same keying throughout project. Furnish two keys for each lock.

B. Surface-Mounted Toilet Accessories, General: Fabricate units with tight seams and joints, exposed edges rolled. Hang doors or access panels with continuous stainless steel piano hinge. Provide concealed anchorage.

C. Recessed Toilet Accessories, General: Fabricate units of all welded construction, without mitered corners. Hang doors of access panels with full-length stainless steel piano hinge. Provide anchorage which is fully concealed when unit is closed.

2.4 MANUFACTURERS

A. Provide products manufactured by Bobrick Washroom Equipment Co., American Specialties, Inc., Bradley Corp., A & J Washroom Accessories or approved equal.

2.5 ACCESSORY SCHEDULE

A. See schedule.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where toilet accessories are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 PREPARATION

A. Accessories which are to be partition mounted shall be closely coordinated with other trades, so that the necessary reinforcing is provided to receive the accessories.

B. Furnish templates and setting drawings and anchor plates required for the proper installation of the accessories at gypsum drywall and masonry partitions. Coordinate the work to assure that base plates and anchoring frames are in the proper position to secure the accessories.

C. Verify by measurements taken at the job site those dimensions affecting the work. Bring field dimensions which are at variance with those on the approved shop drawings to the attention of the Architect. Obtain decision regarding corrective measures before the start of fabrication of items affected.

D. Cooperate in the coordination and scheduling of the work of this Section with the work of other Sections so as not to delay job progress.

3.3 INSTALLATION

A. Install accessories at locations indicated on the drawings, using skilled mechanics, in a plumb, level and secure manner.

B. Concealed anchor assemblies for gypsum drywall partitions shall be securely anchored to metal studs to accommodate accessories. Assemblies shall consist of plates and/or angles tack welded to studs.

C. Secure accessories in place, at their designated locations by means of theftproof concealed set screws, so as to render removing of the accessory with a screwdriver impossible.

D. Unless otherwise indicated, accessories shall conform to heights from the finished floor as shown on the drawings. Where locations are not indicated, such locations shall be as directed by the Architect.

E. Installed accessories shall operate quietly and smoothly for use intended. Doors and operating hardware shall function without binding or unnecessary friction. Dispenser type accessories shall be keyed alike. Prior to final acceptance, master key and one duplicate key shall be given to Owner's authorized agent.

F. The Architect shall be the sole judge of workmanship. Workmanship shall be of the highest quality. Open joints, weld marks, poor connections, etc., will not be permitted. The Architect has the right to reject any accessory if he feels the workmanship is below the standards of this project.

G. Grab bars shall be installed so that they can support a three hundred (300) lb. load for thirty minutes per ANSI A117.1 and ADA US Department of Justice Guidelines.

3.4 CLEANING AND PROTECTION

A. Upon completion of the installation, clean accessories of dirt, paint and foreign matter.

B. During the installation of accessories and until finally installed and accepted, protect accessories with gummed canvas or other means in order to maintain the accessories in acceptable condition.

C. Replace and/or repair installed work which is damaged or defective to the Owner's satisfaction, at no additional cost.

END OF SECTION

SECTION 104416

FIRE EXTINGUISHERS AND CABINETS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. The Work of this Section includes all labor, materials, equipment and services necessary to complete the fire extinguishers and cabinets as shown on the drawings and/or specified herein.

1.3 RELATED SECTIONS

A. Masonry walls - Section 042000.

B. Gypsum drywall - Section 092900.

C. Fire suppression systems - Division 22.

D. Fire hose cabinets and valve cabinets - Division 22.

1.4 QUALITY ASSURANCE

A. Provide portable fire extinguishers, cabinets and accessories by one manufacturer.

B. UL-Listed Products: Provide new portable fire extinguishers which are UL-listed and bear UL "Listing Mark" for type, rating, and classification of extinguisher indicated.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's technical data and installation instructions for all portable fire extinguishers required. For fire extinguisher cabinets include roughing-in dimensions, and details showing mounting methods, relationships to surrounding construction, door hardware, cabinet type and materials, trim style and door construction, style and materials. Where color selections by Architect are required, include color charts showing full range of manufacturer's standard colors and designs available.

B. Samples: Submit samples, 6" square, of each required finish. Prepare samples on metal of same gauge as metal to be used in the work. Where normal color variations

are to be expected, include 2 or more units in each sample showing the limits of such variations.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products of one of the following:

1. J.L. Industries.

2. Larsen's Mfg. Co.

3. Potter Roemer.

2.2 EXTINGUISHERS

A. General: Provide fire extinguishers for each extinguisher cabinet and other locations indicated, in colors and finishes selected by Architect from manufacturer's standard which comply with requirements of governing authorities.

B. Abbreviations indicated below to identify extinguisher type related to UL classification and rating system and not necessarily to type and amount of extinguishing material contained in extinguisher.

C. Multi-Purpose Dry Chemical Type: UL rated 2A-10B:C, 5 lb. nominal capacity, in enameled steel container, for Class A, Class B and Class C fires.

2.3 MOUNTING BRACKETS

A. Provide manufacturer's standard bracket designed to prevent accidental dislodgment of extinguisher, of proper size for type and capacity of extinguisher specified, in manufacturer's standard enamel finish; color to match extinguisher.

2.4 CABINETS

A. Type and Style: Fire extinguisher cabinets shall be metal, semi recessed, with plexiglass panel, sized to fit within the partition or wall depth. Provide fire rated cabinets within fire rated partitions.

B. Color: Fire extinguisher cabinets shall be factory pre-finished with baked enamel in the colors selected by the Architect from the standard range of colors of the selected manufacturer.

C. Design is based on "Model G-2409-5R" of Larsen's Mfg. Co. Other manufacturers noted herein may substitute their equivalent cabinet upon acceptance by the Architect.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions where fire extinguishers and cabinets are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 INSTALLATION

A. Install items included in this Section in locations indicated and at heights to comply with applicable regulations of governing authorities.

1. Prepare recesses in walls for fire extinguisher cabinets as required by type and size of cabinet and style of trim and to comply with manufacturer's instructions.

2. Securely fasten mounting brackets and fire extinguisher cabinets to structure, square and plumb, to comply with manufacturer's instructions.

B. Where exact location of cabinets and bracket-mounted fire extinguishers is not indicated, locate as directed by the Architect.

3.3 IDENTIFICATION

A. Identify fire extinguisher in cabinet with lettering spelling "FIRE EXTINGUISHER" painted on door by silk-screen process or die cut lettering. Provide lettering on door as selected by Architect from manufacturer's standard letter sizes, styles, colors and layouts.

B. Identify bracket-mounted extinguishers with red letter decals spelling 'FIRE EXTINGUISHER' applied to wall surface. Letter size, style and location as selected by the Architect.

3.4 SERVICE

A. Determine the approximate completion date of the work and then inspect, charge, and tag the fire extinguishers at a date not more than 10 days before or not less than one day before actual completion date of the work.

END OF SECTION

SECTION 123661

SOLID SURFACE COUNTERTOPS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the solid surface countertops as shown on the drawings and/or specified herein including, but not limited to, the following:

1. Solid-surface-material countertops
2. Solid surface window stools

1.3 RELATED SECTIONS

A. Architectural Woodwork - Section 064023.

B. Plumbing - Division 22

1.4 QUALITY ASSURANCE

A. Qualifications of installers: Use only personnel who are thoroughly trained and experienced in the skills required and completely familiar with the requirements established for this work.

1.5 SUBMITTALS

A. Product data: Submit manufacturer’s product data, fabrication and installation instructions for countertop materials.

B. Shop Drawings: For countertops, show material, finishes, edge and backsplash profiles, methods of joining and cut outs for fixtures.

C. Samples

1. Submit 3 sets of 12" x 12" samples of each top. Include full range of color and texture to be expected. Architect will review for color and texture only. Compliance with all other requirements is the exclusive responsibility of the Contractor.

1.6 PROJECT CONDITIOS

A. Field Measurements: Verify dimensions of countertops by field measurements before countertop fabrication is complete.

1.7 COORDINATION

B. Coordinate locations of utilities that will penetrate countertops and backsplashes.

PART 2 PRODUCTS

2.1 SOLID-SURFACE-MATERIAL COUNTERTOPS (DIMENSIONS SEE DRAWINGS)

A. Countertops: Refer to finish schedule. Solid surface material with front edge built up with same material.

B. Backsplashes: Solid surface material.

C. Fabrication: Fabricate tops in one piece with shop-applied edges and backsplashes unless otherwise indicated. Comply with solid-surface-material manufacturer’s written instructions for adhesives, sealers, fabrications, and finishing.

1. Fabricate with loos backsplashes for field assembly.

2. Install integral sink bowls in countertops in the shop.

2.2 COUNTERTOP MATERIALS

A. Certified Wood Materials: Fabricate countertops with wood and wood-based products produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

B. Particleboard: ANSI A208.1, Grade M-2, made with binder containing no urea formaldehyde.

C. Adhesives: Adhesives shall not contain urea formaldehyde.

D. Adhesives: Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. Solid Surface Material: Homogeneous solid sheets of filled plastic resin complying with ANSI SS1.

1. Basis of Design Product: Subject to compliance with requirements, provide Solid Surface as manufactured by Wilsonart, or approved equal product.

2. Type: Provide Standard Type unless Special Purpose Type is indicated.
3. Integral Sink Bowls: Comply with ISSFA-2 and ANSI Z124.3, Type 5 or Type 6, without a precoated finish.
4. Colors and Patterns: Refer to finish schedule.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install countertops level to a tolerance of 1/8 inch in 8 feet.

B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Pre-drill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
   1. Install back and side splashes to comply with manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
   2. Seal edges of cutouts in particleboard sub tops by saturating with varnish.

END OF SECTION

SECTION 21 00 50
COMMON WORK RESULTS FOR FIRE PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. General provisions.
   2. Scope.
   3. Permits and Fees.
   4. Visit to Job Site.
   5. Workmanship.
   6. Drawings and Specifications.
   7. Tests.
   8. Allowance for added work.
   9. Incidental construction work.
   10. Access doors
   11. Supervision.
   12. Electrical work by others.
   13. Existing facilities, utilities, etc.
   14. Adaptation of work to existing conditions.
   15. Renovations/alterations.
   16. Submittal procedures.
   17. Product requirements.
   18. Closeout procedures.
   19. Operation and Maintenance Manuals.
   20. As-built Documents.
   21. Demonstration and Training.
   22. Warranty.
   23. Commissioning Support.

PART 2 - NOT APPLICABLE

PART 3 - EXECUTION

3.1 GENERAL PROVISIONS

A. This Contractor's attention is directed to the requirements of Instructions to Bidders, General Conditions and Supplementary General Conditions as bound in the specifications which apply in full to the plumbing work.

B. Where the requirements of this Division conflict with other articles in these Specifications, the Contractor shall utilize the more stringent method.

3.2 SCOPE

A. Provide all labor, materials, tools, equipment, and transportation, and perform all operations necessary for and reasonably incidental to proper execution and completion of all "Fire Protection" work, whether specifically mentioned or not, all as indicated, specified herein, and/or implied thereby to carry out the apparent intent thereof.

B. These drawings may be superseded by later revised or detailed drawings, specifications, or sketches prepared by the Designer, as needed for clarification, and this Contractor shall conform to all reasonable coordination requests.

C. All items not specifically mentioned in the specifications or noted on the drawings, but which obviously are required to make the working installation complete, shall be included automatically.

D. For projects which are bid or awarded as Single Prime contracts, organization of the Specifications into divisions, sections, and articles, and arrangement of the Drawings shall

not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be done by any trade, unless specifically shown or noted otherwise.

3.3 PERMITS AND FEES

A. This Contractor shall secure all permits required for the completion of this contract. He shall obtain and deliver to the Owner all certificates of inspection issued by the authorities having jurisdiction.

3.4 VISIT TO JOB SITE

A. Before submitting a bid, this Contractor shall visit the job site for the purpose of thoroughly examining the site and conditions under which the work must be performed.

B. The submission of a bona fide bid will be construed to mean that this Contractor understands and is satisfied with conditions under which the contract must be fulfilled.

C. No extra compensation will be allowed for situations arising from failure of this Contractor to be thoroughly familiar with site conditions, including charges and requirements for connection to utilities as shown for this project.

3.5 WORKMANSHIP

A. Workmanship in the fabrication, preparation, and installation of materials and equipment shall conform to the best standards of practice of the trades involved.

B. Work shall be performed by experienced and skilled mechanics under the supervision of a competent foreman.

C. Substandard workmanship will be cause for rejection of work and replacement by Contractor.

D. The Contractor shall reimburse the Designer for all costs incurred by the Designer due to Contractor's substandard or non-conforming work.

3.6 DRAWINGS AND SPECIFICATIONS

A. The drawings show the location and arrangement of fixtures, piping, and equipment, together with details of connections of certain principal items.

B. The layout shown shall be followed as closely as circumstances will permit, but this Contractor shall lay out his work so as to avoid conflict with other Contractors and trades, and to avoid any unnecessary cutting or damage to walls, floors, and supporting structural members.

C. This Contractor shall carefully and accurately locate all sleeves and install at the proper time all necessary hangers, inserts, etc., which will be required for the completion of his work, and shall be solely responsible for the accurate and proper location of above items.

D. This Contractor shall refer to architectural, mechanical, and electrical drawings and shall cooperate fully with other Contractors and trades while installing piping, fixtures, and other equipment because of close space limits.

1. In case of conflict, notify Designer before proceeding with installation.
2. Refer to architectural drawings for exact building dimensions and location of partition walls, doors, chases, etc.
3. Plumbing drawings are not to be scaled for such dimensions.

E. The drawings and specifications complement each other and together are intended to give a complete description of the work.

1. Any item of equipment or note of work to be done as shown on plans and not mentioned in the specifications, or mentioned in specifications and not shown in plans, shall be furnished the same as if mentioned or shown in both places.
2. If conflicts exist, then the most stringent method shown or described shall apply.

F. Any switches, controls, or equipment included in this contract work (drawings and/or specifications) that are not specifically shown on drawings shall be located for convenient use and access.

G. Contractor shall coordinate all equipment arrangement and lay-out in field prior to beginning any actual installation of his work.

H. If Contractor notes any discrepancy, omission, or conflict found in plans or specifications, he shall call to the immediate attention of the Designer, prior to receipt of bids.

I. It is the intention that piping, air ducts and light fixtures are designed and laid out to clear each other.
   1. It shall be the responsibility of this Contractor to coordinate his work with that of other trades to avoid any such conflicts.
   2. Any conflicts that occur after work of one trade is installed and was not prior coordinated shall be relocated or rearranged at the total expense of this Contractor, as directed by Designer.
   3. Any conflicts that cannot be corrected in field by relocation or elevation changes shall be reported to the Designer in writing prior to any installation.

J. The drawings are not intended to show each and every complete or accurate detail.
   1. The figures and writing on drawings shall be taken instead of scaling.
   2. It is this Contractor's responsibility to comply with the evident intent for centering and symmetric arrangement.
   3. This Contractor shall take and be responsible for all field measurements.
   4. Exact locations and relations are to be defined in the field and shall be satisfactory to the Designer.

K. Because of the small scale of plumbing drawings it is not possible to indicate all offsets, fittings, and accessories which may be required.
   1. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings and accessories that may be required to meet the conditions.

3.7 TESTS

A. The Designer reserves the right to conduct acceptance tests of all equipment, piping, or any other work furnished under these specifications to determine the fulfillment of special requirements.
   1. Such tests shall be conducted in the presence of authorized representatives of the Contractor, Owner, Engineer, and Architect at such time as the Designer may designate.
   2. This Contractor shall perform all tests, bear cost of same and make adjustments of equipment and wiring as may be deemed necessary by the Designer.

3.8 ALLOWANCE FOR ADDED WORK

A. Before proceeding with any work for which compensation may be claimed or the Owner may claim credit, a detailed estimate shall first be submitted and approved in writing.
   1. No claim for addition to the contract sum will be valid unless so ordered and approved by the Owner and Designer, prior to start of work.
   2. Any conflicts corrected by relocation or elevation changes do not constitute extra work.

3.9 INCIDENTAL CONSTRUCTION WORK

A. All blocking for openings for piping in concrete floors, masonry walls or partitions shall be provided by this Contractor.
   1. This Contractor shall do all cutting and fitting of his work and of other work that may be required to make the several parts come together properly and to fit his work to receive or be received by the work of other Contractors as shown upon, or reasonably implied by the drawings and specifications.

2. He shall properly complete and finish up his work after other Contractors have finished as the Designer may direct.

B. All excavating required for the installation of this system shall be done by this Contractor.
   1. Backfill shall be accomplished as specified in appropriate section of specifications.

C. Chases are prohibited in masonry walls which are not to be plastered or paneled.
   1. Set piping, blocking, carriers, etc. indicated to be concealed before walls are constructed in order that walls may be constructed around them.
   2. This Contractor shall furnish all sleeves in floors, beams, walls, etc., for each such penetration as needed for installing his work and installation of sleeves by General Contractor.

D. Unless otherwise noted, the General Contractor will provide openings and lintels as new construction progresses, but this Contractor shall fully designate his requirements prior to construction.
   1. Failure to furnish his requirements prior to building construction and failure to coordinate his work with the building construction shall make this Contractor responsible for removing, replacing and painting building construction as required for installation of his work.

3.10 ACCESS DOORS

A. Provide and install access doors in walls, ceilings, etc. as required for access to valves and other devices requiring access in ceilings, chases, soffits, etc.

B. Access doors in non-fire rated walls or ceilings shall be as follows:
   1. Nominal 24” x 24” minimum size.
   2. 16-gage steel frame with 14-gage door panel and galvanized steel drywall bead.
   3. Flush style with provision to conceal flange with drywall cement.
   4. Double-acting concealed spring hinges to allow opening to 175 degrees.
   5. Flush, Allen-head operated with steel cam.
   6. Gray prime-painted steel, for painting to match adjacent finished surfaces.
   7. Basis of Design: Milcor Style DW; Comparable Products by Karp, Elmdor, Acudor.

C. Access doors in fire-rated walls or ceilings shall be as follows:
   1. Nominal 24” x 24” minimum size.
   2. UL 1-1/2 hour, Class B fire rating.
   3. Prime-painted stainless steel: 16-gage frame with 20-gage door panel, for painting to match adjacent finished surfaces.
   4. 2” mineral fiber insulation between inner and outer panel.
   5. Continuous hinge, steel with stainless steel pin.
   6. Self-closing and self-latching panel closer.
   7. Flush mounted paddle latch and locking system with flush, key-operated cylinder lock with two keys.
   8. Basis of Design: Milcor Style UFR; Comparable Products by Karp, Elmdor, Acudor.

3.11 SUPERVISION

A. This Contractor shall have in charge of the work at all times during construction a thoroughly competent foreman with extensive experience in the work to be performed under this contract.
   1. Anyone deemed not capable by the Designer shall be replaced immediately upon request, and after satisfactory foreman has been assigned, he shall not be withdrawn without the written consent of the Designer.

3.12 ELECTRICAL WORK BY OTHERS

A. Refer to the drawings for the details of locations of circuit breakers, junction boxes, disconnect switches, conduits and slack wire required where this contractor's electrical work terminates and electrical work by others begins.

B. Fire Protection Contractor is to provide and install tamper and flow switches to be wired by Electrical Contractor to fire alarm system.

3.13 EXISTING FACILITIES

A. In existing facilities, disruption of operations must be kept to a minimum and coordinated with Owner.

1. Work in existing buildings must be cleaned up daily immediately after finishing that portion of work and equipment left in order for Owner to continue operations.
2. When it is necessary to interrupt utility services in the fulfillment of this contract, such interruptions shall be kept to a minimum and coordinated with Owner.
3. Once work has begun, it shall be pursued diligently until completed.

B. Every precaution shall be taken to prevent damage to existing underground lines and structures and public utilities.

1. Damage to existing water and sewer lines, culverts, service connections, underground cables, and similar surface and sub-surface structures shall be at the risk of this Contractor, whether or not locations thereof are shown on plans, and the repairing of such damage shall be by this Contractor and shall be completed without delay.
2. Compensation for such repairs shall be based on normal and reasonable costs.

C. The locations of any existing underground utilities that are shown are in an approximate way only and have not been independently verified by the Owner or its representative.

1. The Contractor shall determine the exact location of all existing utilities before commencing work, and agrees to be fully responsible for any and all damages which might be occasioned by the Contractor’s failure to exactly locate and preserve any and all underground utilities.

3.14 ADAPTATION OF WORK TO EXISTING CONDITIONS

A. It is reasonably implied that this Contractor shall furnish all labor and materials to provide Owner with a new and satisfactory system in these facilities.

1. Contractor is to include necessary work for adaptation of equipment to conditions that may be found to produce conflicts during construction.
2. When any such conditions are encountered, this Contractor is to consult with Designer and then modify installation as directed without additional costs, and to include any incidental materials required.

3.15 RENOVATIONS/ALTERATIONS

A. Before any work is started in existing building, Fire Protection Contractor shall make a thorough survey with Designer and a representative of the Owner of building in which alterations occur and areas which are anticipated routes of access, and furnish a report, signed by all three to Designer. This report shall list by rooms and spaces:

1. Existing conditions and types of resilient flooring, doors, windows, wall and other surfaces not required to be altered throughout and affected areas of building.
2. Existence and conditions and operation of items such as plumbing fixtures, water heaters, valves, etc., required by drawings to be either reused for relocated, or both.
3. Any discrepancies between drawings and existing conditions at site.
4. Areas for working space, materials storage and routes of access to areas within buildings where alterations occur and which have been agreed upon by Contractor and Designer.

B. Any items required by drawings to be either reused or relocated or both, found during this survey to be nonexistent, or in opinion of Designer and Owner's representative, to be in such condition that their use is impossible or impractical, shall be removed and a proposal submitted by Contractor to replace with new items in accordance with specifications which will be furnished by Designer.

C. Re-Survey: Fifteen days before expected partial or final inspection date, Contractor, Designer, Owner's representative, together shall make a thorough re-survey of the areas of buildings involved.
   1. They shall furnish a report on conditions then existing, of plumbing fixtures, equipment, etc. as compared with conditions of same as noted in first condition survey report.
   2. Re-survey report shall also list any damage caused by this Contractor to such flooring and other surfaces, despite protection measures; and, will form basis for determining extent of repair work required of this Contractor to restore damage caused by Contractor's workmen in executing work of this Contract.

3.16 SUBMITTAL PROCEDURES

A. Coordinate preparation and processing of submittals with performance of construction activities.
   1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
   2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
   3. Designer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

B. Contractor approval: Affix review stamp to cover sheet, with initials and date of Contractor’s approval of submittals.
   1. By submitting Shop Drawings, Product Data, Samples and similar submittals, this Contractor represents that the Contractor has determined and verified materials, field measurements and field construction criteria and details related thereto, or will do so, and has checked and coordinated the information contained within such submittals with the requirements of the Work, the Contract Documents and the Work of other trades.

C. Comply with requirements in Division 01 Sections for list of submittals and time requirements for scheduled performance of related construction activities.

D. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows.
   1. Time for review shall commence on Designer's receipt of submittal.
   2. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
   3. Allow 21 days for initial review of each submittal.
      a. Allow additional time if coordination with subsequent submittals is required.
      b. Designer will advise Contractor when a submittal being processed must be delayed for coordination.
   4. Allow 15 days for review of each resubmittal.

E. Identification: Identify submittals as required in Division 01 sections.

F. Deviations: Highlight, encircle, or otherwise specifically identify deviations from the Contract Documents on submittals.

1. Summarize deviations on transmittal or List of Deviations included with submittal.

G. Coordinate first paragraph and subparagraph below with office policy. Marking numerous copies of submittals can be time consuming.

H. Transmittal: Package each submittal individually and appropriately for transmittal and handling.
   1. Transmit each submittal using a transmittal form.
   2. Designer will discard submittals received from sources other than Contractor.

I. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
   1. Note date and content of previous submittal.
   2. Note date and content of revision in label or title block and clearly indicate extent of revision.
   3. Resubmit submittals until they are marked "Furnish as Submitted" or "Furnish as Corrected."
   4. Where submittals contain specific questions or comments, provide a separate sheet with specific answers to each question or comment.

J. At Contractor's written request, copies of Designer's CAD files will be provided to Contractor for Contractor's use in connection with Project, subject to the following conditions:
   1. Allow 21 days from Designer's receipt of written request for CAD files for delivery of files
   2. Files will be delivered via email or compact disc.
   3. Files will be delivered without RN&M Title Blocks, standard details, schedules, etc.
   4. CAD files provided for Contractor's use are not to be construed as the Contract Documents. Use of CAD files for submittals or other uses are at the Contractor's risk.

K. Prepare and submit Action Submittals required by individual Specification Sections.
   1. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
   2. Number of Copies: Submit at least eight copies of Product Data, unless otherwise indicated.
      a. Designer will return all but three copies.
      b. Retain or duplicate sufficient copies for inclusion in Operation and Maintenance Manuals.
   3. Shop Drawings: Prepare Project-specific information, drawn accurately to scale.
      a. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal of Designer's CAD Drawings is otherwise permitted.
   4. Revise subparagraph below to establish a standard sheet size and format.
   5. Sheet Size: At least 8-1/2 by 11 inches but no larger than size of project drawings.
   6. Subparagraph below assumes Architect and Contractor will make copies from opaque print.
   7. Number of Copies: Two opaque (bond) copies of each submittal. Designer will return one copy.
   8. Manufacturers and Materials Suppliers List: Submit three copies of manufacturers and materials suppliers list within 20 days of Contract Award, unless otherwise indicated. Designer will return two copies.
   9. If needed, combine subcontract list in paragraph below with product list above. Subcontract list is required by AIA Document A201 to be submitted as soon as practical after award of the Contract.

10. Subcontract List: Submit within 20 days of Contract Award three copies of list of proposed subcontractors. Designer will return two copies. Subcontract list to include all tiers of subcontractors.

L. Contractor's Review and Approval: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents.
1. Note corrections and field dimensions.
2. Mark with approval stamp before submitting to Designer.

M. Designer's Action: Designer will not review submittals that do not bear Contractor's approval stamp and will return them without action.
1. Designer will review each submittal, make marks to indicate corrections or modifications required, and return it.
2. Designer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:
   a. Furnish as Submitted
   b. Furnish as Corrected: Incorporate comments marked on or attached to submittal.
   c. Revise and Resubmit: Major items of the submittal do not comply, requiring a resubmittal.

N. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.

O. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

P. The Contractor is responsible for compliance with the Contract Documents, dimensions, details, coordination, and satisfactory performance of materials and equipment provided and installed.

3.17 PRODUCT REQUIREMENTS

A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
1. Basis-of-Design Product: Item identified by manufacturer's product name, make, and model number, used to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, dimensions, and other characteristics for purposes of evaluating comparable products of other named manufacturers.
2. Comparable Product: Product that is listed in the Contract Documents, or added by Addendum, and demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified or basis-of-design product.
3. Owner-preferred Alternate Product: Product that is listed in the Contract Documents, and for which an Alternate Bid price is submitted. When an Alternate Bid item is accepted in the Contract, no substitutions will be allowed.
4. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor after award of Contract.
5. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are

allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.

B. Comparable Product Requests: Submit three copies of each request for consideration, at least 10 days prior to receipt of bids, for products not listed in the Contract Documents. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
   1. Documentation: Show compliance with requirements for Comparable Products and the following, as applicable:
      a. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed product.
      b. Detailed comparison of significant qualities of proposed product with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
      c. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
   2. Designer's Action: If necessary, Designer will request additional information or documentation for evaluation. Designer will notify Contractor of approval or rejection of proposed comparable product request.
      a. Form of Approval: Addition of the item to the list of Comparable Products by Addendum, prior to receipt of bids.
      b. Use product specified if Designer cannot make a decision on use of a comparable product request within time allocated.

C. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.
   1. Provide products complete with accessories, trim, finish, fasteners, features, options, and other items needed for a complete installation and indicated use and effect, and as required or recommended by the manufacturer for a complete installation, whether or not specifically indicated on the drawings or specifications.
   2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
   3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
   4. Where products are accompanied by the term "as selected," Designer will make selection.
   5. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.

D. Product Selection Procedures:
   1. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
   2. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
   3. Basis-of-Design Product: Where Specifications name a product and include a list of manufacturers, provide the specified product or a comparable product by one of the

other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named.

E. Responsibility of the Contractor: The responsibility for determining dimensions, utility requirements, fitting of work with other trades, sequencing and coordination of work, for Product Substitutions and Comparable Products rests solely with the Contractor.

F. Manufacturer's Warranties: Where specifications require manufacturer's warranties, the provisions of the Contract Documents take precedence over any manufacturer's "standard" warranty provisions, exclusions, etc.
   1. The start of manufacturer's warranties shall be the date of Substantial Completion of the project or phase of the project, notwithstanding any language or exclusion in any document submitted by the contractor or manufacturer.

3.18 CLOSEOUT PROCEDURES

A. Substantial Completion: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
   1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
   2. Complete startup testing of systems.
   3. Submit test records.
   4. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
   5. Complete final cleaning requirements, including touchup painting.
   6. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
   7. Submit a written request for inspection for Substantial Completion. On receipt of request, Designer will either proceed with inspection or notify Contractor of unfulfilled requirements.
   8. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
   9. Results of completed inspection will form the basis of requirements for Final Completion.

B. Final Completion: Before requesting final inspection for determining date of Final Completion, complete the following:
   1. Submit certified copy of Designer's Substantial Completion inspection list of items to be completed or corrected (punch list). The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
   2. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit documentation of training.
   3. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Designer will either proceed with inspection or notify Contractor of unfulfilled requirements.
   4. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

C. Cleaning: This Contractor shall provide all systems and equipment in a new and clean condition.
   1. Clean all items furnished and installed in accordance with manufacturer's recommendations.
   2. Provide instruction to Owner in proper cleaning of all items provided as part of this Division.
   3. Cooperate with General Contractor in cleaning of building.

3.19 OPERATION AND MAINTENANCE MANUALS

A. Submit four complete copies of Operation and Maintenance Manuals to Designer for review prior to request for inspection for Substantial Completion.

B. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain a title page, table of contents, and manual contents.

C. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:
   1. Subject matter included in manual.
   2. Name and address of Project.
   3. Name and address of Owner.
   4. Date of submittal.
   5. Name, address, and telephone number of Contractor.
   6. Name and address of Architect.
   7. Name and address of Engineer.

D. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

E. List of Material Suppliers and Subcontractors: List contact information for each material supplier and subcontractor.

F. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
   1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
      a. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
   2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
   3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
   4. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
      a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
      b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

G. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

H. Descriptions: Include the following: Product name and model number, Manufacturer's name, Equipment identification with serial number of each component, Equipment function, Operating characteristics, Limiting conditions, Performance curves, Engineering data and tests, Complete nomenclature and number of replacement parts.

I. Include start-up, break-in, and control procedures; stopping and normal shutdown instructions; routine, normal, seasonal, and weekend operating instructions; and required sequences for electric or electronic systems.

J. Describe the sequence of operation, and diagram controls as installed.

K. List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

L. Provide manufacturers' maintenance documentation including maintenance instructions, drawings and diagrams for maintenance, nomenclature of parts and components, and recommended spare parts for each component part or piece of equipment:

M. Include test and inspection instructions, troubleshooting guide, disassembly instructions, and adjusting instructions that detail essential maintenance procedures:

N. Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

O. Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

P. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

Q. Provide complete approved submittal data with all annotations.

R. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.

3.20 AS-BUILT DOCUMENTS

A. As-built Marked Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings.

1. Mark Record Prints to show the actual installation where installation varies from that shown originally.
2. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up As-built Marked Prints.
3. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
4. Record data as soon as possible after installation.
5. Record and check the markup before enclosing concealed installations.
6. Indicate dimensions to locate underground and concealed conduits and lines from fixed reference points.
7. Indicate burial depth for underground lines.
8. Indicate location of all valves and cross-reference to valve tag list.
9. Mark the Contract Drawings completely and accurately.
    a. Mark record sets with erasable, red-colored pencil.

b. Note Addendum numbers, Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

10. Maintain As-built Marked Prints in a clean, legible, up-to-date condition in the project office, and available to the Designer for inspection upon request throughout construction.
11.
12. In first paragraph and subparagraphs below, architects may want to delete titleblock information from CAD files provided to Contractor. See Evaluations. Consult Owner for format required.

B. Record Specifications: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
   1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
   2. Note related Change Orders and As-built Marked Prints where applicable.

3.21 DEMONSTRATION AND TRAINING

A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season. Schedule training with Owner with at least seven days' advance notice.

C. Warranty service: Train Owner in repair and troubleshooting during each warranty service call.

D. For each training session, submit on letterhead name of trainer, date of training, names of Owner’s personnel trained, and systems/equipment trained on.

E. For factory training, documentation to be on letterhead of organization conducting training.

3.22 WARRANTY

A. This Contractor shall guarantee all materials, equipment, workmanship and each and every piece of apparatus which he furnished and which he installs under this contract against defects and failures of any nature for a period of one year from date on which the system is accepted.

B. Apparatus furnished by this Contractor shall be guaranteed to be satisfactory when operated under rated conditions in accordance with manufacturer's instructions and to be of size, function, and capacity specified on drawings or in the specifications.

C. Equipment manufacturers shall warrant equipment furnished for this project for same time span as installing contractors warranty period as set above and elsewhere in these specifications.
   1. Warranty start date shall be as established by the Designer. Refer to General Conditions, Supplementary General Conditions, and Division 1 specifications for establishment of warranty start dates.
   2. The provisions of the Contract Documents supersede and override any manufacturer’s standard warranty provisions.

D. Upon notice from the Designer or Owner, Contractor shall immediately check system, make necessary repairs or adjustments as required; due to faulty workmanship, materials, faults, operation or equipment, without cost to the Owner, and instruct Owner in proper operation, adjustment, and care of systems.

E. During the one-year warranty period, the Contractor shall be responsible for all preventive maintenance, including routine lubrication, filter changing, inspections, and adjustments.

1. Contractor shall provide all materials, consumables, equipment, supplies, etc. required for preventive maintenance.
2. Perform preventive maintenance in accordance with manufacturer's recommendations.
3. Near the end of the warranty period, conduct the required annual test/inspection of the sprinkler system.
4. During preventive maintenance, instruct Owner in proper preventive maintenance procedures.

F. The Contractor shall submit service call tickets, reports, or other documentation of each warranty service call to the Designer.

3.23 COMMISSIONING SUPPORT

A. This contractor shall support all Commissioning as requested by the Commissioning Agent, to include but not limited to the following:
1. Performance tests
2. Piping tests as requested
3. Factory startup of equipment
4. Any commissioning activity, as requested by the Commissioning Agent.

B.

SECTION 21 00 80
PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:
   1. Record Drawings.
   2. Record Specifications.

B. See Division 21 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.

C. See Division 21 Sections for specific requirements for Project Record Documents of the Work in those Sections.

1.2 SUBMITTALS

A. Record Drawings: Comply with the following:
   1. Number of Copies: Submit one set of marked-up Record Prints.

B. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings and Shop Drawings.
   1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.
      a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
      b. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
      c. Indicate dimensions to locate underground and concealed lines from fixed reference points.
      d. Indicate burial depth for underground lines.
   2. Mark the Contract Drawings completely and accurately.
   3. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
   4. Note Addendum numbers, Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Format: Identify and date each Record Drawing; include the designation "AS-BUILT MARKED PRINT" in a prominent location.
   1. Record Prints: Organize Record Prints and newly prepared Record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
   2. Identification: As follows:
      a. Project name.
      b. Date.
      c. Designation "AS-BUILT MARKED PRINTS."
      d. Name of Architect.
      e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
   1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
   2. Note related Change Orders and Record Drawings where applicable.

2.3 RECORD PRODUCT DATA

A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders, Record Specifications, and Record Drawings where applicable.

2.4 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.

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

END OF SECTION 210080

SECTION 21 01 00
PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes through-penetration firestop systems for penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items.

1.2 PERFORMANCE REQUIREMENTS

A. General: For penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.

B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per ASTM E 814 or UL 1479:

1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
2. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:
   a. Penetrations located outside wall cavities.
   b. Penetrations located outside fire-resistance-rated shaft enclosures.

C. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.

1. For floor penetrations with annular spaces exceeding 4 inches in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved, either by installing floor plates or by other means.

D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

1.3 SUBMITTALS

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

B. Shop Drawings: For each through-penetration firestop system, submit documentation, including illustrations, from a qualified testing and inspecting agency, showing each type of construction condition penetrated, relationships to adjoining construction, and type of penetrating item.

1. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular through-penetration firestop condition, submit illustration, with modifications marked, approved by through-penetration firestop system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

C. Qualification Data: For Installer.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:

1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, or another agency performing testing

and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.

2. Through-penetration firestop systems are identical to those tested per testing standard referenced in "Part 1 Performance Requirements" Article. Provide rated systems bearing classification marking of qualified testing and inspecting agency.

B. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.

C. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until each installation has been examined by Owner's inspecting agency and building inspector, if required by authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the through-penetration firestop systems indicated for each application on Drawings or that are produced by one of the following manufacturers:

1. Grace, W. R. & Co. - Conn.
2. Hilti, Inc.
3. Johns Manville.
4. Nelson Firestop Products.
5. 3M; Fire Protection Products Division.
6. Tremco; Sealant/Weatherproofing Division.
7. USG Corporation.

2.2 FIRESTOPPING

A. Compatibility: Provide through-penetration firestop systems that are compatible with one another; with the substrates forming openings; and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.

B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by qualified testing and inspecting agency for firestop systems indicated.

PART 3 - EXECUTION

3.1 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

A. General: Install through-penetration firestop systems to comply with Part 1 "Performance Requirements" Article and with firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

C. Install fill materials for firestop systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.

3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.2 FIELD QUALITY CONTROL

A. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.

B. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued and firestop installations comply with requirements.

END OF SECTION 22 01 00

SECTION 210548
VIBRATION AND SEISMIC CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following: Vibration and seismic restraints and seismic joints at building seismic joints.

1.2 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:
1. Site Class, Assigned Seismic Use Group, and other design criteria as defined in the State Building Code: As shown on Architectural or Structural Drawings.

B. Analysis by Professional Engineer for any Seismic joint which will be required for the seismic category as noted on the Architectural Drawings.

1.3 SUBMITTALS

A. Calculations for Seismic joints at building joints.

B. Product Data: For each product indicated.

C. Delegated-Design Submittal: For vibration isolation and seismic-restraint calculations and details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Welding certificates.

E. Qualification Data: For professional engineer.

1.4 QUALITY ASSURANCE

A. Comply with seismic-restraint requirements in the State Building Code and NFPA 13 unless requirements in this Section are more stringent.

PART 2 - PRODUCTS

2.1 All Products shall be per the approved delegated design.

PART 3 - EXECUTION

3.1 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Installation shall be per requirements of the Delegated Design.

END OF SECTION 210548

SECTION 21 10 00
WATER-BASED FIRE-SUPPRESSION SYSTEMS

PART 1 - GENERAL

1. Water for the sprinkler system will be provided from private water system which will be provided by the site contractor to 12" above the floor in the sprinkler room.
2. The diesel fire pump will be rated as shown on the drawings, complete per NFPA 20. The pump house will be located in the equipment yard and will have a similar exterior finish to match the surrounding buildings and will have a concrete floor.
3. *The sprinkler system will consist of the following:*

    a. *metallic piping and concealed heads for all finished spaces.*

    b. *All piping drops will be hard piped. Corrugated/braided flexible connectors will not be allowed.*

    c. *canopies will be covered by a dry system or dry barrel sprinklers from the building.*

    d. *All heads in finished ceilings will be flat concealed heads. Spaces without ceilings and shell spaces (for future upfitting) to have rough brass heads. Shell spaces shall be prepared for upfitting of ceiling heads in the near future.*

4. *All components to be UL or FM certified.*
5. *Hydraulic calculations will be performed by the installing contractor and the entire system to be in compliance with NFPA 13 and the North Carolina Building Code.*
6. *Future fire supply tank(s) will be added (information included below) when the building is renovated in the future – becoming a high rise.*

PART 2 - GENERAL

2.1 SUMMARY

A. This Section includes the following fire-suppression piping inside the building:
    1. Wet-pipe sprinkler systems.
    2. Dry-pipe sprinkler systems.

2.2 SYSTEM DESCRIPTIONS

A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

B. Dry-Pipe Sprinkler System: Automatic sprinklers are attached to dry piping containing compressed air and that is connected to a dry valve which is connected to the water supply. Sprinklers open when heat melts fusible link or destroys frangible device. When

the air pressure is lost on the piping system, the dry valve trips and introduces water to discharge immediately from sprinklers when they are opened.

2.3 PERFORMANCE REQUIREMENTS

A. Standard Piping System Component Working Pressure: Listed for at least 175 psig.

B. Fire-suppression standpipe system design shall be approved by authorities having jurisdiction.

1. Minimum Residual Pressure at Each Hose-Connection Outlet: Per State Building Code.
2. Unless Otherwise Indicated, the Following Is Maximum Residual Pressure at Required Flow at Each Hose-Connection Outlet: 100 psig.

C. Fire-suppression sprinkler system design shall be approved by authorities having jurisdiction.

1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
2. Sprinkler Occupancy Hazard Classifications: As shown on Drawings.
3. Minimum Density for Automatic-Sprinkler Piping Design: As shown on Drawings.
4. Maximum Protection Area per Sprinkler: As shown on Drawings.
5. Total Combined Hose-Stream Demand Requirement: According to NFPA 13, unless otherwise indicated: As shown on Drawings.

D. Seismic Performance: Fire-suppression piping shall be capable of withstanding the effects of earthquake motions determined according to NFPA 13 and State Building Code.

2.4 SUBMITTALS

A. Product Data: For each product indicated.

B. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations.

C. Field test reports and certificates.

D. Field quality-control test reports.

E. Operation and maintenance data.

2.5 QUALITY ASSURANCE

A. Installer Qualifications: Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

1. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer or NICET Certified Technician in accordance with State General Statutes. Indicate NICET level on all documents (Level III minimum).

B. NFPA Standards: Fire-suppression-system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13, "Installation of Sprinkler Systems."

PART 3 - PRODUCTS

3.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

3.2 STEEL PIPE AND FITTINGS

A. Threaded-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, with factory- or field-formed threaded ends.

1. Cast-Iron Threaded Flanges: ASME B16.1.
2. Malleable-Iron Threaded Fittings: ASME B16.3.
3. Gray-Iron Threaded Fittings: ASME B16.4.

4. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe. Include ends matching joining method.
5. Steel Threaded Couplings: ASTM A 865.

B. Grooved-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, with factory- or field-formed, square-cut- or roll-grooved ends.
1. Grooved-Joint Piping Systems:
a. Manufacturers:
1) Anvil International, Inc.
2) Central Sprinkler Corp.
3) Victaulic Co. of America.
b. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.
c. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, rubber gasket listed for use with housing, and steel bolts and nuts.

3.3 BRAIDED FLEXIBLE CONNECTORS

A. Braided flexible connectors to sprinkler heads are allowed. Include 175-psig minimum working-pressure rating and ends. Unbraided flexible connectors are not allowed. All hose assemblies are to be FM approved.

B. Manufacturers:
1. Victaulic
2. Sprinkleflex
3. Flex Drop

C. Stainless-Steel-Hose/Steel Pipe, Flexible Connectors: Stainless-steel, inner tubing covered with stainless-steel wire braid. Include steel nipples or flanges, welded to hose.

3.4 SPRINKLER SPECIALTY FITTINGS

A. Sprinkler specialty fittings shall be UL listed or FMG approved, with 175-psig minimum working-pressure rating, and made of materials compatible with piping.

B. Outlet Specialty Fittings:
1. Manufacturers:
a. Anvil International, Inc.
b. Central Sprinkler Corp.
c. Victaulic Co. of America.
2. Mechanical-T and -Cross Fittings: UL 213, ductile-iron housing with gaskets, bolts and nuts, and threaded, locking-lug, or grooved outlets.
3. Snap-On and Strapless Outlet Fittings: UL 213, ductile-iron housing or casting with gasket and threaded outlet.

C. Drop-Nipple Fittings: UL 1474, adjustable with threaded inlet and outlet, and seals.
1. Manufacturers:
a. CECA, LLC.
b. Merit.

3.5 LISTED FIRE-PROTECTION VALVES

A. Valves shall be UL listed or FMG approved, with 175-psig minimum pressure rating.

B. Butterfly Valves: UL 1091.
1. NPS 2 and Smaller: Bronze body with threaded ends.
a. Manufacturers:
1) Global Safety Products, Inc.
2) Milwaukee Valve Company.
2. NPS 2-1/2 and Larger: Bronze, cast-iron, or ductile-iron body; wafer type or with grooved ends.
a. Manufacturers:
1) Central Sprinkler Corp.

2) Global Safety Products, Inc.
3) Mueller Company.
4) NIBCO.
5) Victaulic Co. of America.

C. Check Valves NPS 2 and Larger: UL 312, swing type, cast-iron body with flanged or grooved ends.
1. Manufacturers:
a. Central Sprinkler Corp.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. NIBCO.
e. Stockham.

D. Gate Valves: UL 262, OS&Y type.
1. NPS 2 and Smaller: Bronze body with threaded ends.
a. Manufacturers:
1) Crane Co.; Crane Valve Group; Crane Valves.
2) NIBCO.
3) United Brass Works, Inc.
2. NPS 2-1/2 and Larger: Cast-iron body with flanged ends.
a. Manufacturers:
1) Crane Co.; Crane Valve Group; Crane Valves.
2) Crane Co.; Crane Valve Group; Jenkins Valves.
3) Mueller Company.
4) NIBCO.

E. Indicating Valves: UL 1091, with integral indicating device and ends matching connecting piping.
1. Indicator: Electrical, 115-V ac, prewired, 2-circuit, supervisory switch.
2. NPS 2 and Smaller: Ball or butterfly valve with bronze body and threaded ends.
a. Manufacturers:
1) Milwaukee Valve Company.
2) NIBCO.
3) Victaulic Co. of America.
3. NPS 2-1/2 and Larger: Butterfly valve with cast- or ductile-iron body; wafer type or with flanged or grooved ends.
a. Manufacturers:
1) Central Sprinkler Corp.
2) Grinnell Fire Protection.
3) NIBCO.
4) Victaulic Co. of America.

3.6 SPECIALTY VALVES

A. Sprinkler System Control Valves: UL listed or FMG approved, cast- or ductile-iron body with flanged or grooved ends, and 175-psig minimum pressure rating.
1. Manufacturers:
a. Central Sprinkler Corp.
b. Grinnell Fire Protection.
c. Victaulic Co. of America.
d. Viking Corp.
2. Alarm Check Valves: UL 193, designed for horizontal or vertical installation, with bronze grooved seat with O-ring seals, single-hinge pin, and latch design. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer.
a. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
b. Drip Cup Assembly: Pipe drain with check valve to main drain piping.

B. Automatic Drain Valves: UL 1726, NPS 3/4, ball-check device with threaded ends.
   1. Manufacturers:
      a. AFAC Inc.
      b. Grinnell Fire Protection.

3.7 SPRINKLERS

A. Sprinklers shall be UL listed or FMG approved, with 175-psig minimum pressure rating.
B. Manufacturers:
   1. Central Sprinkler Corp.
   2. Grinnell Fire Protection.
   3. Victaulic Co. of America.
   4. Viking Corp.
C. Automatic Sprinklers: With heat-responsive element complying with the following:
   1. UL 1767, for early-suppression, fast-response applications.
D. Sprinkler Types and Categories: Nominal 1/2-inch orifice for "Ordinary" temperature classification rating, unless otherwise indicated or required by application.
E. Sprinkler types, features, and options as follows:
   1. Concealed, flat, white trim – all finished spaces with ceilings.
   2. Rough brass uprights, - all unfinished spaces open to structure.
F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
   1. Ceiling Mounting: White painted steel, 2 piece, with 1-inch vertical adjustment.
G. Sprinkler Guards as needed in areas subject to mechanical damage: Wire-cage type, including fastening device for attaching to sprinkler.

PART 4 - EXECUTION

4.1 PIPING APPLICATIONS, GENERAL

A. Flanges, flanged fittings, unions, nipples, and transition and special fittings with finish and pressure ratings same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.

4.2 SPRINKLER SYSTEM PIPING APPLICATIONS

A. NPS 1-1/2 and Smaller: Threaded-end, black galvanized, standard-weight steel pipe; cast- or malleable-iron threaded fittings; and threaded joints.
B. NPS 1-1/2 and Smaller: Plain-end, black or galvanized, standard-weight steel pipe; locking-lug fittings; and twist-locked joints.
C. NPS 2 and Larger: Threaded-end, black or galvanized, standard-weight steel pipe; cast- or malleable-iron threaded fittings; and threaded joints.
D. NPS 2 and Larger: Grooved-end, black or galvanized, standard-weight steel pipe; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

4.3 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
   1. Listed Fire-Protection Valves: UL listed and FMG approved for applications where required by NFPA 13 and NFPA 14.
      a. Shutoff Duty: Use butterfly or gate valves.
   2. Unlisted General-Duty Valves: For applications where UL-listed and FMG-approved valves are not required by NFPA 13 and NFPA 14.
      a. Shutoff Duty: Use butterfly or gate valves.
      b. Throttling Duty: Use globe valves.

4.4 JOINT CONSTRUCTION

A. Refer to Division 21 Section "Common Work Results for Fire Suppression" for basic piping joint construction.
B. Threaded Joints: Comply with NFPA 13 for pipe thickness and threads. Do not thread pipe smaller than NPS 8 (DN 200) with wall thickness less than Schedule 40 unless

approved by authorities having jurisdiction and threads are checked by a ring gage and comply with ASME B1.20.1.

C. Twist-Locked Joints: Insert plain-end piping into locking-lug fitting and rotate retainer lug one-quarter turn.

D. Pressure-Sealed Joints: Use UL-listed tool and procedure. Include use of specific equipment, pressure-sealing tool, and accessories.

E. Grooved Joints: Assemble joints with listed coupling and gasket, lubricant, and bolts.

1. Ductile-Iron Pipe: Radius-cut-groove ends of piping. Use grooved-end fittings and grooved-end-pipe couplings.
2. Steel Pipe: Square-cut or roll-groove piping as indicated. Use grooved-end fittings and rigid, grooved-end-pipe couplings, unless otherwise indicated.
3. Dry-Pipe Systems: Use fittings and gaskets listed for dry-pipe service.

4.5 PIPING INSTALLATION

A. Refer to Division 21 Section "Common Work Results for Fire Suppression" for basic piping installation.

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 Engineer before deviating from approved working plans.

C. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install unions adjacent to each valve in pipes NPS 2 and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.

E. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 and larger connections.

F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, sized and located according to NFPA 13.

G. Install sprinkler piping with drains for complete system drainage.

H. Hangers and Supports: Comply with NFPA 13 for hanger materials.

1. Install standpipe system piping according to NFPA 14.
2. Install sprinkler system piping according to NFPA 13.

I. Earthquake Protection: Install piping according to NFPA 13 to protect from earthquake damage.

J. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

K. Fill wet-pipe sprinkler system piping with water.

4.6 VALVE INSTALLATION

A. Install listed fire-protection valves, unlisted general-duty valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. 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.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water supply sources.

D. Alarm Check Valves: Install in vertical position for proper direction of flow, including bypass check valve and retarding chamber drain-line connection.

4.7 SPRINKLER APPLICATIONS

A. Where specific types are not indicated, use the following sprinkler types:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Recessed sprinklers.
3. Wall Mounting: Sidewall sprinklers.

4. Sprinkler Finishes:
   a. White finish – sprinkler and trim.

4.8 SPRINKLER SYSTEM TANKS (AS REQUIRED IN THE FUTURE – SEE DRAWINGS WHERE APPLICABLE)

NOTE: INFORMATION IS FOR PLANNING PURPOSES FOR FUTURE INSTALLATION. TANK(S) ARE NOT BEING INSTALLED AT THIS TIME AS PART OF THIS PROJECT.

Single-wall Aboveground Horizontal

Single-wall Steel Storage Tank:

Furnish and install an aboveground, horizontal, single-wall, steel storage tank. The tank shall be in conformance with the Underwriters Laboratories' UL-142 specifications and so labeled. Tank size will be noted on an attached reference drawing.

or

Furnish and install a 35,000 gallon aboveground, horizontal, single-wall, steel storage tank 12’0” inches in diameter by 47’6” long. Tank shall be fabricated from mild carbon steel with flat-flanged heads. Tank gauges: head gauge 3/8, shell gauge 3/8. All items included with the tank shall be coated with red primer. The tank shall be manufactured in conformance with Underwriters Laboratories' UL-142 specifications and so labeled.

The tank shall be fabricated with flanged, or threaded connections as shown on the drawing and as required - 150# flanged connections with flange protectors (where shown and required). Thread protectors shall be inserted in all threaded openings prior to shipment.

Highland tanks are air tested at the factory but MUST be retested at the jobsite by the installer prior to installation.

Options & Accessories (See Drawings):

____ Manway(s) _____ inches in diameter with bolted and gasketed lid
____ Loose-bolt Manway _____ inches in diameter with bolted and gasketed lid (emergency vent)
____ Support Saddles per drawing
____ Emergency Vent
____ External Ladder
____ External Ladder & Platform
____ External Stairway
____ Pump Platform
____ Walkway(s) with Handrails
____ Commercial grit blast (SSPC-6), epoxy primer coat
____ Exterior polyurethane paint _____
____ Other exterior coating _____
____ Internal Ladder(s)
____ Internal coating _____ (Must include interior weld. Minimum size 500 gallon.)
____ Level Sensing System(s)
____ Overfill Containment Chamber

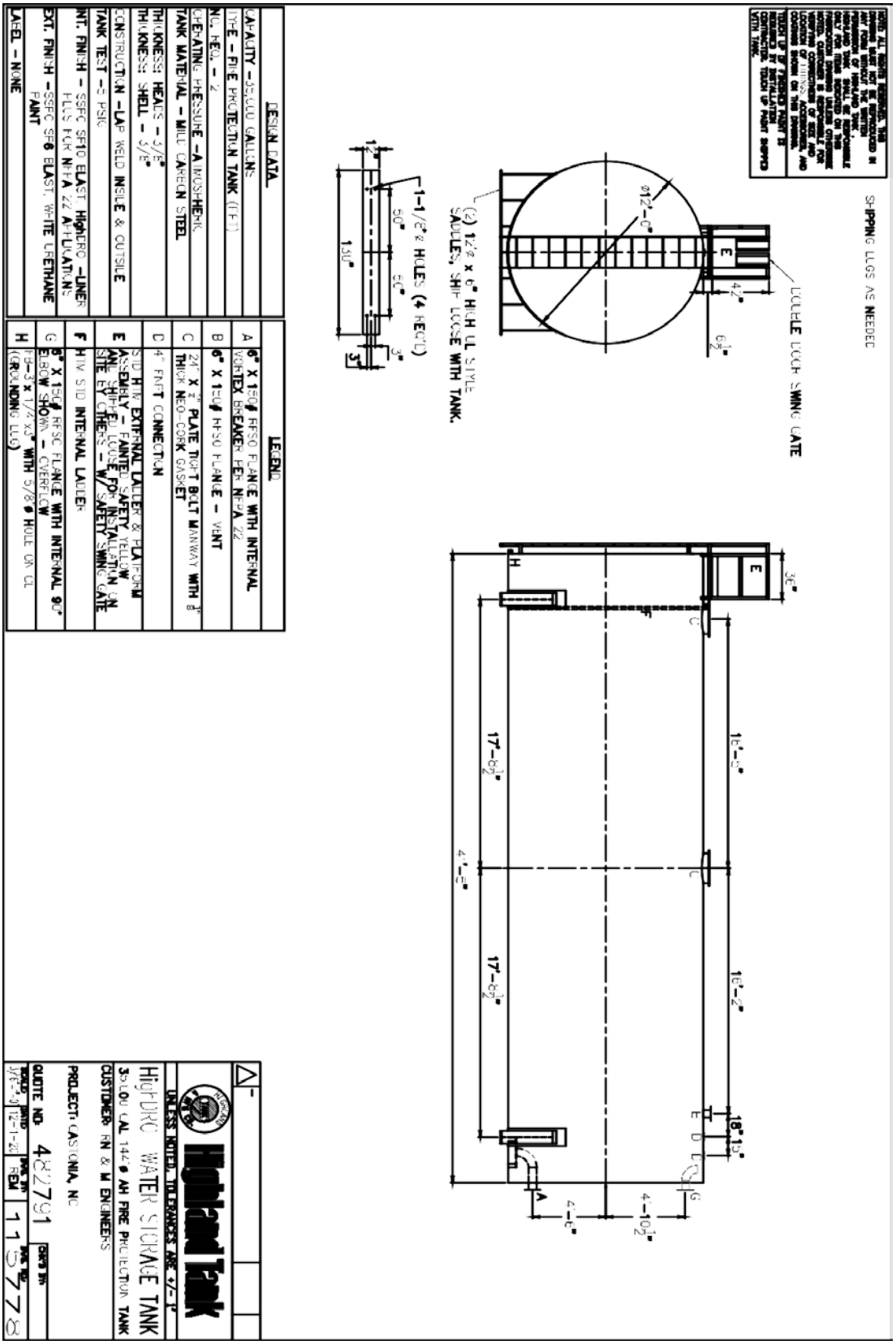
Warranty:

The subject tank is warranted by Highland Tank & Mfg. Co. to be free from defects in manufacturing, workmanship and materials. Highland Tank will repair or replace, at its sole discretion F.O.B. factory, within a period of one year after date of shipment, any item of our manufacture. All other items shall be warranted by their respective manufacturers. Liability hereunder is limited, as stated above, and does not

include labor, installation costs, indirect or consequential damages of any kind. Tanks must be returned to the factory and if found to be defective upon examination, will be repaired, replaced or credit will be issued at our option.

Approved Manufacturer:

Tank to be manufactured by Highland Tank or approved equivalent.


SHIPPING LUGS AS NEEDED
LOCKABLE LOCK SWING GATE
(2) 12"ø x 6" HIGH LL STYLE SADDLES, SHIP LOOSE WITH TANK.
1-1/2"ø HOLES (4 REQ'D)
DESIGN DATA
CAPACITY – 35,000 GALLONS
TYPE – FIRE PROTECTION TANK (FP)
NO. REQ. – 2
OPERATING PRESSURE – ATMOSPHERIC
TANK MATERIAL – MILD CARBON STEEL
THICKNESS: HEADS – 3/8"
THICKNESS: SHELL – 3/8"
CONSTRUCTION – LAP WELD INSIDE & OUTSIDE
TANK TEST – 25 PSIG
INT. FINISH – SSPC SP10 BLAST HighZERO –LINER FILLS PER NFPA 22 AMENDMENTS
EXT. FINISH – SSPC SP6 BLAST, WHITE URETHANE PAINT
LABEL – NONE
LEGEND
A 6" X 150# RFSO FLANGE WITH INTERNAL VORTEX BREAKER PER NFPA 22
B 6" X 150# RFSO FLANGE – VENT
C 24" X 2" PLATE THICK NEO-CORK GASKET
D 4" FNPT CONNECTION
E SID HDW EXTERNAL LADDER & PLATFORM ASSEMBLY – PAINTED SAFETY YELLOW AND SHIPPED LOOSE FOR INSTALLATION ON SITE BY OTHERS – W/ SAFETY SWING GATE
F HDW SID INTERNAL LADDER
G 8" X 150# RFSC FLANGE WITH INTERNAL 90° ELBOW SHOWN – OVERFLOW
H 3/4"-3 x 1/4"x2" WITH 5/8"ø HOLE OR CL (GROUNDING LUG)
Highland Tank
UNLESS NOTED, TOLERANCES ARE +/- 1"
HIGHLAND WATER STORAGE TANK
35,000 GAL 144"ø AH FIRE PROTECTION TANK
CUSTOMER: HN & M ENGINEERS
PROJECT: LASSONIA, NC
QUOTE NO. 42791
DRWG NO. 11537B
SCALE: 1/4"=1'-0"
DATE: 12-1-23
DWN BY: KEM
WAS NO.

4.9 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels and tiles.

B. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing. Use dry-type sprinklers with water supply from heated space.

4.10 LABELING AND IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and NFPA 14.

4.11 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
3. Flush, test, and inspect standpipe systems according to NFPA 14, "System Acceptance" Chapter.
4. Coordinate with fire alarm tests. Operate as required.
5. Verify that equipment hose threads are same as local fire department equipment.

B. Report test results promptly and in writing to Engineer and authorities having jurisdiction.

END OF SECTION 211000

SECTION 211100 – DRY CHEMICAL OR CLEAN AGENT FIRE SUPPRESSION SYSTEM

DRY CHEMICAL FIRE SUPPRESSION SYSTEM:

The fire suppression system for the IT Room shall be an Industrial Dry Chemical fire suppression system. The dry chemical agent shall be ABC (monoammonium phosphate). The dry chemical agent shall be stored in steel cylinders meeting DOT requirements and shall be painted white. The cylinders shall be of the stored pressure type with a maximum pressure of 360 psig @ 70°F. Cylinder valves must be equipped with a pressure gauge. The design concept shall be of the pre-engineered type with piping parameters and discharge nozzle types pre-determined by the fire suppression manufacturer. No hydraulic calculations shall be used to accomplish the piping design. The design application for this hazard shall be Total Flooding. The fire suppression equipment shall be capable of a minimum storage temperature of -40°F. The design, piping and installation shall be in accordance with NFPA 17 and manufacturer's recommendations. Acceptance of the finished system shall be in accordance with NFPA 17 and manufacturer's recommendations. The system shall be interlocked with the building fire alarm system. The system shall be tested by the manufacturer's authorized agent. Testing shall include fire alarm system interface. The contractor shall submit equipment specification sheets, layout and piping drawings, interconnection drawings, and installation instructions as part of the submittals. Approved manufacturers: Kidde, Pro-Chem, Badger.

CLEAN AGENT FIRE SUPPRESSION SYSTEM:

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Clean agent suppression systems using Fike Encardo 25, Ansul Inergen or 3M Novec 1230, or approved equal type system.

1.2 PERFORMANCE REQUIREMENTS

A. This specification is for a full and complete clean agent fire suppression system, to be designed by the installer, and installed in accordance with ANSI/NFPA 2001. Refer to Division 21 Section "Submittal Procedures" for requirements for Delegated Design.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.
B. Shop Drawings: For fire suppression system. Include plans, elevations, sections, details, and attachments to other work.
   1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Wiring Diagrams: For power, signal, and control wiring.
   3. Piping layout diagrams, for agent, pilot, and control piping.
C. Seismic Qualification Certificates: For fire suppression system equipment, accessories, and components, from manufacturer.
D. Welding certificates.
E. Field quality-control reports.
F. Operation and maintenance data.
G. Warranty: Sample of special warranty.
H. Installer to provide all control panels, detecting devices, installation, wiring, connection to control power for a complete functioning system – no change orders will be considered to make system functional.
I. All detection devices and wiring to meet NFPA 70 & 72.
J. All components/assemblies will be Listed.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of system required for this Project.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
C. ANSI/NFPA 2001: Design and install system to comply with ANSI/NFPA 2001 “Clean Agent Fire Extinguishing Systems.”

1.5 WARRANTY
A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace any portion of system that fail(s) in materials or workmanship within specified warranty period.
1. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Fike Fire Systems
2. Ansul
3. Novec

2.2 IDENTIFICATION
A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

2.3 FIELD QUALITY CONTROL
A. Perform tests and inspections.
B. Tests and Inspections: Test system in accordance with requirements of ANSI/NFPA 2001 and authority having jurisdiction.
C. Conduct an end-of-warranty inspection, test, and follow-up demonstration of system operation and maintenance.
D. Prepare test and inspection reports.

2.4 DEMONSTRATION
A. Train Owner's maintenance personnel to adjust, operate, and maintain system. Refer to Division 21 Section “Demonstration and Training” for documentation requirements.

END OF SECTION 211100

SECTION 22 00 50
COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. General provisions.
   2. Scope.
   3. Permits and Fees.
   4. Visit to Job Site.
   5. Workmanship.
   6. Drawings and Specifications.
   7. Tests.
   8. Allowance for added work.
   9. Incidental construction work.
   10. Access Doors
   11. Supervision.
   12. Electrical work by others.
   13. Existing facilities, utilities, etc.
   14. Adaptation of work to existing conditions.
   15. Submittal procedures.
   16. Product requirements.
   17. Closeout procedures.
   18. Operation and Maintenance Manuals.
   19. As-built Documents.
   20. Demonstration and Training.
   21. Warranty.

PART 2 - NOT APPLICABLE

PART 3 - EXECUTION

3.1 GENERAL PROVISIONS

A. This Contractor's attention is directed to the requirements of Instructions to Bidders, General Conditions and Supplementary General Conditions as bound in the specifications which apply in full to the plumbing work.

B. Where the requirements of this Division conflict with other articles in these Specifications, the Contractor shall utilize the more stringent method.

3.2 SCOPE

A. Provide all labor, materials, tools, equipment, and transportation, and perform all operations necessary for and reasonably incidental to proper execution and completion of all "Plumbing" work, whether specifically mentioned or not, all as indicated, specified herein, and/or implied thereby to carry out the apparent intent thereof.

B. These drawings may be superseded by later revised or detailed drawings, specifications, or sketches prepared by the Designer, as needed for clarification, and this Contractor shall conform to all reasonable coordination requests.

C. All items not specifically mentioned in the specifications or noted on the drawings, but which obviously are required to make the working installation complete, shall be included automatically.

D. For projects which are bid or awarded as Single Prime contracts, organization of the Specifications into divisions, sections, and articles, and arrangement of the Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be done by any trade, unless specifically shown or noted otherwise.

3.3 PERMITS AND FEES

A. This Contractor shall secure all permits required for the completion of this contract. He shall obtain and deliver to the Owner all certificates of inspection issued by the authorities having jurisdiction.

3.4 VISIT TO JOB SITE

A. Before submitting a bid, this Contractor shall visit the job site for the purpose of thoroughly examining the site and conditions under which the work must be performed.

B. The submission of a bona fide bid will be construed to mean that this Contractor understands and is satisfied with conditions under which the contract must be fulfilled.

C. No extra compensation will be allowed for situations arising from failure of this Contractor to be thoroughly familiar with site conditions, including charges and requirements for connection to utilities as shown for this project.

3.5 WORKMANSHIP

A. Workmanship in the fabrication, preparation, and installation of materials and equipment shall conform to the best standards of practice of the trades involved.

B. Work shall be performed by experienced and skilled mechanics under the supervision of a competent foreman.

C. Substandard workmanship will be cause for rejection of work and replacement by Contractor.

D. The Contractor shall reimburse the Designer for all costs incurred by the Designer due to Contractor's substandard or non-conforming work.

3.6 DRAWINGS AND SPECIFICATIONS

A. The drawings show the location and arrangement of fixtures, piping, and equipment, together with details of connections of certain principal items.

B. The layout shown shall be followed as closely as circumstances will permit, but this Contractor shall lay out his work so as to avoid conflict with other Contractors and trades, and to avoid any unnecessary cutting or damage to walls, floors, and supporting structural members.

C. This Contractor shall carefully and accurately locate all sleeves and install at the proper time all necessary hangers, inserts, etc., which will be required for the completion of his work, and shall be solely responsible for the accurate and proper location of above items.

D. This Contractor shall refer to architectural, mechanical, and electrical drawings and shall cooperate fully with other Contractors and trades while installing piping, fixtures, and other equipment because of close space limits.

1. In case of conflict, notify Designer before proceeding with installation.
2. Refer to architectural drawings for exact building dimensions and location of partition walls, doors, chases, etc.
3. Plumbing drawings are not to be scaled for such dimensions.

E. The drawings and specifications complement each other and together are intended to give a complete description of the work.

1. Any item of equipment or note of work to be done as shown on plans and not mentioned in the specifications, or mentioned in specifications and not shown in plans, shall be furnished the same as if mentioned or shown in both places.
2. If conflicts exist, then the most stringent method shown or described shall apply.

F. Any switches, controls, or equipment included in this contract work (drawings and/or specifications) that are not specifically shown on drawings shall be located for convenient use and access.

G. Contractor shall coordinate all equipment arrangement and lay-out in field prior to beginning any actual installation of his work.

H. If Contractor notes any discrepancy, omission, or conflict found in plans or specifications, he shall call to the immediate attention of the Designer, prior to receipt of bids.

I. It is the intention that piping, air ducts and light fixtures are designed and laid out to clear each other.

1. It shall be the responsibility of this Contractor to coordinate his work with that of other trades to avoid any such conflicts.

2. Any conflicts that occur after work of one trade is installed and was not prior coordinated shall be relocated or rearranged at the total expense of this Contractor, as directed by Designer.
3. Any conflicts that cannot be corrected in field by relocation or elevation changes shall be reported to the Designer in writing prior to any installation.

J. The drawings are not intended to show each and every complete or accurate detail.
1. The figures and writing on drawings shall be taken instead of scaling.
2. It is this Contractor's responsibility to comply with the evident intent for centering and symmetric arrangement.
3. This Contractor shall take and be responsible for all field measurements.
4. Exact locations and relations are to be defined in the field and shall be satisfactory to the Designer.

K. Because of the small scale of plumbing drawings it is not possible to indicate all offsets, fittings, and accessories which may be required.
1. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings and accessories that may be required to meet the conditions.

3.7 TESTS

A. The Designer reserves the right to conduct acceptance tests of all equipment, piping, or any other work furnished under these specifications to determine the fulfillment of special requirements.
1. Such tests shall be conducted in the presence of authorized representatives of the Contractor, Owner, Engineer, and Architect at such time as the Designer may designate.
2. This Contractor shall perform all tests, bear cost of same and make adjustments of equipment and wiring as may be deemed necessary by the Designer.

3.8 ALLOWANCE FOR ADDED WORK

A. Before proceeding with any work for which compensation may be claimed or the Owner may claim credit, a detailed estimate shall first be submitted and approved in writing.
1. No claim for addition to the contract sum will be valid unless so ordered and approved by the Owner and Designer, prior to start of work.
2. Any conflicts corrected by relocation or elevation changes do not constitute extra work.

3.9 INCIDENTAL CONSTRUCTION WORK

A. All blocking for openings for piping in concrete floors, masonry walls or partitions shall be provided by this Contractor.
1. This Contractor shall do all cutting and fitting of his work and of other work that may be required to make the several parts come together properly and to fit his work to receive or be received by the work of other Contractors as shown upon, or reasonably implied by the drawings and specifications.
2. He shall properly complete and finish up his work after other Contractors have finished as the Designer may direct.

B. All excavating required for the installation of this system shall be done by this Contractor.
1. Backfill shall be accomplished as specified in appropriate section of specifications.

C. Chases are prohibited in masonry walls which are not to be plastered or paneled.
1. Set piping, blocking, carriers, etc. indicated to be concealed before walls are constructed in order that walls may be constructed around them.
2. This Contractor shall furnish all sleeves in floors, beams, walls, etc., for each such penetration as needed for installing his work and installation of sleeves by Contractor.

D. Unless otherwise noted, the Contractor will provide openings and lintels as new construction progresses, but this Contractor shall fully designate his requirements prior to construction.

1. Failure to furnish his requirements prior to building construction and failure to coordinate his work with the building construction shall make this Contractor responsible for removing, replacing and painting building construction as required for installation of his work.

3.10 ACCESS DOORS

A. Provide and install access doors in walls, ceilings, etc. as required for access to valves and other devices requiring access in ceilings, chases, soffits, etc.

B. Access doors in non-fire rated walls or ceilings shall be as follows:
   1. Nominal 24” x 24” minimum size.
   2. 16-gage steel frame with 14-gage door panel and galvanized steel drywall bead.
   3. Flush style with provision to conceal flange with drywall cement.
   4. Double-acting concealed spring hinges to allow opening to 175 degrees.
   5. Flush, Allen-head operated with steel cam.
   6. Gray prime-painted steel, for painting to match adjacent finished surfaces.
   7. Basis of Design: Milcor Style DW; Comparable Products by Karp, Elmdor, Acudor.

C. Access doors in fire-rated walls or ceilings shall be as follows:
   1. Nominal 24” x 24” minimum size.
   2. UL 1-1/2 hour, Class B fire rating.
   3. Prime-painted stainless steel: 16-gage frame with 20-gage door panel, for painting to match adjacent finished surfaces.
   4. 2” mineral fiber insulation between inner and outer panel.
   5. Continuous hinge, steel with stainless steel pin.
   6. Self-closing and self-latching panel closer.
   7. Flush mounted paddle latch and locking system with flush, key-operated cylinder lock with two keys.
   8. Basis of Design: Milcor Style UFR; Comparable Products by Karp, Elmdor, Acudor.

3.11 SUPERVISION

A. This Contractor shall have in charge of the work at all times during construction a thoroughly competent foreman with extensive experience in the work to be performed under this contract.
   1. Anyone deemed not capable by the Designer shall be replaced immediately upon request, and after satisfactory foreman has been assigned, he shall not be withdrawn without the written consent of the Designer.

3.12 ELECTRICAL WORK BY OTHERS

A. Refer to the drawings for the details of locations of circuit breakers, junction boxes, disconnect switches, conduits and slack wire required where this contractor's electrical work terminates and electrical work by others begins.

B. The Electrical Contractor shall furnish and install all power circuits for equipment furnished by others.

C. In Mechanical Rooms the wiring by the Electrical Contractor shall generally terminate in a power wiring gutter, line side of disconnect switches or starters, junction box, or electrical panel.
   1. From these points power wiring to the equipment furnished by the Plumbing Contractor shall generally be by the Plumbing Contractor.
   2. Power wiring to mechanical equipment outside equipment rooms will generally be run by the Electrical Contractor to line side of a disconnect switch or junction box in the vicinity (within 3'-0") of the plumbing equipment.
   3. Power wiring from that point to the equipment will be by the Plumbing Contractor.

D. Plumbing Contractor is to refer to the drawings for location and type of service connections to be provided under the electrical contract.
   1. Where service disconnect switches are required and not furnished as part of the equipment, they shall be furnished and installed by contractor that furnishes the equipment, unless indicated otherwise.

2. Other Contractors shall furnish and install conduit, boxes, wiring and all items of control for equipment they furnish or Owner furnished equipment, unless specifically shown on electrical drawings.

3.13 EXISTING FACILITIES

A. In existing facilities, disruption of operations must be kept to a minimum and coordinated with Owner.
   1. Work in existing buildings must be cleaned up daily immediately after finishing that portion of work and equipment left in order for Owner to continue operations.
   2. When it is necessary to interrupt utility services in the fulfillment of this contract, such interruptions shall be kept to a minimum and coordinated with Owner.
   3. Once work has begun, it shall be pursued diligently until completed.

B. Every precaution shall be taken to prevent damage to existing underground lines and structures and public utilities.
   1. Damage to existing water and sewer lines, culverts, service connections, underground cables, and similar surface and sub-surface structures shall be at the risk of this Contractor, whether or not locations thereof are shown on plans, and the repairing of such damage shall be by this Contractor and shall be completed without delay.
   2. Compensation for such repairs shall be based on normal and reasonable costs.

C. The locations of any existing underground utilities that are shown are in an approximate way only and have not been independently verified by the Owner or its representative.
   1. The Contractor shall determine the exact location of all existing utilities before commencing work, and agrees to be fully responsible for any and all damages which might be occasioned by the Contractor's failure to exactly locate and preserve any and all underground utilities.

3.14 ADAPTATION OF WORK TO EXISTING CONDITIONS

A. It is reasonably implied that this Contractor shall furnish all labor and materials to provide Owner with a new and satisfactory system in these facilities.
   1. Contractor is to include necessary work for adaptation of equipment to conditions that may be found to produce conflicts during construction.
   2. When any such conditions are encountered, this Contractor is to consult with Designer and then modify installation as directed without additional costs, and to include any incidental materials required.

3.15 SUBMITTAL PROCEDURES

A. Coordinate preparation and processing of submittals with performance of construction activities.
   1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
   2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
   3. Designer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

B. Contractor approval: Affix review stamp to cover sheet, with initials and date of Contractor's approval of submittals.
   1. By submitting Shop Drawings, Product Data, Samples and similar submittals, this Contractor represents that the Contractor has determined and verified materials, field measurements and field construction criteria and details related thereto, or will do so, and has checked and coordinated the information contained within such submittals with the requirements of the Work, the Contract Documents and the Work of other trades.

C. Comply with requirements in Division 01 Sections for list of submittals and time requirements for scheduled performance of related construction activities.

D. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows.
   1. Time for review shall commence on Designer's receipt of submittal.
   2. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
   3. Allow 21 days for initial review of each submittal.
      a. Allow additional time if coordination with subsequent submittals is required.
      b. Designer will advise Contractor when a submittal being processed must be delayed for coordination.
   4. Allow 15 days for review of each resubmittal.

E. Identification: Identify submittals as required in Division 01 sections.

F. Deviations: Highlight, encircle, or otherwise specifically identify deviations from the Contract Documents on submittals.
   1. Summarize deviations on transmittal or List of Deviations included with submittal.

G. Coordinate first paragraph and subparagraph below with office policy. Marking numerous copies of submittals can be time consuming.

H. Transmittal: Package each submittal individually and appropriately for transmittal and handling.
   1. Transmit each submittal using a transmittal form.
   2. Designer will discard submittals received from sources other than Contractor.

I. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
   1. Note date and content of previous submittal.
   2. Note date and content of revision in label or title block and clearly indicate extent of revision.
   3. Resubmit submittals until they are marked "Furnish as Submitted" or “Furnish as Corrected."
   4. Where submittals contain specific questions or comments, provide a separate sheet with specific answers to each question or comment.

J. At Contractor's written request, copies of Designer's CAD files will be provided to Contractor for Contractor's use in connection with Project, subject to the following conditions:
   1. Allow 21 days from Designer’s receipt of written request for CAD files for delivery of files
   2. Files will be delivered via email or compact disc.
   3. Files will be delivered without RN&M Title Blocks, standard details, schedules, etc.
   4. CAD files provided for Contractor’s use are not to be construed as the Contract Documents. Use of CAD files for submittals or other uses are at the Contractor’s risk.

K. Prepare and submit Action Submittals required by individual Specification Sections.
   1. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
   2. Number of Copies: Submit at least eight copies of Product Data, unless otherwise indicated.
      a. Designer will return all but three copies.
      b. Retain or duplicate sufficient copies for inclusion in Operation and Maintenance Manuals.
   3. Shop Drawings: Prepare Project-specific information, drawn accurately to scale.
      a. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal of Designer's CAD Drawings is otherwise permitted.
   4. Revise subparagraph below to establish a standard sheet size and format.
   5. Sheet Size: At least 8-1/2 by 11 inches but no larger than size of project drawings.

6. Subparagraph below assumes Architect and Contractor will make copies from opaque print.
7. Number of Copies: Two opaque (bond) copies of each submittal. Designer will return one copy.
8. Manufacturers and Materials Suppliers List: Submit three copies of manufacturers and materials suppliers list within 20 days of Contract Award, unless otherwise indicated. Designer will return two copies.
9. If needed, combine subcontract list in paragraph below with product list above. Subcontract list is required by AIA Document A201 to be submitted as soon as practical after award of the Contract.
10. Subcontract List: Submit within 20 days of Contract Award three copies of list of proposed subcontractors. Designer will return two copies. Subcontract list to include all tiers of subcontractors.

L. Contractor's Review and Approval: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents.
1. Note corrections and field dimensions.
2. Mark with approval stamp before submitting to Designer.

M. Designer's Action: Designer will not review submittals that do not bear Contractor's approval stamp and will return them without action.
1. Designer will review each submittal, make marks to indicate corrections or modifications required, and return it.
2. Designer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:
a. Furnish as Submitted
b. Furnish as Corrected: Incorporate comments marked on or attached to submittal.
c. Revise and Resubmit: Major items of the submittal do not comply, requiring a resubmittal.

N. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.

O. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

P. The Contractor is responsible for compliance with the Contract Documents, dimensions, details, coordination, and satisfactory performance of materials and equipment provided and installed.

3.16 PRODUCT REQUIREMENTS

A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
1. Basis-of-Design Product: Item identified by manufacturer's product name, make, and model number, used to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, dimensions, and other characteristics for purposes of evaluating comparable products of other named manufacturers.
2. Comparable Product: Product that is listed in the Contract Documents, or added by Addendum, and demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified or basis-of-design product.
3. Owner-preferred Alternate Product: Product that is listed in the Contract Documents, and for which an Alternate Bid price is submitted. When an Alternate Bid item is accepted in the Contract, no substitutions will be allowed.

4. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor after award of Contract.
5. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.

B. Comparable Product Requests: Submit three copies of each request for consideration, at least 10 days prior to receipt of bids, for products not listed in the Contract Documents. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
1. Documentation: Show compliance with requirements for Comparable Products and the following, as applicable:
a. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed product.
b. Detailed comparison of significant qualities of proposed product with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
c. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
2. Designer’s Action: If necessary, Designer will request additional information or documentation for evaluation. Designer will notify Contractor of approval or rejection of proposed comparable product request.
a. Form of Approval: Addition of the item to the list of Comparable Products by Addendum, prior to receipt of bids.
b. Use product specified if Designer cannot make a decision on use of a comparable product request within time allocated.

C. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, features, options, and other items needed for a complete installation and indicated use and effect, and as required or recommended by the manufacturer for a complete installation, whether or not specifically indicated on the drawings or specifications.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Designer will make selection.
5. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.

D. Product Selection Procedures:
1. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
2. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.

3. Basis-of-Design Product: Where Specifications name a product and include a list of manufacturers, provide the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named.

E. Responsibility of the Contractor: The responsibility for determining dimensions, utility requirements, fitting of work with other trades, sequencing and coordination of work, for Product Substitutions and Comparable Products rests solely with the Contractor.

F. Manufacturer's Warranties: Where specifications require manufacturer's warranties, the provisions of the Contract Documents take precedence over any manufacturer's "standard" warranty provisions, exclusions, etc.

1. The start of manufacturer's warranties shall be the date of Substantial Completion of the project or phase of the project, notwithstanding any language or exclusion in any document submitted by the contractor or manufacturer.

3.17 CLOSEOUT PROCEDURES

A. Substantial Completion: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.

1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
2. Complete startup testing of systems.
3. Submit test records.
4. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
5. Complete final cleaning requirements, including touchup painting.
6. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
7. Submit a written request for inspection for Substantial Completion. On receipt of request, Designer will either proceed with inspection or notify Contractor of unfulfilled requirements.
8. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
9. Results of completed inspection will form the basis of requirements for Final Completion.

B. Final Completion: Before requesting final inspection for determining date of Final Completion, complete the following:

1. Submit certified copy of Designer's Substantial Completion inspection list of items to be completed or corrected (punch list). The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
2. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit documentation of training.
3. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Designer will either proceed with inspection or notify Contractor of unfulfilled requirements.
4. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

C. Cleaning: This Contractor shall provide all systems and equipment in a new and clean condition.

1. Clean all items furnished and installed in accordance with manufacturer's recommendations.
2. Provide instruction to Owner in proper cleaning of all items provided as part of this Division.
3. Cooperate with CMAR in cleaning of building.

3.18 OPERATION AND MAINTENANCE MANUALS

A. Submit four complete copies of Operation and Maintenance Manuals to Designer for review prior to request for inspection for Substantial Completion.

B. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain a title page, table of contents, and manual contents.

C. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:
   1. Subject matter included in manual.
   2. Name and address of Project.
   3. Name and address of Owner.
   4. Date of submittal.
   5. Name, address, and telephone number of Contractor.
   6. Name and address of Architect.
   7. Name and address of Engineer.

D. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

E. List of Material Suppliers and Subcontractors: List contact information for each material supplier and subcontractor.

F. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
   1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
      a. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
   2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
   3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
   4. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
      a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
      b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

G. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

H. Descriptions: Include the following: Product name and model number, Manufacturer's name, Equipment identification with serial number of each component, Equipment function, Operating characteristics, Limiting conditions, Performance curves, Engineering data and tests, Complete nomenclature and number of replacement parts.

I. Include start-up, break-in, and control procedures; stopping and normal shutdown instructions; routine, normal, seasonal, and weekend operating instructions; and required sequences for electric or electronic systems.

J. Describe the sequence of operation, and diagram controls as installed.

K. List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

L. Provide manufacturers' maintenance documentation including maintenance instructions, drawings and diagrams for maintenance, nomenclature of parts and components, and recommended spare parts for each component part or piece of equipment:

M. Include test and inspection instructions, troubleshooting guide, disassembly instructions, and adjusting instructions that detail essential maintenance procedures:

N. Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

O. Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

P. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

Q. Provide complete approved submittal data with all annotations.

R. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.

3.19 AS-BUILT DOCUMENTS

A. As-built Marked Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings.

1. Mark Record Prints to show the actual installation where installation varies from that shown originally.
2. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up As-built Marked Prints.
3. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
4. Record data as soon as possible after installation.
5. Record and check the markup before enclosing concealed installations.
6. Indicate dimensions to locate underground and concealed conduits and lines from fixed reference points.
7. Indicate burial depth for underground lines.
8. Indicate location of all valves and cross-reference to valve tag list.
9. Mark the Contract Drawings completely and accurately.
    a. Mark record sets with erasable, red-colored pencil.
    b. Note Addendum numbers, Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
10. Maintain As-built Marked Prints in a clean, legible, up-to-date condition in the project office, and available to the Designer for inspection upon request throughout construction.
11.
12. In first paragraph and subparagraphs below, architects may want to delete titleblock information from CAD files provided to Contractor. See Evaluations. Consult Owner for format required.

B. Record Specifications: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
   1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
   2. Note related Change Orders and As-built Marked Prints where applicable.

3.20 DEMONSTRATION AND TRAINING

A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season. Schedule training with Owner with at least seven days' advance notice.

C. Warranty service: Train Owner in repair and troubleshooting during each warranty service call.

D. For each training session, submit on letterhead name of trainer, date of training, names of Owner’s personnel trained, and systems/equipment trained on.

E. For factory training, documentation to be on letterhead of organization conducting training.

3.21 WARRANTY

A. This Contractor shall guarantee all materials, equipment, workmanship and each and every piece of apparatus which he furnished and which he installs under this contract against defects and failures of any nature for a period of one year from date on which the system is accepted.

B. Apparatus furnished by this Contractor shall be guaranteed to be satisfactory when operated under rated conditions in accordance with manufacturer's instructions and to be of size, function, and capacity specified on drawings or in the specifications.

C. Equipment manufacturers shall warrant equipment furnished for this project for same time span as installing contractors warranty period as set above and elsewhere in these specifications.
   1. Warranty start date shall be as established by the Designer. Refer to General Conditions, Supplementary General Conditions, and Division 1 specifications for establishment of warranty start dates.
   2. The provisions of the Contract Documents supersede and override any manufacturer’s standard warranty provisions.

D. Upon notice from the Designer or Owner, Contractor shall immediately check system, make necessary repairs or adjustments as required; due to faulty workmanship, materials, faults, operation or equipment, without cost to the Owner, and instruct Owner in proper operation, adjustment, and care of systems.

E. During the one-year warranty period, the Contractor shall be responsible for all preventive maintenance, including routine lubrication, filter changing, inspections, and adjustments.
   1. Contractor shall provide all materials, consumables, equipment, supplies, etc. required for preventive maintenance.
   2. Perform preventive maintenance in accordance with manufacturer’s recommendations.
   3. During preventive maintenance, instruct Owner in proper preventive maintenance procedures.

F. The Contractor shall submit service call tickets, reports, or other documentation of each warranty service call to the Designer.

G.

END OF SECTION 22 05 00

SECTION 22 00 80
PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:
   1. Record Drawings.
   2. Record Specifications.

B. See Division 22 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.

C. See Division 22 Sections for specific requirements for Project Record Documents of the Work in those Sections.

1.2 SUBMITTALS

A. Record Drawings: Comply with the following:
   1. Number of Copies: Submit one set of marked-up Record Prints.

B. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings and Shop Drawings.
   1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.
      a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
      b. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
      c. Indicate dimensions to locate underground and concealed lines from fixed reference points.
      d. Indicate burial depth for underground lines.
   2. Mark the Contract Drawings completely and accurately.
   3. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
   4. Note Addendum numbers, Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Format: Identify and date each Record Drawing; include the designation "AS-BUILT MARKED PRINT" in a prominent location.
   1. Record Prints: Organize Record Prints and newly prepared Record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
   2. Identification: As follows:
      a. Project name.
      b. Date.
      c. Designation "AS-BUILT MARKED PRINTS."
      d. Name of Architect.
      e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Note related Change Orders and Record Drawings where applicable.

2.3 RECORD PRODUCT DATA

A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
   1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
   2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
   3. Note related Change Orders, Record Specifications, and Record Drawings where applicable.

2.4 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.

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

END OF SECTION 22 00 80

SECTION 22 01 00
PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes through-penetration firestop systems for penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items.

1.2 PERFORMANCE REQUIREMENTS

A. General: For penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.

B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per ASTM E 814 or UL 1479:

1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
2. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:
   a. Penetrations located outside wall cavities.
   b. Penetrations located outside fire-resistance-rated shaft enclosures.

C. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.

1. For floor penetrations with annular spaces exceeding 4 inches in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved, either by installing floor plates or by other means.

D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

1.3 SUBMITTALS

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

B. Shop Drawings: For each through-penetration firestop system, submit documentation, including illustrations, from a qualified testing and inspecting agency, showing each type of construction condition penetrated, relationships to adjoining construction, and type of penetrating item.

1. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular through-penetration firestop condition, submit illustration, with modifications marked, approved by through-penetration firestop system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

C. Qualification Data: For Installer.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:

1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, or another agency performing testing

and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.

2. Through-penetration firestop systems are identical to those tested per testing standard referenced in "Part 1 Performance Requirements" Article. Provide rated systems bearing classification marking of qualified testing and inspecting agency.

B. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.

C. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until each installation has been examined by Owner's inspecting agency and building inspector, if required by authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the through-penetration firestop systems indicated for each application on Drawings or that are produced by one of the following manufacturers:

1. Grace, W. R. & Co. - Conn.
2. Hilti, Inc.
3. Johns Manville.
4. Nelson Firestop Products.
5. 3M; Fire Protection Products Division.
6. Tremco; Sealant/Weatherproofing Division.
7. USG Corporation.

2.2 FIRESTOPPING

A. Compatibility: Provide through-penetration firestop systems that are compatible with one another; with the substrates forming openings; and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.

B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by qualified testing and inspecting agency for firestop systems indicated.

PART 3 - EXECUTION

3.1 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

A. General: Install through-penetration firestop systems to comply with Part 1 "Performance Requirements" Article and with firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

C. Install fill materials for firestop systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.

3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.2 FIELD QUALITY CONTROL

A. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.

B. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued and firestop installations comply with requirements.

END OF SECTION 22 01 00

SECTION 22 05 16
EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Metal-bellows expansion joints.
   2. Pipe bends and loops.
   3. Alignment guides and anchors.
   4. Analysis by Professional Engineer for any Seismic joint which will be required for the seismic category as noted on the Architectural Drawings.

1.2 SUBMITTALS

A. Calculations for Seismic joints at building joints.
B. Product Data: For each type of product indicated.
C. Delegated-Design Submittal: For each anchor and alignment guide indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and bends.
   2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
   3. Alignment Guide Details: Detail field assembly and attachment to building structure.
   4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.
D. Welding certificates.
E. Product certificates.
F. Maintenance data.

1.3 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. Steel Shapes and Plates: AWS D1.1, "Structural Welding Code - Steel."
   2. Welding to Piping: ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 EXPANSION JOINTS

A. Metal-Bellows Expansion Joints: ASTM F 1120, circular-corrugated-bellows type with external tie rods.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
      a. Adsco Manufacturing, LLC.
      b. Flex-Hose Co., Inc.
      c. Metraflex, Inc.
      d. Piping Technology & Products, Inc.
      e. Senior Flexonics, Inc.; Pathway Division.
   2. Metal-Bellows Expansion Joints for Copper Piping: Single-ply phosphor-bronze bellows, copper pipe end connections, and brass shrouds.
   3. Metal-Bellows Expansion Joints for Stainless-Steel Waterway: Single-ply stainless-steel bellows, stainless-steel-pipe end connections, and steel shroud.
   4. Metal-Bellows Expansion Joints for Steel Piping Single-ply stainless-steel bellows, steel pipe end connections, and carbon-steel shroud.
   5. Minimum Pressure Rating: 175 psig unless otherwise indicated.
   6. Configuration Single bellows type, unless otherwise indicated.
   7. End Connections: Flanged or threaded

2.2 ALIGNMENT GUIDES

A. Description: Steel, factory fabricated, with bolted two-section outer cylinder and base for alignment of piping and two-section guiding spider for bolting to pipe.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
      a. Adsco Manufacturing, LLC.
      b. Flex-Hose Co., Inc.
      c. Metraflex, Inc.
      d. Piping Technology & Products, Inc.
      e. Senior Flexonics, Inc.; Pathway Division.

2.3 MATERIALS FOR ANCHORS

A. Steel Shapes and Plates: ASTM A 36/A 36M.
B. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex head.
C. Washers: ASTM F 844, steel, plain, flat washers.
D. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, and tension and shear capacities appropriate for application.
   1. Stud: Threaded, zinc-coated carbon steel.
   2. Expansion Plug: Zinc-coated steel.
   3. Washer and Nut: Zinc-coated steel.
E. Concrete: Portland cement mix, 3000 psi minimum. Comply with requirements in Division 03 Section "Cast-in-Place Concrete" for formwork, reinforcement, and concrete.
F. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink, nonmetallic grout; suitable for interior and exterior applications.
   1. Properties: Nonstaining, noncorrosive, and nongaseous.
   2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 EXPANSION-JOINT INSTALLATION

A. Install manufactured, nonmetallic expansion joints according to FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."
B. Install expansion joints of sizes matching size of piping in which they are installed.
C. Install alignment guides to allow expansion and to avoid end-loading and torsional stress.

3.2 PIPE BEND AND LOOP INSTALLATION

A. Install pipe bends and loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.
B. Attach pipe bends and loops to anchors.
   1. Steel Anchors: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
   2. Concrete Anchors: Attach by fasteners. Follow fastener manufacturer's written instructions.

3.3 SWING CONNECTIONS

A. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.
B. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.
C. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

3.4 ALIGNMENT-GUIDE INSTALLATION

A. Install guides on piping adjoining pipe expansion fittings and loops.
B. Attach guides to pipe and secure to building structure.

3.5 ANCHOR INSTALLATION

A. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

B. Fabricate and install steel anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and AWS D1.1.

C. Construct concrete anchors of poured-in-place concrete of dimensions indicated and include embedded fasteners.

D. Install pipe anchors according to expansion-joint manufacturer's written instructions if expansion joints are indicated.

E. Use grout to form flat bearing surfaces for expansion fittings, guides, and anchors installed on or in concrete.

END OF SECTION 22 05 16

SECTION 22 05 19
METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Thermometers.
   2. Gages.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.
B. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 SOLAR DIGITAL THERMOMETER

A. Manufacturers: Subject to compliance with requirements, provide product by one of the following: Sika, Miljoco, Weiss, Weksler
B. Case: High impact ABS plastic.
C. Stem: Copper-plated steel, aluminum, or brass for thermowell installation and of length to suit installation.
D. Range: -50ºF to 300 ºF minimum, field switchable between Fahrenheit and Celsius.
E. Accuracy: Greater value of 1º or 1%.
F. Resolution: 0.1º.
G. Recalibration: Internal potentiometer.
H. Power: Bi-directional solar photovoltaic elements.
I. Environmental Conditions
   1. Ambient Temperature: -30ºF to 140 ºF.
   2. Maximum Relative Humidity: 100%.

2.2 THERMOWELLS

A. Manufacturers: Same as manufacturer of thermometer being used.
B. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer.

2.3 PRESSURE GAGES

A. Manufacturers: Subject to compliance with requirements, provide product by one of the following: AMETEK, Inc., Ernst Gage Co., Eugene Ernst Products Co., KOBOLD Instruments, Inc., Marsh Bellofram, Miljoco Corp., Noshok, Inc., Palmer - Wahl Instruments Inc., REO TEMP Instrument Corporation, Trerice, H. O. Co., Weiss Instruments, Inc., Weksler Instruments Operating Unit, WIKA Instrument Corporation, Winters Instruments.
B. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.
   1. Case: Liquid-filled type, drawn steel or cast aluminum, 6-inch diameter.
   2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
   3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
   4. Movement: Mechanical, with link to pressure element and connection to pointer.
   5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
   6. Pointer: Red or other dark-color metal.
   7. Window: Glass or plastic.
   8. Ring: Metal or plastic.
   9. Accuracy: Grade C, plus or minus 3 percent of middle half scale.
   10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
   11. Range for Fluids under Pressure: Two times operating pressure.
C. Pressure-Gage Fittings:
   1. Valves: NPS 1/4 brass or stainless-steel needle type.

2. Syphons: NPS 1/4 coil of brass tubing with threaded ends.
3. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

PART 3 - EXECUTION

3.1 THERMOMETER APPLICATIONS

A. Install solar powered digital thermometers in piping as shown on Drawings.
B. Install bimetallic-actuated dial thermometers in the following locations on ductwork as shown on Drawings.

3.2 GAGE APPLICATIONS

A. Install pressure gages as shown on Drawings.

3.3 INSTALLATIONS

A. Install direct-mounting thermometers and adjust vertical and tilted positions.
B. Install thermowells with socket extending to center of pipe and in vertical position in piping tees where thermometers are indicated.
C. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.
D. Install needle-valve and snubber fitting in piping for each pressure gage for fluids (except steam).
E. Install needle-valve and syphon fitting in piping for each pressure gage for steam.

3.4 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance for meters, gages, machines, and equipment.

3.5 ADJUSTING

A. Calibrate thermometers according to manufacturer's written instructions, after installation.
B. Adjust faces of meters and gages to proper angle for best visibility.

END OF SECTION 22 05 19

SECTION 22 05 23
GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Water System Valves
   a. Ball Valves
   b. Butterfly Valves
   c. Swing Check Valves
   d. Spring Loaded Check Valves
   e. Stop & Waste Valves
   f. Balance Valves
   g. Drain Valves
   h. Buried Water Service Valves
   i. Corporation Stop Valves
   j. Curb Stop Valves
2. Waste System Valves
   a. Gate Valves
   b. Ball Valves
   c. Swing Check Valves
   d. Spring Loaded Check Valves
3. Natural Gas Systems
   a. Shut-off Valves
   b. Exterior Below Grade Shutoff Valves
   c. Gas Pressure Regulators
4. Compressed Air Systems
   a. Shut-off Valves
   b. Safety Exhaust Shut-off Valves
   c. Pressure Reducing Valves
5. Specialty Valves and Valve Accessories
   a. Gauge Valves
   b. Water Pressure Reducing Valves
   c. Safety Relief Valves
   d. Sewer Air and Vacuum Valves

B. Related Sections:

1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

1.2 SUBMITTALS

A. Product Data: For each type of valve indicated.

1.3 QUALITY ASSURANCE

A. ASME Compliance: ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.

B. NSF Compliance: NSF 61 for valve materials for potable-water service.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Each valve type shall be of same manufacturer.

E. Valve Actuator Types:
1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
2. Handwheel: For valves other than quarter-turn types.
3. Handlever: For quarter-turn valves NPS 6 and smaller[**except plug valves**].
4. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

F. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
1. Gate Valves: With rising stem.
2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
3. Butterfly Valves: With extended neck.

G. Valve-End Connections:
1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Solder Joint: With sockets according to ASME B16.18.
3. Threaded: With threads according to ASME B1.20.1.

2.2 WATER SYSTEM VALVES

A. All water system valves to be rated at not less than 125 water working pressure at 240 degrees F unless noted otherwise.

B. Ball valves:
1. 3" and smaller: Two or three piece bronze body; sweat ends, chrome plated bronze ball; glass filled teflon seat; teflon packing and threaded packing nut; blowout-proof stem; 600 psig WOG. Provide valve stem extensions for valves installed in all piping with insulation. Apollo 70-200, Grinnell 3700, Hammond 8511, Milwaukee BA150, Nibco S580-70, Watts B-6001.

C. Butterfly valves:
1. 2-1/2" and larger: Cast or ductile iron body; stainless steel shaft; bronze, copper or teflon bushings; EPDM resilient seat; EPDM seals; bronze, aluminum-bronze, EPDM encapsulated ductile iron or stainless steel disc. 200 psig WOG through 12", 150 psig WOG through 24". Valve assembly to be bubble tight to 175 psig with no downstream flange/pipe attached. Use tapped lug type valves with stud bolts or cap screws, or grooved end connection valves, permitting removal of downstream piping while using the valve for system shutoff. Centerline LT series, DeZurik 632, Grinnell Series 8000, Hammond 6200 Series, Milwaukee M or C Series, Nibco LD2000/LC2860, Victaulic 300/608/700/709, Watts BF-03.
2. Provide 10 position locking lever handle actuators for valves 6" and smaller. Provide worm gear operators with external position indication for valves 8" and larger.
3. Provide valve stem and neck extensions for butterfly valves when used in low temperature service subject to condensation buildup where handles do not clear insulation.

D. Swing check valves:
1. 3" and smaller: Bronze body, sweat ends, Y-pattern, regrindable bronze seat, renewable bronze disc, Class 125, suitable for installation in a horizontal or vertical line with flow upward. Crane 1342, Grinnell 3300SJ, Hammond IB941, Nibco S413B, Watts CVYS.
2. 4" and larger: Cast iron body, flanged ends, bronze trim, bolted cap, renewable bronze seat and disc, Class 125, non-asbestos gasket, suitable

for installation in a horizontal or vertical line with flow upward. Crane 373, Grinnell 6300A, Hammond IR1124, Milwaukee F2974, Nibco F918B, Watts Series 411.

E. Spring loaded check valves:
   1. 2" and smaller: Bronze body, sweat or threaded ends, bronze trim, stainless steel spring, stainless steel center guide pin, Class 125, teflon seat unless only bronze available. ConBraCo 61 series, Grinnell 3600SJ, Mueller 203BP, Nibco S480Y, Val-Matic S1400 series.
   2. 2-1/2" and larger: Cast or ductile iron body, wafer or globe type, bronze trim, bronze or EPDM seat, stainless steel spring, stainless steel stem if stem is required, Class 125. APCO 300 or 600 series, Centerline CLC with full body option, Hammond IR9354, Milwaukee 1800 series, Mueller Steam 101AP or 105AP, Nibco W910 or F910, Val-Matic 1400 or 1800 or 8000 series.

F. STOP & WASTE VALVES:
   1. 1” and smaller, Bronze body, sweat or threaded ends, 400 psi WOG, stainless steel ball and stem, full port ball valve, with threaded drain cap, Watts B-6300/6301 SS series. Apollo, Grinnell, Hammond, Milwaukee or Nibco manufacturer.

G. Balance valves:
   1. 2" and smaller: Two or three piece bronze body ball valve, sweat or threaded ends, chrome plated brass ball, glass filled teflon seat, threaded packing nut, with adjustable memory stop position indicator and extended handle stem, suitable for 400 psig water working pressure at 240 degrees F. Watts B-6000/B-6001 BS Apollo, Grinnell, Hammond, Milwaukee Or Nibco manufacturer.

H. Drain valves:
   1. 3/4 inch ball valve with integral threaded hose adapter, sweat or threaded inlet connections, with threaded cap and chain on hose threads, Watts B-6000-CC/B-6001-CC series.

I. Buried Water Service Gate valves:
   1. Cast iron body, resilient elastomer coated cast iron disc, permanently lubricated stuffing box, bronze non-rising stem and stem nut, double O-ring stem seal, Delrin thrust bearings, electroplated nuts and bolts, cast iron operating nut, AWWA C509, rated for 200 psi. Coat valve inside and out with fusion bonded epoxy, AWWA C550. Clow F-6100, Kennedy 1571, M&H 3067, Mueller A-2360, Waterous 500, Watts 406RW.

J. UNDERGROUND WATER SERVICE BUTTERFLY VALVES:
   1. Rubber-seated butterfly valve meeting the requirements of AWWA C504, for Class 150B. Body and disc shall be constructed of cast iron. Disc shall be lens shaped.
   2. Interior and exterior surfaces of valve shall be provided with epoxy coating meeting the requirements of AWWA C550. Disc shall be provided with a stainless steel disc edge.
   3. Valve stem shall be stainless steel. Packing shall be permanent duty “chevron V-type” or “O-ring” type. Bearings shall be permanent, non-metallic, and self-lubricating.
   4. Valve seat shall be a single piece of elastomeric material that is not penetrated by the valve shaft.
   5. Provide manual operator that is suitable for underground service and includes a standard 2” square operating nut.
   6. Valve shall be provided with mechanical joint connections.
   7. Mueller, Clow, Henry Pratt, or approved equal.

K. Corporation Stop valves:
1. 2" and smaller: Bronze body ground key valve, bronze plug, AWWA taper thread inlet and copper flare outlet nut connections or compression type, AWWA C800.

L. Curb Stop valves:
1. 2" and smaller: Bronze body plug valve, bronze plug, quarter turn check, O-ring seals, copper flare nut connections or compression type, AWWA C800.

2.3 valve boxes

A. GATE/BUTTERFLY VALVE BOXES:
1. Valve boxes shall be 5 1/4", cast iron valve boxes. Boxes shall be threaded, three-piece design with stay-put "WATER" cover. Provide appropriately sized bonnet.
2. Provide valve box extensions as necessary to accommodate depth of cover shown on plans, or 6.5' minimum.
3. Valve boxes shall be Tyler, or approved equal.

2.4 CURB STOP BOXES:

A. Curb stop boxes shall be 1 1/4" minimum diameter, cast iron, arch style, valve boxes. Boxes shall be telescopic, extendable to accommodate 7' bury. Lid shall be two piece threaded, with a plug having a pentagonal bolt for removal.

B. Ford, Mueller, or approved equal.

2.5 WASTE SYSTEM VALVES

A. Gate valves:
1. 2" and smaller: Bronze body, bronze trim, threaded ends, solid wedge, rising stem, union bonnet, malleable iron hand wheel, suitable for 300 psi WOG. Crane 431UB, Grinnell 3080, Hammond IB629, Lunkenheimer 3151, Milwaukee 1151(M), Nibco T134, Powell 2714, Stockham B120.
2. 2-1/2" and larger: Iron body, bronze trim, bolted bonnet, O.S. & Y., solid wedge, flanged, suitable for 200 psi WOG. Crane 465-1/2, Grinnell 6020A, Hammond IR1140, Lunkenheimer 1430, Milwaukee F2885, Nibco F617-O, Powell 1793, Stockham G623.

B. Ball valves:
1. 3" and smaller: Two or three piece bronze body; sweat or threaded ends, chrome plated bronze ball; glass filled teflon seat; teflon packing and threaded packing nut; blowout-proof stem; 400 psig WOG. Apollo 70-200, Grinnell 3700, Hammond 8511, Milwaukee BA150, Nibco S585-70, Watts B-6001.

C. Swing check valves:
1. 1-1/2" and smaller: Bronze body, threaded ends, Y-pattern, regrindable bronze seat, renewable bronze disc, Class 125, suitable for installation in a horizontal or vertical line with flow upward. Crane 1342, Grinnell 3300SJ, Hammond IB941, Nibco S413B, Watts CVYS.
2. 2" and larger: Cast iron body, flanged ends, bronze trim, bolted cap, renewable bronze seat and disc, Class 125, non-asbestos gasket, outside lever and weight or spring, suitable for installation in a horizontal or vertical line with flow upward. Crane 383, Grinnell 6300A, Milwaukee F2974, Nibco F918B.

D. Spring loaded check valves:
1. 2" and smaller: Bronze body, sweat or threaded ends, bronze trim, stainless steel spring, stainless steel center guide pin, Class 125, teflon seat unless only bronze available. ConBraCo 61 series, Grinnell 3600SJ, Mueller 203BP, Nibco S480Y, Val-Matic S1400 series.

2. 2-1/2" and larger: Cast or ductile iron body, wafer or globe type, bronze trim, bronze or EPDM seat, stainless steel spring, stainless steel stem if stem is required, Class 125. APCO 300 or 600 series, Centerline CLC with full body option, Hammond IR9354, Milwaukee 1800 series, Mueller Steam 101AP or 105AP, Nibco W910 or F910, Val-Matic 1400 or 1800 or 8000 series.

2.6 NATURAL GAS SYSTEMS

A. Shut-off valves:
1. 4" and smaller: Ball or eccentric plug valve, bronze or cast iron body, 2" and under threaded ends, 2-1/2" and over flanged ends, chrome plated bronze ball, bronze or nickel plated cast iron plug, TFE or Hycar seats and seals, lever handle, 175 psi W.O.G., U.L listed for use as natural gas shut-off. Apollo 80-100, DeZurik 425.
2. 5" and larger: Cast iron body, flanged ends, stainless steel bearings, resilient faced plugs, totally enclosed hand wheel actuators, 175 psi W.O.G., U.L. listed for use as natural gas shut-off.

B. Exterior below grade shut-off valves:
1. Plug or ball valve, body of same polyethylene type as piping system, pipe stub ends, high strength plastic stem and operating nut, position indicator, polyethylene plug or polypropylene ball, Buna-N seats and double stem seals, rated for 96 psi natural gas service (150 psi non-lethal service).

C. Gas pressure regulators:
1. 2" and smaller: Cast iron body, aluminum spring and diaphragm, Nitrile diaphragm, threaded ends, 150 psi W.O.G., -20 degrees F to 150 degrees F.

2.7 COMPRESSED AIR SYSTEMS

A. Shut-off valves:
1. 3" and smaller: Two or three piece bronze body; threaded ends, chrome plated bronze ball; glass filled teflon seat; teflon packing and threaded packing nut; blowout-proof stem; 600 psig WOG. Apollo 70-100, Milwaukee BA100, Nibco T585-70 or T-590-Y, Watts B-6000.

B. Safety exhaust shut-off valves:
1. 3" and smaller: Two or three piece bronze body; threaded ends, chrome plated bronze ball; downstream vent port; glass filled teflon seat; teflon packing and threaded packing nut; blowout-proof stem; 175 psig WOG. Apollo 70-100-41, Watts B-6000.

C. Pressure reducing valves:
1. Bronze or aluminum body and trim, diaphragm or balanced piston, 250 psig maximum, 0-125 psig adjustable output, internal relief, 1/4" outlet gauge tapping.

2.8 SPECIALTY VALVES AND VALVE ACCESSORIES

A. Gauge valves:
1. Use 1/4" ball valves. Needle valves and gauge cocks will not be accepted.

B. Water pressure reducing valves:
1. Bronze body, diaphragm operated, with an integral thermal expansion bypass valve, inlet union, stainless steel strainer, renewable monel or stainless steel seat and adjustable reduced pressure range, 300 psig at 160 degrees F. Pre-set for the scheduled pressure. A. W. Cash, Conbraco, Watts, Wilkins.

C. Safety relief valves:
1. Bronze body, temperature and pressure actuated, stainless steel stem and spring, thermostat with non-metallic coating, test lever, suitable for 125 psig water working pressure at 240 degrees F, sized for full BTUH input and operating pressure of equipment, with valve capacity on metal label. For

equipment less than or equal to 200,000 BTUH input, provide AGA, UL or ASME listed and labeled valve. Provide ASME listed and labeled valve for larger equipment. Bell & Gossett, A. W. Cash, Conbraco, Watts, Wilkins. Temperature and pressure relief valve shall be sized per AGA rating for BTUH input.

D. Sewer air and vacuum valves:
   1. Combination air release/air and vacuum valve consisting of cast iron elongated body; size as shown on drawings; stainless steel valve, trim and float; Hycar or Buna-N rubber seat; inlet, backflushing and blowoff valves; 5' backflushing hose with quick disconnect fittings; 150 psig. Apco Series 440 SCAV, Crispin S20A/S20 Series, Val-Matic 800 Series.

PART 3 - EXECUTION

3.1 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
B. Locate valves for easy access and provide separate support where necessary.
C. Install valves in horizontal piping with stem at or above center of pipe.
D. Install valves in position to allow full stem movement.
E. Install swing check valves for proper direction of flow and in horizontal position with hinge pin level.
F. Install valve tags/identification per Division 22 Section “Identification for Plumbing Piping and Equipment” prior to installation of ceilings.

3.2 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

END OF SECTION 22 05 23

SECTION 22 05 29
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Steel pipe hangers and supports.
   2. Trapeze pipe hangers.
   3. Metal framing systems.
   4. Thermal-hanger shield inserts.
   5. Fastener systems.
   6. Equipment supports.

B. See Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.

C. See Division 22 Section "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.

D. See Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.2 DEFINITIONS

A. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.4 SUBMITTALS

A. Product Data: For the following:
   1. Steel pipe hangers and supports.
   2. Thermal-hanger shield inserts.
   3. Powder-actuated fastener systems.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
   1. Trapeze pipe hangers. Include Product Data for components.
   2. Metal framing systems. Include Product Data for components.
   3. Equipment supports.

C. Welding certificates.

1.5 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Available Manufacturers:
1. AAA Technology & Specialties Co., Inc.
2. Bergen-Power Pipe Supports.
3. B-Line Systems, Inc.; a division of Cooper Industries.
4. Carpenter & Paterson, Inc.
5. Empire Industries, Inc.
6. ERICO/Michigan Hanger Co.
7. Globe Pipe Hanger Products, Inc.
8. Grinnell Corp.
9. GS Metals Corp.
10. National Pipe Hanger Corporation.
11. PHD Manufacturing, Inc.
12. PHS Industries, Inc.
13. Piping Technology & Products, Inc.
14. Tolco Inc.

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Available Manufacturers:
1. B-Line Systems, Inc.; a division of Cooper Industries.
2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
3. GS Metals Corp.
4. Power-Strut Div.; Tyco International, Ltd.
5. Thomas & Betts Corporation.
6. Tolco Inc.
7. Unistrut Corp.; Tyco International, Ltd.

C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Available Manufacturers:
1. Carpenter & Paterson, Inc.
2. ERICO/Michigan Hanger Co.
3. PHS Industries, Inc.
4. Pipe Shields, Inc.
5. Rilco Manufacturing Company, Inc.
6. Value Engineered Products, Inc.

C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.

D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.
E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
1. Available Manufacturers:
a. Hilti, Inc.
b. ITW Ramset/Red Head.
c. Masterset Fastening Systems, Inc.
d. MKT Fastening, LLC.
e. Powers Fasteners.
B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
1. Available Manufacturers:
a. B-Line Systems, Inc.; a division of Cooper Industries.
b. Empire Industries, Inc.
c. Hilti, Inc.
d. ITW Ramset/Red Head.
e. MKT Fastening, LLC.
f. Powers Fasteners.

2.7 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.8 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
E. Use padded hangers for piping that is subject to scratching.
F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.

2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
5. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
6. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
7. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
8. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.

G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.

H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.

I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
   a. Light (MSS Type 31): 750 lb.
   b. Medium (MSS Type 32): 1500 lb.
   c. Heavy (MSS Type 33): 3000 lb.
8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
   2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
   3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.

L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

N. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.2 HANGER AND SUPPORT INSTALLATION

A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
   1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
   2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:
   1. Install powder-actuated fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
   2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

I. Install lateral bracing with pipe hangers and supports to prevent swaying.

J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

K. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.

M. Insulated Piping: Comply with the following:

1. Attach clamps and spacers to piping.
   a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
   b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
   c. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.
2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
4. Shield Dimensions for Pipe: Not less than the following:
   a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
   b. NPS 4: 12 inches long and 0.06 inch thick.
   c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
   d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
   e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
5. Pipes NPS 8 and Larger: Include wood inserts.
6. Insert Material: Length at least as long as protective shield.
7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.6 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 22 05 29

SECTION 220533 - HEAT TRACING FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes plumbing piping heat tracing for freeze prevention, domestic hot-water-temperature maintenance, and snow and ice melting on roofs and in gutters and downspouts with the following electric heating cables:
   1. Plastic insulated, series resistance.
   2. Self-regulating, parallel resistance.

1.2 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each type of product indicated.
   1. Schedule heating capacity, length of cable, spacing, and electrical power requirement for each electric heating cable required.

B. Shop Drawings: For electric heating cable. Include plans, sections, details, and attachments to other work.
   1. Wiring Diagrams: Power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and maintenance data.

E. Warranty: Special warranty specified in this Section.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.4 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace electric heating cable that fails in materials or workmanship within specified warranty period.
   1. Warranty Period: **10** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Chromalox, Inc.; Wiegard Industrial Division; Emerson Electric Company.
   2. Easy Heat Inc.
   3. Nelson Heat Trace.
   4. Pyrotenax; a division of Tyco Thermal Controls.
   5. Raychem; a division of Tyco Thermal Controls.

B. Heating Element: Pair of parallel No. **16** AWG, **nickel-coated,** stranded copper bus wires embedded in crosslinked conductive polymer core, which varies heat output in response to temperature along its length. Terminate with waterproof, factory-assembled nonheating leads with connectors at one end, and seal the opposite end watertight. Cable shall be capable of crossing over itself once without overheating.

C. Electrical Insulating Jacket: Flame-retardant polyolefin.

D. Cable Cover: Stainless-steel braid, and polyolefin outer jacket with UV inhibitor.

E. Maximum Operating Temperature (Power On): **45 deg F**

F. Maximum Exposure Temperature (Power Off): **75 deg F**.

G. Maximum Operating Temperature: **150 deg F**

H. Capacities and Characteristics:
   1. Maximum Heat Output **8 W/ft.**
   2. Number of Parallel Cables: 2**.**
   3. Spiral Wrap Pitch: 2 **inches.**
   4. Volts: **120**V.
   5. Full-Load Amperes: 17**.**
   6. Maximum Overcurrent Protection: 20**.**

2.2 CONTROLS

A. Pipe-Mounting Thermostats for Freeze Protection:
   1. Remote bulb unit with adjustable temperature range from **30 to 50 deg F**.
   2. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected cable.

3. Remote bulb on capillary, resistance temperature device, or thermistor for directly sensing pipe-wall temperature.
4. Corrosion-resistant, waterproof control enclosure.

2.3 ACCESSORIES

A. Cable Installation Accessories: Fiberglass tape, heat-conductive putty, cable ties, silicone end seals and splice kits, and installation clips all furnished by manufacturer, or as recommended in writing by manufacturer.
B. Warning Labels: Refer to Division 22 Section "Identification for Plumbing Piping and Equipment."
C. Warning Tape: Continuously printed "Electrical Tracing"; vinyl, at least 3 mils thick, and with pressure-sensitive, permanent, waterproof, self-adhesive back.
   1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.
   2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Install the following types of electric heating cable for the applications described:
   1. Freeze Protection for Domestic Water: Self-regulating, parallel-resistance heating cable.

3.2 INSTALLATION

A. Install electric heating cable across expansion, construction, and control joints according to manufacturer's written recommendations using cable protection conduit and slack cable to allow movement without damage to cable.
B. Electric Heating Cable Installation for Freeze Protection for Piping:
   1. Install electric heating cables after piping has been tested and before insulation is installed.
   2. Install electric heating cables according to IEEE 515.1.
   3. Install insulation over piping with electric cables according to Division 22 Section "Plumbing Insulation."
   4. Install warning tape on piping insulation where piping is equipped with electric heating cables.
C. Set field-adjustable switches and circuit-breaker trip ranges.
D. Protect installed heating cables, including nonheating leads, from damage.
E. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
F. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Testing: Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction, or concrete.
   1. Test cables for electrical continuity and insulation integrity before energizing.
   2. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.
B. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounting cables.
C. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 220533

SECTION 220548 - VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes performance requirements for delegated design of vibration and seismic controls.

1.2 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading: Refer to Structural Drawings for Seismic Design Category, Building Use Group, and Seismic design parameters.

1.3 SUBMITTALS

A. Product Data: For all products provided.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint calculations and details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Welding certificates.

D. Qualification Data: For professional engineer.

E. Field quality-control test reports.

1.4 QUALITY ASSURANCE

A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproved by ICC-ES, or preapproved by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

A. Products shall be selected by engineer providing delegated design services.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Delegated Design Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.2 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment Restraints:

1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inches.
2. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

B. Piping Restraints:

1. Comply with requirements in MSS SP-127.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

F. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

G. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

3.3 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Division 22 Section "Domestic Water Piping" for piping flexible connections.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.
B. Tests and Inspections:
   1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
   2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
   3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
   4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
   5. Test to 90 percent of rated proof load of device.
   6. Measure isolator restraint clearance.
   7. Measure isolator deflection.
   8. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
C. Remove and replace malfunctioning units and retest as specified above.
D. Prepare test and inspection reports, certified by Professional Engineer who provided Delegated Design.

3.5 ADJUSTING

A. Adjust isolators after piping system is at operating weight.
B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
C. Adjust active height of spring isolators.
D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 220548

SECTION 22 05 53
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Equipment labels.
   2. Pipe labels.
   3. Valve tags.
   4. Ceiling markers for concealed valves.

1.2 SUBMITTAL

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

B. Color Code Schedule: Per ANSI/ASME A13.1

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:
   1. Material and Thickness: Brass, 0.032-inch Stainless steel, 0.025-inch Aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
   2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
   3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
   4. Fasteners: Stainless-steel rivets or self-tapping screws.

B. Plastic Labels for Equipment:
   1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
   2. Letter Color: White.
   3. Background Color: Black.
   4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
   5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
   6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
   7. Fasteners: Stainless-steel rivets or self-tapping screws.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive. Stenciling is not allowed.
C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

2.3 VALVE TAGS
A. General Requirements for Valve Tags: 1-1/2” diameter 19 gage brass, black-filled.
B. Lettering: ¼” top line service abbreviation, ½” bottom line sequential number.
C. Mounting: #16 brass jack chain.

2.4 CEILING MARKERS
A. All concealed plumbing items are to be indicated on the ceiling to readily show their location. The contractor to either use color coding per the Site standard or ANSI/ASME A13.1 for color selection. Marking shall be a color dot sticker.

PART 3 - EXECUTION

3.1 PREPARATION
A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION
A. Install or permanently fasten labels on each major item of mechanical equipment.
B. Locate equipment labels where accessible and visible.
C. Install all pipe labels, equipment labels, and valve tags prior to concealing piping, equipment, or valves.

3.3 PIPE LABEL INSTALLATION
A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "Interior Painting High-Performance Coatings."
B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
C. Pipe Label Color Schedule: Per ANSI/ASME A13.1 for the following systems:
1. Domestic Cold Water Piping.
2. Domestic Hot Water Piping.
3. Domestic Hot Water Recirculation Piping.
4. Sanitary Waste Piping
5. Sanitary Vent Piping
6. Rain Leader
7. Emergency Overflow Leader

8. Dental Air
9. Compressed Air
10. Dental Vacuum

3.4 VALVE TAG INSTALLATION

A. Install valve tags on valves as follows:
   1. All main and branch shut-off valves.
   2. All water heater shut-off/isolation valves.
   3. All pump shut-off valves.

B. Valve tag list:
   1. Mount valve tag list in main mechanical equipment room, in frame under glass.
   2. Provide copy of valve tag list in Operation and Maintenance Manuals.
   3. Indicate valve tag numbers on as-built marked prints.

END OF SECTION 22 05 53

SECTION 22 07 00
PLUMBING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

1. Section Includes insulation materials and methods for plumbing piping and equipment.

1.2 SUBMITTALS

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

B. Shop Drawings:

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.
8. Detail field application for each equipment type.

C. Field quality-control reports.

1.3 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

B. Heat Loss Characteristics: Minimum pipe insulation thickness shall be an insulation having a maximum conductivity (k) of 0.27 Btu per inch/h*ft^{2}* ^{o}F.

1.4 DEFINITIONS

A. Concealed: shafts, furred spaces, spaces above finished ceilings, utility tunnels, and crawl spaces. All other areas, including walk-through tunnels, shall be considered exposed.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Products shall not contain asbestos, lead, mercury, or mercury compounds.

B. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

E. Manufacturers: Armstrong, Certainteed Manson, Childers, Dow, Extol, Halstead, H.B. Fuller, Imcoa, Knauf, Owens-Corning, Pittsburgh Corning, Rubatex, Johns-Mansville, or approved equal.

F. Insulating materials shall be fire retardant, moisture and mildew resistant, and vermin proof.

G. Insulation shall be suitable to receive jackets, adhesives and coatings as indicated.

2.2 RIGID FIBERGLASS INSULATION:

A. Minimum nominal density of 3 lbs. per cu. ft., and thermal conductivity of not more than 0.23 at 75 degrees F, minimum compressive strength of 25 PSF at 10% deformation, rated for service to 450 degrees F.

B. White kraft reinforced foil vapor barrier all service jacket, factory applied to insulation with a self-sealing pressure sensitive adhesive lap, maximum permeance of .02 perms and minimum beach puncture resistance of 50 units.

2.3 SEMI-RIGID FIBERGLASS INSULATION:

A. Minimum nominal density of 3 lbs. per cu. ft., thermal conductivity of not more than 0.28 at 75 degrees F, minimum compressive strength of 125 PSF at 10% deformation, rated for service to 450 degrees F. Insulation fibers perpendicular to jacket and scored for wrapping cylindrical surfaces.

B. White kraft reinforced foil vapor barrier all service jacket, factory applied to insulation with a maximum permeance of .02 perms and minimum beach puncture resistance of 50 units.

2.4 ELASTOMERIC INSULATION:

A. Flexible closed cell, minimum nominal density of 5.5 lbs. per cu. ft., thermal conductivity of not more than 0.27 at 75 degrees F, minimum compressive strength of 4.5 psi at 25% deformation, maximum water vapor transmission of 0.17 perm inch, maximum water absorption of 6% by weight, rated for service range of -20 degrees F to 220 degrees F on piping and 180 degrees F where adhered to equipment.

2.5 URETHANE INSULATION:

A. Rigid closed cell polyisocyanurate, minimum nominal density of 1.8 lbs. per cu. ft., thermal conductivity of not more than 0.19 at 75 degrees F aged 180 days, minimum compressive strength of 19 psi parallel and 10 psi perpendicular, maximum water vapor transmission of 4 perm inch, maximum water absorption of .2% by volume, rated for service range of -290 degrees F to 300 degrees F.

2.6 PVC FITTING COVERS AND JACKETS:

A. White PVC film, gloss finish one side, semi-gloss other side, FS LP-535D, Composition A, Type II, Grade GU. Ultraviolet inhibited indoor/outdoor grade to be used where exposed to high humidity, ultraviolet radiation, in kitchens or food processing areas or installed outdoors. Jacket thickness to be .02 inch (20 mil).

2.7 INSULATION INSERTS AND PIPE SHIELDS

A. Manufacturers: B-Line, Pipe Shields, Value Engineered Products

B. Construct inserts with calcium silicate, minimum 140 psi compressive strength. Piping 12” and larger, supplement with high density 600 psi structural calcium silicate insert. Provide galvanized steel shield. Insert and shield to be minimum 180 degree coverage on bottom of supported piping and full 360 degree coverage on clamped piping. On roller mounted piping and piping designed to slide on support, provide additional load distribution steel plate.

C. Where contractor proposes shop/site fabricated inserts and shields, submit schedule of materials, thicknesses, gauges and lengths for each pipe size to demonstrate equivalency to pre-engineered pre-manufactured product described above. On low temperature systems, extruded polystyrene may be substituted for calcium silicate provided insert and shield length and gauge are increased to compensate for lower insulation compressive strength.

D. Precompressed 20# density molded fiberglass blocks, Hamfab or equal, of same thickness as adjacent insulation may be substituted for calcium silicate inserts with one 1”x 6” block for piping through 2-1/2” and three 1” x 6” blocks for piping through 4”. Submit shield schedule to demonstrate equivalency to pre-engineered/pre-manufactured product described above.

E. Wood blocks will not be accepted.

2.8 ACCESSORIES

A. All products shall be compatible with surfaces and materials on which they are applied, and be suitable for use at operating temperatures of the systems to which they are applied.
B. Adhesives, sealants, and protective finishes shall be as recommended by insulation manufacturer for applications specified.
C. Insulation bands to be 3/4 inch wide, constructed of aluminum or stainless steel. Minimum thickness to be .015 inch for aluminum and .010 inch for stainless steel.
D. Tack fasteners to be stainless steel ring grooved shank tacks.
E. Staples to be clinch style.
F. Insulating cement to be ANSI/ASTM C195, hydraulic setting mineral wool.
G. Finishing cement to be ASTM C449.
H. Fibrous glass or canvas fabric reinforcing shall have a minimum untreated weight of 6 oz./sq. yd.
I. Bedding compounds to be non-shrinking and permanently flexible.
J. Vapor barrier coatings to be non-flammable, fire resistant, polymeric resin.
K. Fungicidal water base coating (Foster 40-20 or equal) to be compatible with vapor barrier coating.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 PIPING, VALVE, AND FITTING INSULATION

A. General:
    1. Install insulation with butt joints and longitudinal seams closed tightly. Provide minimum 2” lap on jacket seams and 2” tape on butt joints, firmly cemented with lap adhesive. Additionally secure with staples along seams and butt joints. Coat staples with vapor barrier mastic on systems requiring vapor barrier.
    2. Water supply piping insulation shall be continuous throughout the building and installed adjacent to and within building walls to a point directly behind the fixture that is being supplied.
    3. Install insulation continuous through pipe hangers and supports with hangers and supports on the exterior of insulation.
    4. Where riser clamps are required to be attached directly to piping requiring vapor barrier, extend insulation and vapor barrier jacketing/coating around riser clamp.
B. Insulation Inserts and Pipe Shields:
    1. Provide insulation inserts and pipe shields at all hanger and support locations. Inserts may be omitted on 3/4” and smaller copper piping provided 12” long 22 gauge pipe shields are used.
C. Fittings and Valves:
    1. Fittings, valves, unions, flanges, couplings and specialties may be insulated with factory molded or built up insulation of the same thickness as adjoining insulation.
    2. Cover insulation with fabric reinforcing and mastic or where temperatures do not exceed 150 degrees, PVC fitting covers.
    3. Secure PVC fitting covers with tack fasteners and 1-1/2” band of mastic over ends, throat, seams or penetrations.
    4. On systems requiring vapor barrier, use vapor barrier mastic.
D. Elastomeric and Polyolefin:

1. Where practical, slip insulation on piping during pipe installation when pipe ends are open.
2. Miter cut fittings allowing sufficient length to prevent stretching.
3. Completely seal seams and joints for vapor tight installation.
4. For elastomeric insulation, apply full bed of adhesive to both surfaces.
5. For polyeolefin, seal factory preglued seams with roller and field seams and joints with full bed of hot melt polyolefin glue to both surfaces.

3.3 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant.
   3. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   4. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
   5. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant.
   3. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   4. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
   5. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

3.4 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

A. Do not insulate over equipment access manholes, fittings, nameplates or ASME stamps. Bevel and seal insulation at these locations.

B. Semi-Rigid Fiberglass:
   1. Apply insulation to equipment shells using weld pins, bonding adhesive, banded and wired in place.
   2. Fill all joints, seams and depressions with insulating cement to a smooth, even surface.
   3. Cover with reinforcing fabric and 2 coats of mastic. .
   4. Use vapor barrier mastic on systems requiring a vapor barrier.

C. Elastomeric/Polyolefin:
   1. Apply full cover coat of adhesive to surface to be insulated, insulation and edge butt joints.
   2. Place insulation with edge joints firmly butted pressing to surface for full adhesion.
   3. Seal seams and joints vapor tight.

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. All hot and cold water piping shall be insulated.

C. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

D. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

E. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in

place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.

3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
2. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.7 Piping Insulation Schedule:

A. Provide insulation on all piping as indicated in the following schedule:

Service	Insulation Types	Insulation Thickness
Hot Water Supply	Rigid Fiberglass	1"
Hot Water Circulating	Rigid Fiberglass	1”
Cold Water	Rigid Fiberglass	½”
Tempered Water	Rigid Fiberglass	1”
Non-Potable Cold Water	Rigid Fiberglass *	1”
Non-Potable Hot Water	Rigid Fiberglass *	1”
All Horizontal Storm Piping and 4'-0" of vertical Piping thereafter, & Roof Drain bodies	Rigid Fiberglass	1”

* = Elastomeric type is acceptable

B. The following piping and fittings are not to be insulated:

1. Chrome plated exposed supplies and stops (except where specifically noted).
2. Water hammer arrestors.
3. Piping unions and flanges for systems not requiring a vapor barrier.

3.8 Equipment Insulation Schedule:

A. Provide equipment insulation as follows:

1. Storage Tanks: Semi-Rigid Fiberglass, 2" thick.

2. Backflow Preventer: Elastomeric, ½" thick, sheet type, pipe size type or combination of both. Fabricated for ease of removal and replacement when testing and servicing is required

END OF SECTION 22 07 00

SECTION 22 11 16
DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. All components and fittings for domestic water **and air piping** are to be Lead Free.

B. Section Includes:

1. Aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
2. Specialty valves.

1.2 SUBMITTALS

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

B. Field quality-control reports.

1.3 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 61 for potable domestic water piping and components.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.

1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.3 PIPING JOINING MATERIALS

A. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

B. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.4 SPECIALTY VALVES

A. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.

B. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.

2.5 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.

B. Provide and install bronze ball valves in lieu of dielectric fittings.

2.6 FLEXIBLE CONNECTORS

A. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig

2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.

B. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
1. Working-Pressure Rating: Minimum 200 psig
2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
3. End Connections NPS 2-1/2) and Larger: Flanged steel nipple.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install sway bracing to keep piping from swaying in hangers.

C. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages and Division 22 Section "Domestic Water Piping Specialties" for drain valves and strainers.

D. Install shutoff valve immediately upstream of each dielectric fitting.

E. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for pressure-reducing valves.

F. Install piping level and plumb.

G. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

H. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

I. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

J. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

K. Install piping adjacent to equipment and specialties to allow service and maintenance.

L. Install piping to permit valve servicing.

M. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.

N. Install piping free of sags and bends.

O. Install fittings for changes in direction and branch connections.

P. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

Q. Install pressure gages on suction and discharge piping from each plumbing pump and packaged booster pump. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages.

R. Install thermostats in hot-water circulation piping. Comply with requirements in Division 22 Section "Domestic Water Pumps" for thermostats.

S. Install thermometers on outlet piping from each water heater. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.

T. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."

U. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."

V. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

3.2 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.

E. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

F. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.3 VALVE INSTALLATION

A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.

B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 (DN 50) and smaller. Use butterfly or gate valves for piping NPS 2-1/2 (DN 65) and larger.

C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."
   1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
   2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.

D. Install auto-flow valve in each hot-water circulation return branch and discharge side of each pump and circulator. Use ball valves for piping NPS 2 (DN 50) and smaller and butterfly valves for piping NPS 2-1/2 (DN 65) and larger. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves.

3.4 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

3.5 FLEXIBLE CONNECTOR INSTALLATION

A. Install bronze-hose flexible connectors in copper domestic water tubing.

3.6 WATER METER INSTALLATION

A. See details on drawings.

3.7 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.

B. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch

E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
4. NPS 2-1/2: 108 inches with 1/2-inch rod.
5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
6. NPS 6: 10 feet with 5/8-inch rod.

F. Install supports for vertical copper tubing every 10 feet.

G. Where piping is installed in metal studs, install in punched hole and install plastic bushings to prevent contact between pipe and stud.

3.8 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment and machines to allow service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
3. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.
4. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.9 IDENTIFICATION

A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.

B. Label pressure piping with system operating pressure.

3.10 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Piping Inspections:

1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
   a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
   b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

C. Domestic Water Piping Tests:
1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
4. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and for corrective action required.

D. Domestic water piping will be considered defective if it does not pass tests and inspections.
E. Prepare test and inspection reports.

3.11 CLEANING

A. Clean and disinfect potable domestic water piping as follows:
1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
   a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
   b. Fill and isolate system according to either of the following:
      1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
      2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

B. Prepare and submit reports of purging and disinfecting activities.
C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.12 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
C. Under-building-slab, domestic water, NPS 3 and smaller, shall be the following:
1. Soft copper tube, ASTM B 88, Type K; wrought-copper solder-joint fittings joints.
D. Aboveground domestic water piping, shall be:
1. Hard copper tube, ASTM B 88, Type L; cast-wrought- copper solder-joint fittings; and soldered joints.

3.13 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
1. Shutoff Duty: Use ball valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
2. Throttling Duty: Use globe valves for piping NPS 2 and smaller. Use butterfly valves with flanged ends for piping NPS 2-1/2 and larger.
3. Hot-Water Circulation Piping, Balancing Duty: Lead free auto-flow valves .
4. Drain Duty: Hose-end drain valves.
B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION 22 11 16

SECTION 22 11 19
DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following domestic water piping specialties:
1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Temperature-actuated water mixing valves.
6. Strainers.
7. Hose bibbs.
8. Wall hydrants.
9. Drain valves.
10. Water hammer arresters.
11. Trap-seal primer valves.

B. See Division 22 Section "Domestic Water Piping" for water meters.

C. See Division 22 Section "Drinking Fountains and Water Coolers" for water filters for water coolers.

1.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.3 SUBMITTALS

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

B. Field quality-control test reports.

C. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. NSF Compliance:
1. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Conbraco Industries, Inc.
b. FEBCO; SPX Valves & Controls.
c. Watts Industries, Inc.; Water Products Div.
d. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1001.
3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
4. Body: Bronze.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Rough bronze.

B. Hose-Connection Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Conbraco Industries, Inc.
   b. MIFAB, Inc.
   c. Watts Industries, Inc.; Water Products Div.
   d. Woodford Manufacturing Company.
   e. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1001.
3. Body: Bronze, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Chrome or nickel plated in interior finished areas, Rough bronze in equipment rooms and exterior.

2.2 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Ames Co.
   b. Conbraco Industries, Inc.
   c. FEBCO; SPX Valves & Controls.
   d. Watts Industries, Inc.; Water Products Div.
   e. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
5. Size: As shown on drawings.
6. Body: Bronze for NPS 2 and smaller; steel with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
7. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
8. Configuration: Designed for horizontal, straight through flow.
9. Accessories:
   a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
   b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

B. Double-Check Backflow-Prevention Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Ames Co.
   b. Conbraco Industries, Inc.
   c. FEBCO; SPX Valves & Controls.
   d. Watts Industries, Inc.; Water Products Div.
   e. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1015.
3. Operation: Continuous-pressure applications, unless otherwise indicated.
4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
5. Size: As shown on Drawings.
6. Body: Bronze for NPS 2 and smaller; steel with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
7. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
8. Configuration: Designed for horizontal, straight through flow.
9. Accessories:
   a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.

C. Backflow-Preventer Test Kits:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Conbraco Industries, Inc.
   b. FEBCO; SPX Valves & Controls.
   c. Watts Industries, Inc.; Water Products Div.
   d. Zurn Plumbing Products Group; Wilkins Div.
2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

2.3 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:
1. Basis of Design Product: as shown on drawings. Comparable products by:
   a. Conbraco Industries, Inc.
   b. Watts Industries, Inc.; Water Products Div.
   c. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 200 psig.
4. Size: As shown on Drawings.
5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
6. Valves for Booster Heater Water Supply: Include integral bypass.
7. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

2.4 BALANCING VALVES

A. Auto flow control valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. FDI.
   b. Griswold.
   c. Hays.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 2 or smaller.
4. Body: Copper alloy.
5. Seats and Seals: Replaceable.
6. End Connections: Solder joint or threaded.

2.5 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Water-Temperature Limiting Devices:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Armstrong International, Inc.
   b. Conbraco Industries, Inc.
   c. Leonard Valve Company.
   d. Symmons Industries, Inc.
   e. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig.
4. Type: Thermostatically controlled water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded union inlets and outlet.
7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Tempered-Water Setting: As shown on Drawings.
9. Tempered-Water Design Flow Rate: As shown on Drawings.
10. Valve Finish: Chrome plated or Rough bronze.

B. Primary, Thermostatic, Water Mixing Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Armstrong International, Inc.
   b. Lawler Manufacturing Company, Inc.
   c. Leonard Valve Company.
   d. Symmons Industries, Inc.
2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig.
4. Type: Exposed-mounting or Cabinet-type, thermostatically controlled water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded union inlets and outlet.
7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Valve Pressure Rating: 125 psig minimum, unless otherwise indicated.
9. Tempered-Water Setting: As shown on Drawings.
10. Tempered-Water Design Flow Rate: As shown on Drawings.
11. Selected Valve Flow Rate at 45-psig Pressure Drop: As shown on Drawings.
12. Pressure Drop at Design Flow Rate: As shown on Drawings.

2.6 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:
1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. Perforation Size:
   a. Strainers NPS 2 and Smaller: 0.020 inch.
   b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
   c. Strainers NPS 5 and Larger: 0.10 inch.
6. Drain: Pipe plug.

2.7 HOSE BIBBS

A. Hose Bibbs:
1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: Rough bronze.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Wheel handle.
13. Operation for Finished Rooms: Operating key.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.8 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Josam Company.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   d. Watts Drainage Products Inc.
   e. Woodford Manufacturing Company.
   f. Zurn Plumbing Products Group; Light Commercial Operation.
2. Standard: ASME A112.21.3M for exposed-outlet, self-draining wall hydrants.
3. Pressure Rating: 125 psig.
4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4 or NPS 1.
7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Box: Deep, flush mounting with cover.
9. Box and Cover Finish: Polished nickel bronze.
10. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
11. Nozzle and Wall-Plate Finish: Polished nickel bronze.
12. Operating Keys(s): Two with each wall hydrant.

B. Vacuum Breaker Wall Hydrants:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Smith, Jay. R. Mfg. Co.; Division of Smith Industries, Inc.
   b. Watts Industries, Inc.; Water Products Div.
   c. Woodford Manufacturing Company.
   d. Zurn Plumbing Products Group; Light Commercial Operation.
2. Standard: ASSE 1019, Type A or Type B.
3. Type: Freeze-resistant, automatic draining with integral air-inlet valve.
4. Classification: Type B, for automatic draining with hose removed or with hose attached and nozzle closed.

5. Pressure Rating: 125 psig.
6. Operation: Loose key.
7. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
8. Inlet: NPS 1/2 or NPS 3/4.
9. Outlet: Exposed with garden-hose thread complying with ASME B1.20.7.

2.9 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:
1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.10 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AMTROL, Inc.
   b. Josam Company.
   c. MIFAB, Inc.
   d. PPP Inc.
   e. Sioux Chief Manufacturing Company, Inc.
   f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   g. Tyler Pipe; Wade Div.
   h. Watts Drainage Products Inc.
   i. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.11 TRAP-SEAL PRIMER VALVES

A. Supply-Type, Trap-Seal Primer Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. MIFAB, Inc.
   b. PPP Inc.
   c. Sioux Chief Manufacturing Company, Inc.
   d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   e. Watts Industries, Inc.; Water Products Div.
2. Standard: ASSE 1018.
3. Pressure Rating: 125 psig minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.

7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
1. Locate backflow preventers in same room as connected equipment or system.
2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
3. Do not install bypass piping around backflow preventers.

C. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.

D. Install balancing valves in locations where they can easily be adjusted.

E. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
1. Install thermometers and water regulators if specified.
2. Install cabinet-type units recessed in or surface mounted on wall as specified.

F. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, solenoid valve, and pump.

G. Install water hammer arresters in water piping according to PDI-WH 201 and at quick acting valves.

H. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

I. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

J. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
1. Intermediate atmospheric-vent backflow preventers.
2. Reduced-pressure-principle backflow preventers.
3. Double-check backflow-prevention assemblies.
4. Water pressure-reducing valves.
5. Primary, thermostatic, water mixing valves.
6. Supply-type, trap-seal primer valves.

K. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:
   1. Test each backflow preventer according to authorities having jurisdiction and the device's reference standard.

B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.3 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 22 11 19

SECTION 22 13 16
DRAIN, WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

1. This Section includes drain, waste, and vent piping, including rain water leaders.

1.2 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
   1. Soil, Waste, and Vent Piping: 10-foot head of water.

1.3 SUBMITTALS

A. Field quality-control inspection and test reports.

1.4 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Hub-and-Spigot, Cast-Iron Pipe and Fittings: ASTM A 74, Service class, CISPI approved, domestic manufactured.
   1. Gaskets: ASTM C 564, rubber.

B. Hubless Cast-Iron Pipe and Fittings: ASTM A 888 or CISPI 301, CISPI approved, domestic manufactured.
   1. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
      a. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.

C. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
   1. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought-copper, solder-joint fittings.

D. Acid Drain: CPVC Type IV, Grade I, ASTM Cell Class 23447.
   1. All system components shall be certified by NSF International for use in chemical waste drain systems and bear the mark NSF-cw. All system piping shall be Schedule 40 CPVC produced to the dimensional requirements of ASTM F 2618 and the manufacturer's specifications. All pipe fittings shall be CPVC drainage patterns meeting the requirements of ASTM F 2618 and the manufacturer's specifications, as applicable.
   2. Solvent welded joints shall be made with ChemDrain One-Step solvent cement conforming to ASTM F 493. The system shall be protected from items that are not compatible with

CPVC compounds; materials like thread sealants, plasticized vinyl products, fire stopping devices or other aggressive chemical agents.

3.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Special pipe fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.

B. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

3.2 SANITARY WASTE AND VENT

A. Interior Above Ground may be one of the following:
1. Hubless cast iron soil pipe and fittings, ASTM A888; with no-hub couplings, CISPI 310.
2. Type M copper water tube, H (drawn) temper, ASTM B88; with cast copper drainage fittings (DWV), ANSI B16.23; wrought copper drainage fittings (DWV), ANSI B16.29; lead free (<.2%) solder, ASTM B32; flux, ASTM B813; copper phosphorous brazing alloy, AWS A5.8 BCuP. Mechanically formed brazed tee connections may be used in lieu of specified tee fittings for vent branch takeoffs up to one-half (1/2) the diameter of the main.

B. Interior Below Ground:
1. Cast iron soil pipe and fittings, hub and spigot, service weight, ASTM A74; with neoprene rubber compression gaskets, ASTM C564 and CISPI HSN 85.

3.3 RAIN WATER LEADERS

A. Same as Sanitary Waste and Vent piping above.

3.4 PIPING INSTALLATION

A. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

C. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."

D. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Wall penetration systems are specified in Division 22 Section "Common Work Results for Plumbing."

E. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

F. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

G. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

H. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
   1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
   2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
   3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

I. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

J. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.5 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
   1. Gasketed Joints: Make with rubber gasket matching class of pipe and fittings.
   2. Hubless Joints: Make with rubber gasket and sleeve or clamp.

C. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.6 HANGER AND SUPPORT INSTALLATION

A. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
   1. Vertical Piping: MSS Type 8 or Type 42, clamps.
   2. Individual, Straight, Horizontal Piping Runs: According to the following:
      a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
      c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
   3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.

4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
4. NPS 6: 60 inches with 3/4-inch rod.
5. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

G. Install supports for vertical cast-iron soil piping every 15 feet.

H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/4: 84 inches with 3/8-inch rod.
2. NPS 1-1/2: 108 inches with 3/8-inch rod.
3. NPS 2: 10 feet with 3/8-inch rod.
4. NPS 2-1/2: 11 feet with 1/2-inch rod.
5. NPS 3: 12 feet with 1/2-inch rod.
6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
7. NPS 6: 12 feet with 3/4-inch rod.

I. Install supports for vertical steel piping every 15 feet.

J. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/4: 72 inches with 3/8-inch rod.
2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
3. NPS 2-1/2: 108 inches with 1/2-inch rod.
4. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
5. NPS 6: 10 feet with 5/8-inch rod.

K. Install supports for vertical copper tubing every 10 feet.

L. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

B. Connect drainage and vent piping to the following:
1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 22 Section "Sanitary Waste Piping Specialties."

2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 22 Section "Sanitary Waste Piping Specialties."
4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

3.8 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
   1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
   2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction.
   1. Piping shall be tested to 10’ of static head, prior to backfill.
   2. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
   3. Prepare reports for tests and required corrective action.

3.9 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 22 13 16

SECTION 22 13 19
SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following sanitary drainage piping specialties:
   1. Cleanouts.
   2. Floor drains.
   3. Miscellaneous sanitary drainage piping specialties.
   4. Flashing materials.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for grease interceptors.

1.3 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Exposed Cast-Iron Cleanouts:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Josam Company; Josam Div.
      b. MIFAB, Inc.
      c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
      d. Tyler Pipe; Wade Div.
      e. Watts Drainage Products Inc.
      f. Zurn Plumbing Products Group.
   2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
   3. Size: Same as connected drainage piping
   4. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch or Hubless, cast-iron soil pipe test tee as required to match connected piping.
   5. Closure: Countersunk or raised-head, brass plug.
   6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Cast-Iron Floor Cleanouts:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Josam Company; Josam Div.
      b. Sioux Chief Manufacturing Company, Inc.
      c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
      d. Tyler Pipe; Wade Div.
      e. Watts Drainage Products Inc.

f. Zurn Plumbing Products Group.
2. Standard: ASME A112.36.2M for adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Not required.
7. Outlet Connection: Inside calk.
8. Closure: Brass plug with straight threads and gasket.
9. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy in finished areas; rough bronze in service areas, equipment rooms, etc..
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Medium Duty.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Josam Company; Josam Div.
b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
d. Tyler Pipe; Wade Div.
e. Watts Drainage Products Inc.
f. Zurn Plumbing Products Group.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hub-and-spigot, cast-iron soil pipe T-branch or Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk or raised-head, drilled-and-threaded brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Josam Company; Josam Div.
b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
d. Tyler Pipe; Wade Div.
e. Watts Drainage Products Inc.
f. Zurn Plumbing Products Group.
2. Standard: ASME A112.6.3 without backwater valve.
3. Pattern: Area drain.
4. Body Material: Gray iron.
5. Seepage Flange: Required.
6. Anchor Flange: Required.
7. Clamping Device: Required.
8. Outlet: Bottom.
9. Sediment Bucket: As scheduled.
10. Top or Strainer Material: Nickel bronze.
11. Top of Body and Strainer Finish: Chrome plated Nickel bronze, except in equipment rooms.
12. Top Shape: Round, except Square in areas with hard tile floor finishes.
13. Dimensions of Top or Strainer: 5” diameter unless otherwise noted.
14. Top Loading Classification: Light Duty.

15. Funnel: Not required.
16. Trap Material: Cast iron.
17. Trap Pattern: Deep-seal P-trap.
18. Trap Features: Trap-seal primer valve drain connection.
19. Additional Requirements: See drawings for additional floor drain requirements.

2.3 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Deep-Seal Traps:
1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.
   a. NPS 2: 4-inch- minimum water seal.
   b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.

B. Air-Gap Fittings:
1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

C. Sleeve Flashing Device:
1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

D. Stack Flashing Fittings:
1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

E. Vent Caps:
1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

2.4 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.

B. Fasteners: Metal compatible with material and substrate being fastened.

C. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

D. Solder: ASTM B 32, lead-free alloy.

E. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
   1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
   2. Locate at each change in direction of piping greater than 45 degrees.
   3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
   4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
   1. Position floor drains for easy access and maintenance.
   2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
      a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
      b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
      c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
   3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
   4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

F. Install deep-seal traps on floor drains and other waste outlets, if indicated.

G. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
   1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
   2. Size: Same as floor drain inlet.

H. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

I. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

J. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

K. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."

F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

3.4 LABELING AND IDENTIFYING

A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.5 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 22 13 19

SECTION 221413
FACILITY STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following storm drainage piping inside the building.
   1. Pipe, tube, and fittings.
   2. Special pipe fittings.

1.2 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
   1. Storm Drainage Piping: 10-foot head of water.

1.3 SUBMITTALS

A. Field quality-control inspection and test reports.

1.4 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS, shall bear the CISPI approval.

A. Hub-and-Spigot, Cast-Iron Pipe and Fittings: ASTM A 74, Service class.
   1. Gaskets: ASTM C 564, rubber.
B. Hubless Cast-Iron Pipe and Fittings: ASTM A 888 or CISPI 301.
   1. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
      a. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve, similar to Clamp All couplings rated at 15 psi and FM approved.
C. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
   1. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Special pipe fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.
B. Aboveground storm drainage piping shall be the following:
   1. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and coupled joints.
C. Underground storm drainage piping shall be the following:
   1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.

3.2 PIPING INSTALLATION

A. Storm sewer and drainage piping outside the building are specified in Division 33 Section "Storm Utility Drainage Piping."
B. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."
C. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers. Cleanouts are specified in Division 22 Section "Storm Drainage Piping Specialties."
D. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."
E. Install wall-penetration-fitting system at each service pipe penetration through foundation wall. Make installation watertight.
F. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
G. Make changes in direction for storm piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

H. Lay buried building drain piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

I. Install storm drainage piping at the following minimum slopes, unless otherwise indicated:
   1. Building Storm Drain: 1 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
   2. Horizontal Storm-Drainage Piping: 2 percent downward in direction of flow.

J. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

K. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.3 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

C. Hubless Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

D. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.4 VALVE INSTALLATION

A. Backwater Valves: Install backwater valves in piping subject to backflow.
   1. Horizontal Piping: Horizontal backwater valves.[Use normally closed type, unless otherwise indicated.]
   2. Install backwater valves in accessible locations.
   3. Backwater valve are specified in Division 22 Section "Storm Drainage Piping Specialties."

3.5 HANGER AND SUPPORT INSTALLATION

A. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
   1. Vertical Piping: MSS Type 8 or Type 42, clamps.
   2. Individual, Straight, Horizontal Piping Runs: According to the following:
      a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
      c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
   3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
   4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
   2. NPS 3: 60 inches with 1/2-inch rod.
   3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
   4. NPS 6: 60 inches with 3/4-inch rod.
   5. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

G. Install supports for vertical cast-iron soil piping every 15 feet.

H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/4: 84 inches with 3/8-inch rod.
   2. NPS 1-1/2: 108 inches with 3/8-inch rod.
   3. NPS 2: 10 feet with 3/8-inch rod.

4. NPS 2-1/2: 11 feet with 1/2-inch rod.
5. NPS 3: 12 feet with 1/2-inch rod.
6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
7. NPS 6: 12 feet with 3/4-inch rod.

I. Install supports for vertical steel piping every 15 feet.

J. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/4: 72 inches with 3/8-inch rod.
2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
3. NPS 2-1/2: 108 inches with 1/2-inch rod.
4. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
5. NPS 6: 10 feet with 5/8-inch rod.

K. Install supports for vertical copper tubing every 10 feet.

L. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

A. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

B. Connect storm drainage piping to roof drains and storm drainage specialties.

3.7 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test storm drainage piping according to procedures of authorities having jurisdiction.

3.8 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 221413

SECTION 221423
STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following storm drainage piping specialties:
   1. Cleanouts.
   2. Roof drains.
   3. Miscellaneous storm drainage piping specialties.

1.2 SUBMITTALS

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

1.3 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Exposed Cast-Iron Cleanouts:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Josam Company; Josam Div.
      b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
      c. Watts Drainage Products Inc.
      d. Zurn Plumbing Products Group;
   2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
   3. Size: Same as connected drainage piping
   4. Body Material Hubless, cast-iron soil pipe test tee as required to match connected piping.
   5. Closure: Countersunk, brass plug.
   6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Cast-Iron Floor Cleanouts:
   1. Subject to compliance with requirements, provide products by one of the following:
      a. Josam Company; Josam Div.
      b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
      c. Watts Drainage Products Inc.
      d. Zurn Plumbing Products Group;
   2. Standard: ASME A112.36.2M for adjustable housing cast-iron soil pipe with cast-iron ferrule threaded, adjustable housing cleanout.
   3. Size: Same as connected branch.
   4. Type: Adjustable housing
   5. Body or Ferrule: **Cast iron**.
   6. Closure: Brass plug with tapered threads
   7. Adjustable Housing Material: Cast iron with threads.
   8. Frame and Cover Material and Finish: Polished bronze.

9. Frame and Cover Shape: **Round**
10. Top Loading Classification: **Light** Duty.
11. Riser: ASTM A 74, **Service** class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Josam Company; Josam Div.
   b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   c. Watts Drainage Products Inc.
   d. Zurn Plumbing Products Group;
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

2.2 METAL ROOF DRAINS

A. ZURN Z100 adjustable style drain with optional cast iron dome.

B.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions. Roof materials are specified in Division 07.
1. Install roof-drain flashing collar or flange so that there will be no leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
2. Position roof drains for easy access and maintenance.

F. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

G. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
   1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
   1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
   2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
   3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221423

SECTION 223300 - ELECTRIC DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Light-commercial electric water heaters.
   2. Commercial electric booster heaters.
   3. Water heater accessories.

1.2 SUBMITTALS

A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Operation and maintenance data.

D. Warranty.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

C. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9" for all components that will be in contact with potable water.

1.4 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric water heaters that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including storage tank and supports.
      b. Faulty operation of controls.
      c. Deterioration of metals, metal finishes, and other materials beyond normal use.
   2. Warranty Period(s): From date of Substantial Completion:
      a. Commercial Electric Water Heaters: Five years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Basis of Design Product: As shown on Drawings.
   2. Comparable Products: As listed.

2.2 COMMERCIAL ELECTRIC WATER HEATERS

A. Commercial, Storage Electric Water Heaters: Comply with UL 1453 requirements for storage-tank-type water heaters.
   1. Basis of Design Product: As shown on Drawings.
   2. Comparable Products by one of the following:
      a. Bock Water Heaters, Inc.
      b. Bradford White Corporation.
      c. Lochinvar Corporation.
      d. State Industries, Inc.
   3. Storage-Tank Construction: Non-ASME-code, non-metallic composite material.
      a. Tappings: Factory fabricated of materials compatible with tank and piping connections. Attach tappings to tank before testing.
         1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
         2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
      b. Pressure Rating: 150 psig.
      c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.
   4. Factory-Installed Storage-Tank Appurtenances:
      a. Anode Rod: None required.
      b. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
      c. Insulation: Comply with ASHRAE/IESNA 90.1.
      d. Jacket: High density polyethylene dent and scratch resistant.
      e. Heating Elements: Electric, screw-in or bolt-on immersion type arranged in multiples of three.
         1) Staging: Input not exceeding 18 kW per step.
      f. Temperature Control: Adjustable thermostat.
      g. Safety Controls: High-temperature-limit and low-water cutoff devices or systems.
      h. Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3, for combination temperature and pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.
   5. Special Requirements:
      a. NSF 5 construction.
      b. Compliance with North Carolina Building Code.
   6. Energy Management System Interface: Normally closed dry contacts for enabling and disabling water heater.
   7. Capacity and Characteristics: Refer to Drawings.

2.3 WATER HEATER ACCESSORIES

A. Water Heater Stands: Water heater manufacturer's factory-fabricated steel stand for floor mounting and capable of supporting water heater and water. Include dimension that will support bottom of water heater a minimum of 18 inches above the floor.

B. Water Heater Mounting Brackets: Water heater manufacturer's factory-fabricated steel bracket for wall mounting and capable of supporting water heater and water.

C. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of water heater and include drain outlet not less than NPS 3/4.

D. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2.

E. Shock Absorbers: ASSE 1010 or PDI WH 201, Size A water hammer arrester.

PART 3 - EXECUTION

3.1 WATER HEATER INSTALLATION

A. Install commercial water heaters on concrete bases.
   1. Exception: Omit concrete bases for commercial water heaters if installation on stand, bracket, suspended platform, or direct on floor is indicated.
   2. Concrete base construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Install water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

C. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial, water-heater, relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

D. Install water heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Division 22 Section "Domestic Water Piping Specialties" for hose-end drain valves.

E. Install thermometer on outlet piping of water heaters. Refer to Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.

F. Install water regulator, with integral bypass relief valve, in booster-heater inlet piping and water hammer arrester in booster-heater outlet piping.

G. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.

H. Fill water heaters with water.

3.2 CONNECTIONS

A. Install piping adjacent to water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including connections.

B. Perform the following field tests and inspections:
1. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, confirm proper operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace water heaters that do not pass tests and inspections and retest as specified above.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial electric water heaters. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 223300

SECTION 224000
PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Faucets for lavatories, sinks, and other fixtures.
   2. Flushometers.
   3. Toilet seats.
   4. Protective shielding guards.
   5. Fixture supports.
   6. Water closets.
   7. Urinals.
   8. Lavatories.
   9. Sinks.
   10. Service sinks.
   11. Mop sinks.

B. Related Sections include the following:
   1. Division 22 Section "Drinking Fountains and Water Coolers."

1.2 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities, conforming to the requirements of the North Carolina Building Code.

C. FRP: Fiberglass-reinforced plastic.

D. PMMA: Polymethyl methacrylate (acrylic) plastic.

E. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.3 SUBMITTALS

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

B. Shop Drawings: Diagram power, signal, and control wiring, rough-in dimension drawings.

C. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; Public Law 101-336, "Americans with Disabilities Act"; and North Carolina Building Codefor plumbing fixtures for people with disabilities.

C. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

D. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

E. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

F. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
   1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
   2. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
   3. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
   4. Stainless-Steel Residential Sinks: ASME A112.19.3.

5. Vitreous-China Fixtures: ASME A112.19.2M.

G. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
4. Faucets: ASME A112.18.1.
5. Hose-Connection Vacuum Breakers: ASSE 1011.
6. Hose-Coupling Threads: ASME B1.20.7.
7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
8. NSF Potable-Water Materials: NSF 61.
9. Pipe Threads: ASME B1.20.1.
10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
11. Supply Fittings: ASME A112.18.1.
12. Brass Waste Fittings: ASME A112.18.2.

H. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
1. Atmospheric Vacuum Breakers: ASSE 1001.
2. Brass and Copper Supplies: ASME A112.18.1.
3. Manual-Operation Flushometers: ASSE 1037.
4. Plastic Tubular Fittings: ASTM F 409.
5. Brass Waste Fittings: ASME A112.18.2.
6. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.

I. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Off-Floor Fixture Supports: ASME A112.6.1M.
2. Pipe Threads: ASME B1.20.1.
3. Plastic Toilet Seats: ANSI Z124.5.
4. Supply and Drain Protective Shielding Guards: ICC A117.1.

PART 2 - PRODUCTS

2.1 LAVATORY FAUCETS

A. Basis of Design Product: As shown on Drawings.

B. Description: Single-control mixing, Single-control nonmixing, or Two-handle mixing valve as shown on Drawings. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.

C. Characteristics: Equivalent to Basis of Design Product, and as described on Drawings.

2.2 SINK FAUCETS

A. Basis of Design Product: As shown on Drawings.

B. Characteristics: Equivalent to Basis of Design Product, and as described on Drawings.

2.3 FLUSHOMETERS

A. Basis of Design Product: As shown on Drawings.

B. Characteristics: Equivalent to Basis of Design Product, and as described on Drawings.

2.4 TOILET SEATS

A. Description: Toilet seat for water-closet-type fixture. Molded, solid plastic with antimicrobial agent. Configuration, size, hinge type, color, as described on Drawings, equivalent to Basis of Design Product. Heavy-duty commercial class.

2.5 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers,:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. McGuire Manufacturing Co., Inc.
b. TRUEBRO, Inc.
c. Zurn Plumbing Products Group; Tubular Brass Plumbing Products Operation.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot-water supply and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

2.6 FIXTURE SUPPORTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Josam Company.
2. MIFAB Manufacturing Inc.
3. Smith, Jay R. Mfg. Co.
4. Zurn Plumbing Products Group; Specification Drainage Operation.

B. Urinal Supports,:
1. Description: Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture for wall-mounting, urinal-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

C. Lavatory Supports,:
1. Description: Type II, lavatory carrier with concealed arms and tie rod for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

D. Sink Supports,:
1. Description: Type II, sink carrier with hanger plate, bearing studs, and tie rod for sink-type fixture. Include steel uprights with feet.

2.7 WATER CLOSETS

A. Description: Equal to Basis of Design Product, and as otherwise described on Drawings.

2.8 URINALS

A. Description: Equal to Basis of Design Product, and as otherwise described on Drawings.

2.9 LAVATORIES

A. Description: Equal to Basis of Design Product, and as otherwise described on Drawings.

2.10 SINKS

A. Description: Equal to Basis of Design Product, and as otherwise described on Drawings.

2.11 SERVICE SINKS

A. Floor-mounted, molded stone mop basins.
1. Description: Equal to Basis of Design Product, and as otherwise described on Drawings.
2. Accessories and Trim: As shown on Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.

C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.

D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

E. Install wall-mounting fixtures with tubular waste piping attached to supports.

F. Install fixtures level and plumb according to roughing-in drawings.
G. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
H. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
I. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
J. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
K. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.
L. Install toilet seats on water closets.
M. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
N. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
O. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
P. Install shower flow-control fittings with specified maximum flow rates in shower arms.
Q. Install traps on fixture outlets.
    1. Exception: Omit trap on fixtures with integral traps.
    2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
R. Install escutcheons at piping wall and ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."
S. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

E. Install fresh batteries in sensor-operated mechanisms, where not direct-powered (or if backup feature available).

3.4 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224000

SECTION 224700 - WATER COOLERS

PART 1 - GENERAL

1.1 SUMMARY

1. This Section includes electric water coolers.

1.2 SUBMITTALS

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

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Operation and maintenance data.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for fixtures for people with disabilities.

C. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

D. ARI Standard: Comply with ARI's "Directory of Certified Drinking Water Coolers" for style classifications.

E. ARI Standard: Comply with ARI 1010, "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers," for water coolers and with ARI's "Directory of Certified Drinking Water Coolers" for type and style classifications.

F. ASHRAE Standard: Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants" for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant unless otherwise indicated.

PART 2 - PRODUCTS

2.1 Electric Water Coolers

A. Wall mounted barrier free electric water cooler with stainless steel basin, self-closing front and side mounted push bars, wall hanger and 1-1/4" tailpiece, characteristics as shown on Drawings. Color to be selected by Architect/Engineer from manufacturers standard color selection.

B. Basis of Design Product: As shown on Drawings.

C. Comparable products by Elkay, Oasis, Halsey-Taylor.

D. Trap: 1-1/4"x1-1/4" 17 ga. cast brass trap.

E. Stop/Supply: ½" ball valve with ½" riser (concealed).

2.2 FIXTURE SUPPORTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Josam Co.
2. Smith, Jay R. Mfg. Co.
3. Zurn Plumbing Products Group; Specification Drainage Operation.

B. Description: ASME A112.6.1M, water cooler carriers. Include vertical, steel uprights with feet and tie rods and bearing plates with mounting studs matching fixture to be supported.

1. Type I: Hanger-type carrier with two vertical uprights.
2. Type II: Bilevel, hanger-type carrier with three vertical uprights.
3. Supports for Accessible Fixtures: Include rectangular, vertical, steel uprights instead of steel pipe uprights.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Use carrier off-floor supports for wall-mounting fixtures, unless otherwise indicated.

B. Set freestanding and pedestal drinking fountains on floor.

C. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view.

3.2 INSTALLATION

A. Install off-floor supports affixed to building substrate and attach wall-mounting fixtures, unless otherwise indicated.

B. Install fixtures level and plumb. For fixtures indicated for children, install at height required by authorities having jurisdiction.

C. Install water-supply piping with shutoff valve on supply to each fixture to be connected to water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be

easily reached for operation. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

D. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

E. Install pipe escutcheons at wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding pipe fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."

F. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.3 CONNECTIONS

A. Connect fixtures with water supplies, traps, and risers, and with soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Water Cooler Testing: After electrical circuitry has been energized, test for compliance with requirements. Test and adjust controls and safeties.

1. Remove and replace malfunctioning units and retest as specified above.
2. Report test results in writing.

3.5 ADJUSTING

A. Adjust fixture flow regulators for proper flow and stream height.

B. Adjust water cooler temperature settings.

END OF SECTION 224700

SECTION 230000 - GENERAL REQUIREMENTS FOR HVAC WORK

A. GENERAL CONDITIONS: This Contractor's attention is directed to the requirements of Instructions to Bidders, General Conditions and Supplementary General Conditions as bound in the specifications which apply in full to the HVAC contract. Where the requirements of this Division conflict with other articles in these Specifications, the Contractor shall utilize the more stringent method.
B. SCOPE: Provide all labor, materials, tools, equipment, and transportation, and perform all operations necessary for and reasonably incidental to proper execution and completion of all "HVAC" work, whether specifically mentioned or not, all as indicated, specified herein, and/or implied thereby to carry out the apparent intent thereof. These drawings may be superseded by later revised or detailed drawings, specifications, or sketches prepared by the Designer, as needed for clarification, and this Contractor shall conform to all reasonable coordination requests. All items not specifically mentioned in the specifications or noted on the drawings, but which obviously are required to make the working installation complete, shall be included automatically.
For projects which are bid or awarded as Single Prime contracts, organization of the Specifications into divisions, sections, and articles, and arrangement of the Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be done by any trade, unless specifically shown or noted otherwise.
C. PERMITS & FEES: This Contractor shall secure all permits required for the completion of this contract. He shall obtain and deliver to the Owner all certificates of inspection issued by the authorities having jurisdiction.
D. VISIT TO JOB SITE: Before submitting a bid, this Contractor shall visit the job site for the purpose of thoroughly examining the site and conditions under which the work must be performed. The submission of a bona fide bid will be construed to mean that this Contractor understands and is satisfied with conditions under which the contract must be fulfilled. No extra compensation will be allowed for situations arising from failure of this Contractor to be thoroughly familiar with site conditions, including charges and requirements for connection to utilities as shown for this project.
E. WORKMANSHIP: Workmanship in the fabrication, preparation, and installation of materials and equipment shall conform to the best standards of practice of the trades involved. Work shall be performed by experienced and skilled mechanics under the supervision of a competent foreman. Substandard workmanship will be cause for rejection of work and replacement by Contractor. The Contractor shall reimburse the Designer for all costs incurred by the Designer due to Contractor’s substandard or non-conforming work.
F. DRAWINGS AND SPECIFICATIONS: The drawings show the location and arrangement of ducts, piping, grilles and diffusers, and equipment, together with details of connections of certain principal items. The layout shown shall be followed as closely as circumstances will permit, but this Contractor shall lay out his work so as to avoid conflict with other Contractors and trades, and to avoid any unnecessary cutting or damage to walls, floors, and supporting structural members. He shall, therefore, carefully and accurately locate all sleeves and install at the proper time all necessary hangers, inserts, etc., which will be required for the completion of his work, and shall be solely responsible for the accurate and proper location of above items.
This Contractor shall refer to architectural, plumbing, and electrical drawings and shall cooperate fully with other Contractors and trades while installing piping, ducts, and other equipment because of close space limits. In case of conflict, notify Designer before proceeding with installation. Refer to architectural drawings for exact building dimensions and location of partition walls, doors, chases, etc. HVAC drawings are not to be scaled for such dimensions.
The drawings and specifications complement each other and together are intended to give a complete description of the work. Any item of equipment or note of work to be done as shown on plans and not mentioned in the specifications, or mentioned in specifications and not shown in plans, shall be furnished the same as if mentioned or shown in both places. If conflicts exist, then the most stringent method shown or described shall apply.
Any switches, controls, or equipment included in this contract work (drawings and/or specifications) that are not specifically shown on drawings shall be located for convenient use and access. Contractor shall coordinate all equipment arrangement and lay-out in field prior to beginning any actual installation of his work.
If Contractor notes any discrepancy, omission, or conflict found in plans or specifications, he shall call to

the immediate attention of the Designer, prior to receipt of bids.
It is the intention that piping, air ducts and light fixtures are designed and laid out to clear each other. It shall be the responsibility of this Contractor to coordinate his work with that of other trades to avoid any such conflicts. Any conflicts that occur after work of one trade is installed and was not prior coordinated shall be relocated or rearranged at the total expense of this Contractor, as directed by Designer. Any conflicts that cannot be corrected in field by relocation or elevation changes shall be reported to the Designer in writing prior to any installation.
The drawings are not intended to show each and every complete or accurate detail. The figures and writing on drawings shall be taken instead of scaling. It is this Contractor's responsibility to comply with the evident intent for centering and symmetric arrangement. This Contractor shall take and be responsible for all field measurements. Exact locations and relations are to be defined in the field and shall be satisfactory to the Designer.
Because of the small scale of HVAC drawings it is not possible to indicate all offsets, fittings, and accessories which may be required. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings and accessories that may be required to meet the conditions.
G. TESTS: The right is reserved to conduct acceptance tests of all equipment, piping, ducts, or any other work furnished under these specifications to determine the fulfillment of special requirements. Such tests shall be conducted in the presence of authorized representatives of the Contractor, Owner, Engineer, and Architect at such time as the Designer may designate. This Contractor shall perform all tests, bear cost of same and make adjustments of equipment and wiring as may be deemed necessary by the Designer.
H. ALLOWANCE FOR ADDED WORK: Before proceeding with any work for which compensation may be claimed or the Owner may claim credit, a detailed estimate shall first be submitted and approved in writing. No claim for addition to the contract sum will be valid unless so ordered and approved by the Owner and Designer, prior to start of work. Any conflicts corrected by relocation or elevation changes do not constitute extra work.
I. INCIDENTAL CONSTRUCTION WORK: All blocking for openings for piping or ducts in concrete floors, masonry walls or partitions shall be provided by this Contractor. This Contractor shall do all cutting and fitting of his work and of other work that may be required to make the several parts come together properly and to fit his work to receive or be received by the work of other Contractors as shown upon, or reasonably implied by the drawings and specifications. He shall properly complete and finish up his work after other Contractors have finished as the Designer may direct.
All excavating required for the installation of this system shall be done by this Contractor. Backfill shall be accomplished as specified in appropriate section of specifications.
Chases are prohibited in masonry walls which are not to be plastered or paneled. Set piping, blocking, carriers, etc. indicated to be concealed before walls are constructed in order that walls may be constructed around them. This Contractor shall furnish all sleeves in floors, beams, walls, etc., for each such penetration as needed for installing his work and installation of sleeves by General Contractor. Unless otherwise noted, the General Contractor will provide openings and lintels as new construction progresses, but this Contractor shall fully designate his requirements prior to construction. Failure to furnish his requirements prior to building construction and failure to coordinate his work with the building construction shall make this Contractor responsible for removing, replacing and painting building construction as required for installation of his work.
J. SUPERVISION: This Contractor shall have in charge of the work at all times during construction a thoroughly competent foreman with extensive experience in the work to be performed under this contract. Anyone deemed not capable by the Designer shall be replaced immediately upon request, and after satisfactory foreman has been assigned, he shall not be withdrawn without the written consent of the Designer.
K. ELECTRICAL WORK BY OTHERS: Refer to the drawings for the details of locations of circuit breakers, junction boxes, disconnect switches, conduits and slack wire required where this contractor's electrical work terminates and electrical work by others begin.
The Electrical Contractor shall furnish and install all power circuits for equipment furnished by others. In Mechanical Rooms the wiring by the Electrical Contractor shall generally terminate in a power wiring gutter, line side of disconnect switches or starters, junction box, or electrical panel. From these points power wiring to the equipment furnished by the HVAC Contractor shall generally be by the HVAC Contractor. Power wiring to mechanical equipment outside equipment rooms will generally be run by the

Electrical Contractor to line side of a disconnect switch or junction box in the vicinity (within 3'-0") of the plumbing equipment. Power wiring from that point to the equipment will be by the HVAC Contractor. HVAC Contractor is to refer to the drawings for location and type of service connections to be provided under the electrical contract. Where service disconnect switches are required and not furnished as part of the equipment, they shall be furnished and installed by contractor that furnishes the equipment, unless indicated otherwise. Other Contractors shall furnish and install conduit, boxes, wiring and all items of control for equipment they furnish or Owner furnished equipment, **unless specifically** shown on electrical drawings.

L. EXISTING FACILITIES: In existing facilities, disruption of operations must be kept to a minimum and coordinated with Owner. Work in existing buildings must be cleaned up daily immediately after finishing that portion of work and equipment left in order for Owner to continue operations. When it is necessary to interrupt utility services in the fulfillment of this contract, such interruptions shall be kept to a minimum and coordinated with Owner. Once work has begun, it shall be pursued diligently until completed.

Every precaution shall be taken to prevent damage to existing underground lines and structures and public utilities. Damage to existing water and sewer lines, culverts, service connections, underground cables, and similar surface and sub-surface structures shall be at the risk of this Contractor, whether or not locations thereof are shown on plans, and the repairing of such damage shall be by this Contractor and shall be completed without delay. Compensation for such repairs shall be based on normal and reasonable costs.

The locations of any existing underground utilities that are shown are in an approximate way only and have not been independently verified by the Owner or its representative. The Contractor shall determine the exact location of all existing utilities before commencing work, and agrees to be fully responsible for any and all damages which might be occasioned by the Contractor’s failure to exactly locate and preserve any and all underground utilities.

M. ADAPTATION OF WORK TO EXISTING CONDITIONS: It is reasonably implied that this Contractor is to furnish all labor and materials to provide Owner with a new and satisfactory system in these facilities. Contractor is to include necessary work for adaptation of equipment to conditions that may be found to produce conflicts during construction. When any such conditions are encountered, this Contractor is to consult with Designer and then modify installation as directed without additional costs, and to include any incidental materials required.

O. HVAC SYSTEM USE DURING CONSTRUCTION: The permanent HVAC system may be used during construction to control temperature and relative humidity when allowed by the General Conditions, Supplementary General Conditions, or elsewhere in the Contract Documents, and approved by the Designer. Such use shall be subject to compliance with SMACNA “IAQ Guideline for Occupied Buildings under Construction" and the following guidelines. The building permanent HVAC system is designed to provide comfort conditions in accordance with ASHRAE standards in the completed and occupied facility. The system may or may not be designed to provide for dehumidification or other special control sequences. The Designer does not warrant use of the system during construction for drying out concrete slabs or similar construction operations; such use is solely at the discretion of the Contractor.

Submit the following for approval:

1. Construction indoor-air-quality management plan, describing Contractor’s means and methods for intended use of the building permanent HVAC system.
2. Product data for temporary filtration media.

During construction, submit the following Construction Documentation:

1. Six photographs at three different times during the construction period, along with a brief description of the SMACNA approach employed, documenting implementation of the indoor-air-quality management measures, such as protection of ducts and on-site stored or installed absorptive materials.
2. Signed statement describing the building air flush-out procedures including the dates when flush-out was begun and completed and statement that filtration media was replaced after flush-out.
3. Report from testing and inspecting agency indicating results of indoor-air-quality testing and documentation showing compliance with indoor-air-quality testing procedures and requirements.

If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period, install filter media having a MERV 8 according to ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction. Replace all air filters as required, but not less than weekly, during operation and immediately prior to occupancy. Building shall be maintained in broom clean

condition, with no dust-producing operations during operation of air handling equipment.
Building Flush Out
1. After construction ends, prior to occupancy and with all interior finishes installed, perform a building flush-out by supplying a total volume of 14000 cu. ft. of outdoor air per sq. ft. of floor area while maintaining an internal temperature of at least 60 deg F and a relative humidity no higher than 60 percent.
2. Air-Quality Testing: Conduct baseline indoor-air-quality testing, after construction ends and prior to occupancy, using testing protocols consistent with the EPA's "Compendium of Methods for the Determination of Air Pollutants in Indoor Air," and as additionally detailed in the USGBC's “LEED for Schools Reference Guide."
Use of the permanent HVAC system during Construction shall not in any way affect warranty start dates established in the General Conditions, Supplementary General Conditions, or elsewhere in the Specifications. Contractor shall clean ducts, air handling equipment, heating and cooling coils, grilles and diffusers, and any other equipment as necessary prior to Final Acceptance, in order to provide the Owner a complete operating system in new and clean condition.

P. LEED RESPONSIBILITY:

1. The HVAC Contractor and sub-tier Contractors shall bare the responsibility for applicable portions of work as they pertain to requirements for LEED certification, shall coordinate with other trades as required for LEED certification, and demonstrate proof of compliance for LEED certification.

2. The HVAC Contractor shall provide to the General Contractor a LEED Project Representative for the HVAC systems to participate with the LEED Project Management and Coordination to provide the following:

a. Construction Indoor Air Quality (IAQ) Management Plan
b. HVAC&R CFC Refrigerant Waste Disposal Plan

END OF SECTION 230000

SECTION 230010 - SUBMITTAL PROCEDURES

PART 1 - PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

1.2 DEFINITIONS

A. Action Submittals: Written and graphic information that requires Engineer's responsive action.

B. Informational Submittals: Written information that does not require Engineer's responsive action. Submittals may be rejected for not complying with requirements.

1.3 SUBMITTAL PROCEDURES

A. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
    a. Designer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

B. Submittals Schedule: Comply with requirements in Division 01 Section "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities.

C. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Designer's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 21 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Designer will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 15 days for review of each resubmittal.

D. Identification: Place a permanent label or title block on each submittal for identification.

1. Indicate name of firm or entity that prepared each submittal on label or title block.
2. Provide a space on label or beside title block to record Contractor's review and approval markings and action taken by Architect.

E. Deviations: Highlight, encircle, or otherwise specifically identify deviations from the Contract Documents on submittals. Summarize deviations on transmittal or List of Deviations included with submittal.

F. Additional Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.

G. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will discard submittals received from sources other than Contractor.

H. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked "Furnish as Submitted” or “Furnish as Corrected."

I. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

J. Use for Construction: Use only final submittals with mark indicating "Furnish as Submitted” or Furnish as Corrected" taken by Designer.

1.4 CONTRACTOR'S USE OF DESIGNER'S CAD FILES

A. General: At Contractor's written request, copies of Designer's CAD files will be provided to Contractor for Contractor's use in connection with Project, subject to the following conditions:

1. Allow 21 days from Designer's receipt of written request for CAD files for delivery of files
2. Files will be delivered via email or compact disc.
3. Files will be delivered without RN&M Title Blocks, and without standard details, schedules, etc.
4. CAD files provided for Contractor's use are not to be construed as the Contract Documents. Use of CAD files for submittals or other uses are at the Contractor's risk.

B. DISCLAIMER

1. The drawings have been reproduced from a computer disk copy of an original file at Reece, Noland & McElrath, Inc., and are an instrument of service. The firm assumes no responsibility for additions, deletions, or any differences which may exist between electronic files and the original drawings. This material is furnished in our usual electronic format for file and resource only. The information contained on this disk or other media and on it's plot are based upon file information and has not been field validated or verified with actual field conditions and the user is advised to refer to all actual field conditions prior to utilization, and to coordinate with other current contract documents applicable at time of use.
2. It is mutually understood that any possible use of this material as a reference resource is done so at the total risk of the user. We expressly disclaim that this material is suitable for any use except reference file of the present project construction; consequently we assume no liability for any other purpose using this material, or use by the owner or others that may gain access in the future.
3. No warranty either expressed or implied is given with respect to the accuracy of the information provided in this material and the user must assume all risks in connection with the use thereof.
4. It must be explicitly understood and agreed that once the CADD media leaves our hands, we have absolutely no control over that media, and that it could be utilized wrongfully, changed, or altered to produce drawings or other material bearing facsimiles of our name, our professional seals, our signatures, or that the material may deteriorate or be accidentally altered; additionally, the right given by us to you to use the material is a joint right – we retain the right to use the material for our own purposes; either of us shall have the right to reuse, alter, modify or delete the material without consequences to the other party. You and any user, agree to defend, indemnify, and hold Reece, Noland & McElrath, Inc. harmless from all claims, injuries, damages, losses, expenses, and attorney fees arising out of the use, modification or reuse of these materials.
5. Use of this material is at the sole risk of the user. Any other use of this material is not permitted without our review and expressed written permission. This material may not be reproduced without name, professional seal(s), signatures, logos, or title block data.
6. Use of this data indicates your acceptance of the above provisions. If you do not agree with them, you should return the materials and data to us without any use.
7. This material is protected under copyright laws and you must use them only as outlined above and treat like any other copyright material. Any use of this material is at the user's risk; furthermore, user agrees to indemnify and hold harmless Reece, Noland & McElrath, Inc. from all claims arising from the use, modifications, or reuse of these materials.

1.5 ACTION SUBMITTALS

A. General: Prepare and submit Action Submittals required by individual Specification Sections.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:
   a. Manufacturer's written recommendations.
   b. Manufacturer's product specifications.
   c. Manufacturer's installation instructions.

d. Manufacturer's catalog cuts.
e. Wiring diagrams showing factory-installed wiring.
f. Printed performance curves.
g. Operational range diagrams.
h. Compliance with specified referenced standards.
i. Testing by recognized testing agency.

4. Number of Copies: Submit at least eight copies of Product Data, unless otherwise indicated. Designer will return all but three copies. Mark up and retain one returned copy as a Project Record Document.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal of Designer's CAD Drawings is otherwise permitted.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
a. Dimensions.
b. Identification of products.
c. Fabrication and installation drawings.
d. Roughing-in and setting diagrams.
e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
f. Shopwork manufacturing instructions.
g. Templates and patterns.
h. Schedules.
i. Notation of coordination requirements.
j. Notation of dimensions established by field measurement.
k. Relationship to adjoining construction clearly indicated.
l. Seal and signature of professional engineer if specified.
m. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.

2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 30 by 40 inches.

3. Number of Copies: Submit two opaque (bond) copies of each submittal. Designer will return one copy.

D. Submittals Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."

E. Manufacturers and Materials Suppliers List: Submit a list of manufacturers of materials and materials/equipment suppliers, within 20 days of Contract Award.

1. Number of Copies: Submit three copies of manufacturers and materials suppliers list, unless otherwise indicated. Designer will return two copies.

F. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design.

1. Number of Copies: Submit three copies of subcontractor list, unless otherwise indicated. Designer will return two copies.
2. Subcontract list to include all tiers of subcontractors.
3. Submit subcontract list within 20 days of Contract Award.

1.6 INFORMATIONAL SUBMITTALS

A. General: Prepare and submit Informational Submittals required by other Specification Sections.

1. Number of Copies: Submit two copies of each submittal, unless otherwise indicated. Designer will not return copies.
2. Certificates and Certifications: Provide a notarized statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
3. Test and Inspection Reports: Comply with requirements specified in Division 01 Section "Quality Requirements."

B. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
C. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.
D. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
E. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
F. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
G. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
H. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
I. Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
J. Research/Evaluation Reports: Prepare written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project.
K. Preconstruction Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
L. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
M. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
N. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements specified in Division 23 Section "Operation and Maintenance Data."
O. Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.
P. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer.
Q. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:
    1. Statement on condition of substrates and their acceptability for installation of product.
    2. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
    3. Results of operational and other tests and a statement of whether observed performance complies with requirements.

R. Material Safety Data Sheets (MSDSs): Submit information directly to Owner; do not submit to Designer.

1. Designer will not review submittals that include MSDSs and will return them for resubmittal.

1.7 DELEGATED DESIGN

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

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit threecopies of a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 2 - PART 2 - EXECUTION

2.1 CONTRACTOR'S REVIEW

A. Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Designer.

B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

2.2 DESIGNER'S ACTION

A. General: Designer will not review submittals that do not bear Contractor's approval stamp and will return them without action.

B. Action Submittals: Designer will review each submittal, make marks to indicate corrections or modifications required, and return it. Designer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:

1. Furnish as Submitted
2. Furnish as Corrected: Incorporate comments marked on or attached to submittal.
3. Revise and Resubmit: Major items of the submittal do not comply, requiring a resubmittal.

C. Informational Submittals: Designer will review each submittal and will not return it, or will return it if it does not comply with requirements. Designer will forward each submittal to appropriate party.

D. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.

E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

F. The Contractor is responsible for compliance with the Contract Documents, dimensions, details, coordination, and satisfactory performance of materials and equipment provided and installed.

END OF SECTION 230010

SECTION 230020 - REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

A. General: Basic Contract definitions are included in the General Conditions of the Contract.

B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "approved," "required," and "permitted" have the same meaning as "directed."

D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

H. "Provide": Furnish and install, complete and ready for the intended use.

I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.2 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents, unless otherwise indicated.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source, at no additional cost to the Owner.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

A. All work performed shall be in accordance with the latest requirements of the current edition of the North Carolina State Building Code, and all other state and local codes, rules, regulations, ordinances, and standards.

B. Contractor shall notify Designer in writing prior to receipt of bids if Contractor notes any discrepancy between laws, codes, ordinances, rules, regulations, and these specifications

C. In cases where the drawings or specifications exceed requirements of codes, standards, and ordinances, work shall be done in accordance with the requirements of the specifications.

D. Any work installed in violation of codes, standards, and ordinances shall be reworked to be in compliance with codes, standards, and ordinances, at Contractor’s expense.

END OF SECTION 230020

SECTION 230030 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.

B. See Division 23 Section "Closeout Procedures" for submitting warranties for Contract closeout.

C. See Divisions 23 Sections for specific requirements for warranties on products and installations specified to be warranted.

1.2 DEFINITIONS

A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Basis-of-Design Product: Item identified by manufacturer’s product name, make, and model number, used to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, and other characteristics for purposes of evaluating comparable products of other named manufacturers.

2. Comparable Product: Product that is listed by manufacturer’s name in the Contract Documents, or added by Addendum, and demonstrated and approved through submittal process, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified or basis-of-design product. By listing a Comparable Product in the Contract Documents, the Designer does NOT represent that the Comparable Product has the same dimensions, physical properties, power and other connections, or other characteristics as the Basis-of-Design Product. In choosing to provide a Comparable Product, the Contractor is responsible for all changes to services, electrical and other connections, dimensions, coordination requirements with all trades, and any other differences between the Comparable Product and the Basis-of-Design product.

3. Owner-preferred Alternate Product: Product that is listed by manufacturer’s product name, make, and model number in the Contract Documents, and for which an Alternate Bid price is submitted. When an Alternate Bid item is accepted in the Contract, no substitutions or use of Comparable Products will be allowed.

4. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.

B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor after award of Contract, because of extraordinary circumstances.

1.3 SUBMITTALS

A. Comparable Product Requests: Submit three copies of each request for consideration, at least 10 days prior to receipt of bids, for products not listed in the Contract Documents. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Documentation: Show compliance with requirements for Comparable Products and the following, as applicable:

a. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed product.

b. Detailed comparison of significant qualities of proposed product with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.

c. Product Data, including drawings and descriptions of products and fabrication and installation procedures.

2. Designer's Action: If necessary, Designer will request additional information or documentation for evaluation. Designer will notify Contractor of approval or rejection of proposed comparable product request.
    a. Form of Approval: Addition of the item to the list of Comparable Products by Addendum, prior to receipt of bids.
    b. Use product specified if Designer cannot make a decision on use of a comparable product request within time allocated.

B. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
1. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
    a. Statement indicating why specified material or product cannot be provided.
    b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
    c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
    d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
    e. Samples, where applicable or requested.
    f. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
    g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
    h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
    i. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
    j. Cost information, including a proposal of change, if any, in the Contract Sum.
    k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
    l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
2. Designer's Action: If necessary, Designer will request additional information or documentation for evaluation of a request for substitution. Designer will notify Contractor of acceptance or rejection of proposed substitution.
    a. Form of Acceptance: Change Order.
    b. Use product specified if Designer cannot make a decision on use of a proposed substitution within time necessary to not affect project schedule.

C. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 21 Section "Submittal Procedures." Show compliance with requirements.

1.4 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.

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

C. Storage:
   1. Store products to allow for inspection and measurement of quantity or counting of units.
   2. Store materials in a manner that will not endanger Project structure.
   3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
   4. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
   5. Protect stored products from damage and liquids from freezing.

1.6 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
   1. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
   2. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.
   1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
   2. Specified Form: When specified forms are included with the Specifications, prepare a written document using appropriate form properly executed.
   3. Refer to Division 21 Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Division 21 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.
   1. Provide products complete with accessories, trim, finish, fasteners, features, options, and other items needed for a complete installation and indicated use and effect, and as required or recommended by the manufacturer for a complete installation, whether or not specifically indicated on the drawings or specifications.
   2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
   3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
   4. Where products are accompanied by the term "as selected," Designer will make selection.
   5. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.

B. Product Selection Procedures:
   1. Basis-of-Design Product: Where Drawings or Specifications name a product by manufacturer, make, and model number, and include a list of manufacturers (Comparable Products), provide the Basis-of-Design product or a Comparable Product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product identified by manufacturer, make, and model number (Basis-of-Design Product). Comply with provisions in Part 2 "Comparable Products" Article for consideration of products by unnamed manufacturers.
   2. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, and textures" or a similar phrase, select a product that complies with other specified requirements.
      a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Designer will select color, pattern, density, or texture from manufacturer's product line that does not include premium items.
      b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Designer will select color, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

A. Timing: Designer will consider requests for Comparable Products up to 10 days prior to receipt of bids, unless otherwise specified in General Conditions, Supplementary General Conditions, or Division 1 Sections.

B. Contractor shall be responsible for all costs associated with implementation or inclusion of a Comparable Product, including reimbursement of Designer’s costs and costs to modify work of other trades to accept the Comparable Product. This requirement applies equally to Comparable Products listed in the Contract Documents and those requested, approved, and added by Addendum prior to receipt of bids.

C. Conditions: Designer will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Designer will return requests without action, except to record noncompliance with these requirements:
   1. Evidence that the proposed product does not require extensive revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
   2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
   3. Evidence that proposed product provides specified warranty.
   4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
   5. Samples, if requested.

2.3 PRODUCT SUBSTITUTIONS

A. Timing: Designer will consider requests for substitution if received within 60 days after the Notice of Award.

B. Contractor shall be responsible for all costs associated with implementation or inclusion of a Product Substitution, including reimbursement of Designer’s costs and costs to modify work of other trades to accept the Product Substitution.

C. Conditions: Designer will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Designer will return requests without action, except to record noncompliance with these requirements:
   1. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations.
   2. Requested substitution does not require extensive revisions to the Contract Documents.
   3. Requested substitution is consistent with the Contract Documents and will produce indicated results.

4. Substitution request is fully documented and properly submitted.
5. Requested substitution will not adversely affect Contractor's Construction Schedule.
6. Requested substitution has received necessary approvals of authorities having jurisdiction.
7. Requested substitution is compatible with other portions of the Work.
8. Requested substitution has been coordinated with other portions of the Work.
9. Requested substitution provides specified warranty.

PART 3 - EXECUTION

3.1 RESPONSIBILITIES OF CONTRACTOR

A. General: The responsibility for determining dimensions, utility requirements, fitting of work with other trades, sequencing and coordination of work, for Product Substitutions and Comparable Products rests solely with the Contractor.

END OF SECTION 230030

SECTION 230040 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:
   1. Construction layout.
   2. General installation of products.
   3. Progress cleaning.
   4. Starting and adjusting.
   5. Protection of installed construction.
   6. Correction of the Work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.
   1. Before construction, verify the location and points of connection of utility services.

B. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.
   1. Before construction, verify the location at points of connection of underground electrical services.
   2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

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

3.2 PREPARATION

A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work. Exact locations, arrangement, and coordination in the field are Contractor's responsibility.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings. Follow the obvious intent for symmetry, centering, and good practice in installation.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Designer. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

3.3 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
   1. Make vertical work plumb and make horizontal work level.
   2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
   3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
   4. Install conduits to run parallel and perpendicular to building lines.
   5. Coordinate locations of piping, ductwork, and equipment with casework, soffits, piping, structural elements, etc. prior to roughing in. No claims for additional cost will be entertained to relocate Contractor's failure to coordinate prior to installation.
   6. The drawings are diagrammatic in nature. Do not scale drawings for locations of devices, boxes, and equipment.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

G. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
   1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Designer.
   2. Allow for building movement, including thermal expansion and contraction.
   3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

H. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.4 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
   1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
   2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F.
   3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
   1. Remove liquid spills promptly.
   2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
G. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.
H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.5 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.
C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 01 Section "Quality Requirements."

3.6 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.7 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 23 Section "Cutting and Patching."
    1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
B. Restore permanent facilities used during construction to their specified condition.
C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 230040

SECTION 230050 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes procedural requirements for cutting and patching.

B. See Division 23 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

C. See Division 23 Section "Penetration Firestopping" for patching fire-rated construction.

1.2 QUALITY ASSURANCE

A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.

B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.

C. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.

D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Designer's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

1.3 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

B. In-Place Materials: Use materials identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.

1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place finishes or primers.
2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.

B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas. When such interruptions are required by operations, notify Designer in writing at least 72 hours prior to beginning such work.

3.3 PERFORMANCE

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
   1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
   2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
   3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
   4. Excavating and Backfilling: Comply with requirements in applicable specification Sections where required by cutting and patching operations.
   5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
   6. Proceed with patching after construction operations requiring cutting are complete.

C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.
   1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
   2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
   3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
   4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
   5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION 230050

SECTION 230060 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
   1. Inspection procedures.
   2. Warranties.
   3. Final cleaning.

B. See Division 23 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.

C. See Division 23 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.

D. See Division 23 Section "Demonstration and Training" for requirements for instructing Owner's personnel.

E. See Division 23 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.2 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
   1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
   2. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
   3. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
   4. Prepare and submit Project Record Documents, operation and maintenance manuals, damage or settlement surveys, and similar final record information.
   5. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
   6. Complete startup testing of systems.
   7. Submit test records.
   8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
   9. Advise Owner of changeover in power and other utilities.
   10. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
   11. Complete final cleaning requirements, including touchup painting.
   12. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Designer will either proceed with inspection or notify Contractor of unfulfilled requirements.
   1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
   2. Results of completed inspection will form the basis of requirements for Final Completion.

1.3 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:
   1. Submit certified copy of Designer's Substantial Completion inspection list of items to be completed or corrected (punch list). The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
   2. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit documentation of training.

B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Designer will either proceed with inspection or notify Contractor of unfulfilled requirements.

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

1.4 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Preparation: Submit one copy of list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.

1.5 WARRANTIES

A. Submittal Time: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.

B. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

C. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

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

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
d. Remove tools, construction equipment, machinery, and surplus material from Project site.
e. Remove snow and ice to provide safe access to building.
f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.

g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
h. Sweep concrete floors broom clean in unoccupied spaces.
i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
k. Remove labels that are not permanent.
l. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
    1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
m. Wipe surfaces of electrical equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
n. Replace parts subject to unusual operating conditions.
o. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
p. Leave Project clean and ready for occupancy.

C. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION 230060

SECTION 230070 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for preparing operation and maintenance manuals.

1.2 SUBMITTALS

A. Manual: Submit one copy of each manual in final form at least 15 days before final inspection. Designer will return copy with comments within 15 days after final inspection. Correct or modify each manual to comply with Designer's comments. Submit 4 copies of each corrected manual within 15 days of receipt of Designer's comments.

PART 2 - PRODUCTS

2.1 MANUALS, GENERAL

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain a title page, table of contents, and manual contents.

B. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:
   1. Subject matter included in manual.
   2. Name and address of Project.
   3. Name and address of Owner.
   4. Date of submittal.
   5. Name, address, and telephone number of Contractor.
   6. Name and address of Architect.
   7. Name and address of Engineer.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

D. List of Material Suppliers and Subcontractors: List contact information for each material supplier and subcontractor.

E. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
   1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
   2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
   3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
   4. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
      a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
      b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.2 SYSTEMS AND EQUIPMENT OPERATIONS AND MAINTENANCE MANUAL

A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

B. Descriptions: Include the following:

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

C. Operating Procedures: Include start-up, break-in, and control procedures; stopping and normal shutdown instructions; routine, normal, seasonal, and weekend operating instructions; and required sequences for electric or electronic systems.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

E. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

F. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including maintenance instructions, drawings and diagrams for maintenance, nomenclature of parts and components, and recommended spare parts for each component part or piece of equipment:

G. Maintenance Procedures: Include test and inspection instructions, troubleshooting guide, disassembly instructions, and adjusting instructions that detail essential maintenance procedures:

H. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

I. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

J. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

K. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

L. Test and Balance Reports: See Division 23 Section “Testing Adjusting and Balancing for HVAC.”

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.

B. Manufacturers' Data: Provide complete approved submittal data with all annotations.

C. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.

D. Comply with Division 23 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 230070

SECTION 230080 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:
   1. Record Drawings.
   2. Record Specifications.

B. See Division 23 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.

C. See Division 23 Sections for specific requirements for Project Record Documents of the Work in those Sections.

1.2 SUBMITTALS

A. Record Drawings: Comply with the following:
   1. Number of Copies: Submit one set of marked-up Record Prints.

B. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings and Shop Drawings.
   1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.
      a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
      b. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
      c. Indicate dimensions to locate underground and concealed lines from fixed reference points.
      d. Indicate burial depth for underground lines.
   2. Mark the Contract Drawings completely and accurately.
   3. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
   4. Note Addendum numbers, Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Format: Identify and date each Record Drawing; include the designation "AS-BUILT MARKED PRINT" in a prominent location.
   1. Record Prints: Organize Record Prints and newly prepared Record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
   2. Identification: As follows:
      a. Project name.
      b. Date.
      c. Designation "AS-BUILT MARKED PRINTS."
      d. Name of Architect.
      e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
   1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
   2. Note related Change Orders and Record Drawings where applicable.

2.3 RECORD PRODUCT DATA

A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders, Record Specifications, and Record Drawings where applicable.

2.4 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.

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

END OF SECTION 230080

SECTION 230090 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

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

B. See Division 23 Sections for specific requirements for demonstration and training for products in those Sections.

1.2 SUBMITTALS

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

B. Documentation of Training: Submit with Operation and Maintenance Manuals. Include date and time of training, subjects/systems covered, and names of Owner’s personnel present.

1.3 QUALITY ASSURANCE

A. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 01 Section "Quality Requirements," experienced in operation and maintenance procedures and training.

B. Coordinate content of training modules with content of approved operation and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections, and as follows:
   1. HVAC Systems
   2. Specific equipment
   3. HVAC Controls

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following:
   1. Basis of System Design, Operational Requirements, and Criteria: Include system and equipment descriptions, operating standards, regulatory requirements, equipment function, operating characteristics, limiting conditions, and performance curves.
   2. Documentation: Review emergency, operations, and maintenance manuals; Project Record Documents; identification systems; warranties and bonds; and maintenance service agreements.
   3. Emergencies: Include instructions on stopping; shutdown instructions; operating instructions for conditions outside normal operating limits; instructions on meaning of warnings, trouble indications, and error messages; and required sequences for electric or electronic systems.
   4. Operations: Include startup, break-in, control, and safety procedures; stopping and normal shutdown instructions; routine, normal, seasonal, and weekend operating instructions; operating procedures for emergencies and equipment failure; and required sequences for electric or electronic systems.
   5. Adjustments: Include alignments and checking, noise, vibration, economy, and efficiency adjustments.
   6. Troubleshooting: Include diagnostic instructions and test and inspection procedures.
   7. Maintenance: Include inspection procedures, types of cleaning agents, methods of cleaning, procedures for preventive and routine maintenance, and instruction on use of special tools.
   8. Repairs: Include diagnosis, repair, and disassembly instructions; instructions for identifying parts; and review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 INSTRUCTION

A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
   1. Owner will describe Owner's operational philosophy.

B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
   1. Schedule training with Owner with at least seven days' advance notice.

C. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.

END OF SECTION 230090

SECTION 230100 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes through-penetration firestop systems for penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items.

1.2 PERFORMANCE REQUIREMENTS

A. General: For penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.

B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per ASTM E 814 or UL 1479:

1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
2. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:
   a. Penetrations located outside wall cavities.
   b. Penetrations located outside fire-resistance-rated shaft enclosures.

C. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.

1. For floor penetrations with annular spaces exceeding 4 inches in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved, either by installing floor plates or by other means.

D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

1.3 SUBMITTALS

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

B. Shop Drawings: For each through-penetration firestop system, submit documentation, including illustrations, from a qualified testing and inspecting agency, showing each type of construction condition penetrated, relationships to adjoining construction, and type of penetrating item.

1. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular through-penetration firestop condition, submit illustration, with modifications marked, approved by through-penetration firestop system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

C. Qualification Data: For Installer.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:

1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
2. Through-penetration firestop systems are identical to those tested per testing standard referenced in "Part 1 Performance Requirements" Article. Provide rated systems bearing classification marking of qualified testing and inspecting agency.

B. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.

C. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until each installation has been examined by Owner's inspecting agency and building inspector, if required by authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the through-penetration firestop systems indicated for each application on Drawings or that are produced by one of the following manufacturers:
   1. Grace, W. R. & Co. - Conn.
   2. Hilti, Inc.
   3. Johns Manville.
   4. Nelson Firestop Products.
   5. 3M; Fire Protection Products Division.
   6. Tremco; Sealant/Weatherproofing Division.
   7. USG Corporation.

2.2 FIRESTOPPING

A. Compatibility: Provide through-penetration firestop systems that are compatible with one another; with the substrates forming openings; and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.

B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by qualified testing and inspecting agency for firestop systems indicated.

PART 3 - EXECUTION

3.1 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

A. General: Install through-penetration firestop systems to comply with Part 1 "Performance Requirements" Article and with firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
   1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

C. Install fill materials for firestop systems by proven techniques to produce the following results:
   1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
   2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
   3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.2 FIELD QUALITY CONTROL

A. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.

B. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued and firestop installations comply with requirements.

END OF SECTION 230100

SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. General provisions.
2. Scope.
3. Permits and Fees.
4. Visit to Job Site.
5. Workmanship.
6. Drawings and Specifications.
7. Tests.
8. Allowance for added work.
9. Incidental construction work.
10. Access Doors.
11. Supervision.
12. Electrical work by others.
13. Existing facilities, utilities, etc.
14. Adaptation of work to existing conditions.
15. Renovations/alterations.
16. Submittal procedures.
17. Product requirements.
18. Closeout procedures.
19. Operation and Maintenance Manuals.
20. As-built Documents.
21. Demonstration and Training.
22. Warranty.

PART 2 - NOT APPLICABLE

PART 3 - EXECUTION

3.1 GENERAL PROVISIONS

A. This Contractor's attention is directed to the requirements of Instructions to Bidders, General Conditions and Supplementary General Conditions as bound in the specifications which apply in full to the HVAC work.

B. Where the requirements of this Division conflict with other articles in these Specifications, the Contractor shall utilize the more stringent method.

3.2 SCOPE

A. Provide all labor, materials, tools, equipment, and transportation, and perform all operations necessary for and reasonably incidental to proper execution and completion of all "HVAC" work, whether specifically mentioned or not, all as indicated, specified herein, and/or implied thereby to carry out the apparent intent thereof.

B. These drawings may be superseded by later revised or detailed drawings, specifications, or sketches prepared by the Designer, as needed for clarification, and this Contractor shall conform to all reasonable coordination requests.

C. All items not specifically mentioned in the specifications or noted on the drawings, but which obviously are required to make the working installation complete, shall be included automatically.

D. For projects which are bid or awarded as Single Prime contracts, organization of the Specifications into divisions, sections, and articles, and arrangement of the Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be done by any trade, unless specifically shown or noted otherwise.

3.3 PERMITS AND FEES

A. This Contractor shall secure all permits required for the completion of this contract. He shall obtain and deliver to the Owner all certificates of inspection issued by the authorities having jurisdiction.

3.4 VISIT TO JOB SITE

A. Before submitting a bid, this Contractor shall visit the job site for the purpose of thoroughly examining the site and conditions under which the work must be performed.

B. The submission of a bona fide bid will be construed to mean that this Contractor understands and is satisfied with conditions under which the contract must be fulfilled.
C. No extra compensation will be allowed for situations arising from failure of this Contractor to be thoroughly familiar with site conditions, including charges and requirements for connection to utilities as shown for this project.

3.5 WORKMANSHIP

A. Workmanship in the fabrication, preparation, and installation of materials and equipment shall conform to the best standards of practice of the trades involved.
B. Work shall be performed by experienced and skilled mechanics under the supervision of a competent foreman.
C. Substandard workmanship will be cause for rejection of work and replacement by Contractor.
D. The Contractor shall reimburse the Designer for all costs incurred by the Designer due to Contractor’s substandard or non-conforming work.

3.6 DRAWINGS AND SPECIFICATIONS

A. The drawings show the location and arrangement of fixtures, piping, and equipment, together with details of connections of certain principal items.
B. The layout shown shall be followed as closely as circumstances will permit, but this Contractor shall lay out his work so as to avoid conflict with other Contractors and trades, and to avoid any unnecessary cutting or damage to walls, floors, and supporting structural members.
C. This Contractor shall carefully and accurately locate all sleeves and install at the proper time all necessary hangers, inserts, etc., which will be required for the completion of his work, and shall be solely responsible for the accurate and proper location of above items.
D. This Contractor shall refer to architectural, mechanical, and electrical drawings and shall cooperate fully with other Contractors and trades while installing piping, fixtures, and other equipment because of close space limits.
    1. In case of conflict, notify Designer before proceeding with installation.
    2. Refer to architectural drawings for exact building dimensions and location of partition walls, doors, chases, etc.
    3. HVAC drawings are not to be scaled for such dimensions.
E. The drawings and specifications complement each other and together are intended to give a complete description of the work.
    1. Any item of equipment or note of work to be done as shown on plans and not mentioned in the specifications, or mentioned in specifications and not shown in plans, shall be furnished the same as if mentioned or shown in both places.
    2. If conflicts exist, then the most stringent method shown or described shall apply.
F. Any switches, controls, or equipment included in this contract work (drawings and/or specifications) that are not specifically shown on drawings shall be located for convenient use and access.
G. Contractor shall coordinate all equipment arrangement and lay-out in field prior to beginning any actual installation of his work.
H. If Contractor notes any discrepancy, omission, or conflict found in plans or specifications, he shall call to the immediate attention of the Designer, prior to receipt of bids.
I. It is the intention that piping, air ducts and light fixtures are designed and laid out to clear each other.
    1. It shall be the responsibility of this Contractor to coordinate his work with that of other trades to avoid any such conflicts.
    2. Any conflicts that occur after work of one trade is installed and was not prior coordinated shall be relocated or rearranged at the total expense of this Contractor, as directed by Designer.
    3. Any conflicts that cannot be corrected in field by relocation or elevation changes shall be reported to the Designer in writing prior to any installation.
J. The drawings are not intended to show each and every complete or accurate detail.
    1. The figures and writing on drawings shall be taken instead of scaling.
    2. It is this Contractor's responsibility to comply with the evident intent for centering and symmetric arrangement.
    3. This Contractor shall take and be responsible for all field measurements.

4. Exact locations and relations are to be defined in the field and shall be satisfactory to the Designer.

K. Because of the small scale of HVAC drawings it is not possible to indicate all offsets, fittings, and accessories which may be required.
1. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings and accessories that may be required to meet the conditions.

3.7 TESTS

A. The Designer reserves the right to conduct acceptance tests of all equipment, piping, or any other work furnished under these specifications to determine the fulfillment of special requirements.
1. Such tests shall be conducted in the presence of authorized representatives of the Contractor, Owner, Engineer, and Architect at such time as the Designer may designate.
2. This Contractor shall perform all tests, bear cost of same and make adjustments of equipment and wiring as may be deemed necessary by the Designer.

3.8 ALLOWANCE FOR ADDED WORK

A. Before proceeding with any work for which compensation may be claimed or the Owner may claim credit, a detailed estimate shall first be submitted and approved in writing.
1. No claim for addition to the contract sum will be valid unless so ordered and approved by the Owner and Designer, prior to start of work.
2. Any conflicts corrected by relocation or elevation changes do not constitute extra work.

3.9 INCIDENTAL CONSTRUCTION WORK

A. All blocking for openings for piping in concrete floors, masonry walls or partitions shall be provided by this Contractor.
1. This Contractor shall do all cutting and fitting of his work and of other work that may be required to make the several parts come together properly and to fit his work to receive or be received by the work of other Contractors as shown upon, or reasonably implied by the drawings and specifications.
2. He shall properly complete and finish up his work after other Contractors have finished as the Designer may direct.

B. All excavating required for the installation of this system shall be done by this Contractor.
1. Backfill shall be accomplished as specified in appropriate section of specifications.

C. Chases are prohibited in masonry walls which are not to be plastered or paneled.
1. Set piping, blocking, carriers, etc. indicated to be concealed before walls are constructed in order that walls may be constructed around them.
2. This Contractor shall furnish all sleeves in floors, beams, walls, etc., for each such penetration as needed for installing his work and installation of sleeves by General Contractor.

D. Unless otherwise noted, the General Contractor will provide openings and lintels as new construction progresses, but this Contractor shall fully designate his requirements prior to construction.
1. Failure to furnish his requirements prior to building construction and failure to coordinate his work with the building construction shall make this Contractor responsible for removing, replacing and painting building construction as required for installation of his work.

3.10 ACCESS DOORS

A. Provide and install access doors in walls, ceilings, etc. as required for access to valves, dampers, fire dampers, controls, and other devices requiring access in ceilings, chases, soffits, etc.

B. Access doors in non-fire rated walls or ceilings shall be as follows:
1. Nominal 24” x 24” minimum size.
2. 16-gage steel frame with 14-gage door panel and galvanized steel drywall bead.
3. Flush style with provision to conceal flange with drywall cement.
4. Double-acting concealed spring hinges to allow opening to 175 degrees.
5. Flush, Allen-head operated with steel cam.
6. Gray prime-painted steel, for painting to match adjacent finished surfaces.

7. Basis of Design: Milcor Style DW; Comparable Products by Karp, Elmdor, Acudor.

C. Access doors in fire-rated walls or ceilings shall be as follows:
1. Nominal 24” x 24” minimum size.
2. UL 1-1/2 hour, Class B fire rating.
3. Prime-painted stainless steel: 16-gage frame with 20-gage door panel, for painting to match adjacent finished surfaces.
4. 2” mineral fiber insulation between inner and outer panel.
5. Continuous hinge, steel with stainless steel pin.
6. Self-closing and self-latching panel closer.
7. Flush mounted paddle latch and locking system with flush, key-operated cylinder lock with two keys.
8. Basis of Design: Milcor Style UFR; Comparable Products by Karp, Elmdor, Acudor.

3.11 SUPERVISION

A. This Contractor shall have in charge of the work at all times during construction a thoroughly competent foreman with extensive experience in the work to be performed under this contract.
1. Anyone deemed not capable by the Designer shall be replaced immediately upon request, and after satisfactory foreman has been assigned, he shall not be withdrawn without the written consent of the Designer.

3.12 ELECTRICAL WORK BY OTHERS

A. Refer to the drawings for the details of locations of circuit breakers, junction boxes, disconnect switches, conduits and slack wire required where this contractor's electrical work terminates and electrical work by others begins.

B. The Electrical Contractor shall furnish and install all power circuits for equipment furnished by others.

C. In Mechanical Rooms the wiring by the Electrical Contractor shall generally terminate in a power wiring gutter, line side of disconnect switches or starters, junction box, or electrical panel.
1. From these points power wiring to the equipment furnished by the HVAC Contractor shall generally be by the HVAC Contractor.
2. Power wiring to mechanical equipment outside equipment rooms will generally be run by the Electrical Contractor to line side of a disconnect switch or junction box in the vicinity (within 3'-0") of the HVAC equipment.
3. Power wiring from that point to the equipment will be by the HVAC Contractor.

D. HVAC Contractor is to refer to the drawings for location and type of service connections to be provided under the electrical contract.
1. Where service disconnect switches are required and not furnished as part of the equipment, they shall be furnished and installed by contractor that furnishes the equipment, unless indicated otherwise.
2. Other Contractors shall furnish and install conduit, boxes, wiring and all items of control for equipment they furnish or Owner furnished equipment, unless specifically shown on electrical drawings.

3.13 EXISTING FACILITIES

A. In existing facilities, disruption of operations must be kept to a minimum and coordinated with Owner.
1. Work in existing buildings must be cleaned up daily immediately after finishing that portion of work and equipment left in order for Owner to continue operations.
2. When it is necessary to interrupt utility services in the fulfillment of this contract, such interruptions shall be kept to a minimum and coordinated with Owner.
3. Once work has begun, it shall be pursued diligently until completed.

B. Every precaution shall be taken to prevent damage to existing underground lines and structures and public utilities.
1. Damage to existing water and sewer lines, culverts, service connections, underground cables, and similar surface and sub-surface structures shall be at the risk of this Contractor, whether or not locations thereof are shown on plans, and the repairing of such damage shall be by this Contractor and shall be completed without delay.
2. Compensation for such repairs shall be based on normal and reasonable costs.

C. The locations of any existing underground utilities that are shown are in an approximate way only and have not been independently verified by the Owner or its representative.
   1. The Contractor shall determine the exact location of all existing utilities before commencing work, and agrees to be fully responsible for any and all damages which might be occasioned by the Contractor's failure to exactly locate and preserve any and all underground utilities.

3.14 ADAPTATION OF WORK TO EXISTING CONDITIONS

A. It is reasonably implied that this Contractor shall furnish all labor and materials to provide Owner with a new and satisfactory system in these facilities.
   1. Contractor is to include necessary work for adaptation of equipment to conditions that may be found to produce conflicts during construction.
   2. When any such conditions are encountered, this Contractor is to consult with Designer and then modify installation as directed without additional costs, and to include any incidental materials required.

3.15 RENOVATIONS/ALTERATIONS

A. Before any work is started in existing building, HVAC Contractor shall make a thorough survey with Designer and a representative of the Owner of building in which alterations occur and areas which are anticipated routes of access, and furnish a report, signed by all three to Designer. This report shall list by rooms and spaces:
   1. Existing conditions and types of resilient flooring, doors, windows, wall and other surfaces not required to be altered throughout and affected areas of building.
   2. Existence and conditions and operation of items such as HVAC fixtures, water heaters, valves, etc., required by drawings to be either reused for relocated, or both.
   3. Any discrepancies between drawings and existing conditions at site.
   4. Areas for working space, materials storage and routes of access to areas within buildings where alterations occur and which have been agreed upon by Contractor and Designer.

B. Any items required by drawings to be either reused or relocated or both, found during this survey to be nonexistent, or in opinion of Designer and Owner's representative, to be in such condition that their use is impossible or impractical, shall be removed and a proposal submitted by Contractor to replace with new items in accordance with specifications which will be furnished by Designer.

C. Re-Survey: Fifteen days before expected partial or final inspection date, Contractor, Designer, Owner's representative, together shall make a thorough re-survey of the areas of buildings involved.
   1. They shall furnish a report on conditions then existing, of HVAC fixtures, equipment, etc. as compared with conditions of same as noted in first condition survey report.
   2. Re-survey report shall also list any damage caused by this Contractor to such flooring and other surfaces, despite protection measures; and, will form basis for determining extent of repair work required of this Contractor to restore damage caused by Contractor's workmen in executing work of this Contract.

3.16 SUBMITTAL PROCEDURES

A. Coordinate preparation and processing of submittals with performance of construction activities.
   1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
   2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
   3. Designer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

B. Contractor approval: Affix review stamp to cover sheet, with initials and date of Contractor's approval of submittals.
   1. By submitting Shop Drawings, Product Data, Samples and similar submittals, this Contractor represents that the Contractor has determined and verified materials, field measurements and field construction criteria and details related thereto, or will do so, and has checked and coordinated the information contained within such submittals with the requirements of the Work, the Contract Documents and the Work of other trades.

C. Comply with requirements in Division 01 Sections for list of submittals and time requirements for scheduled performance of related construction activities.
D. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows.
   1. Time for review shall commence on Designer's receipt of submittal.
   2. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
   3. Allow 21 days for initial review of each submittal.
      a. Allow additional time if coordination with subsequent submittals is required.
      b. Designer will advise Contractor when a submittal being processed must be delayed for coordination.
   4. Allow 15 days for review of each resubmittal.
E. Identification: Identify submittals as required in Division 01 sections.
F. Deviations: Highlight, encircle, or otherwise specifically identify deviations from the Contract Documents on submittals.
   1. Summarize deviations on transmittal or List of Deviations included with submittal.
H. Transmittal: Package each submittal individually and appropriately for transmittal and handling.
   1. Transmit each submittal using a transmittal form.
   2. Designer will discard submittals received from sources other than Contractor.
I. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
   1. Note date and content of previous submittal.
   2. Note date and content of revision in label or title block and clearly indicate extent of revision.
   3. Resubmit submittals until they are marked "Furnish as Submitted" or “Furnish as Corrected."
   4. Where submittals contain specific questions or comments, provide a separate sheet with specific answers to each question or comment.
J. At Contractor's written request, copies of Designer's CAD files will be provided to Contractor for Contractor's use in connection with Project, subject to the following conditions:
   1. Allow 21 days from Designer’s receipt of written request for CAD files for delivery of files
   2. Files will be delivered via email or compact disc.
   3. Files will be delivered without RN&M Title Blocks, standard details, schedules, etc.
   4. CAD files provided for Contractor’s use are not to be construed as the Contract Documents. Use of CAD files for submittals or other uses are at the Contractor’s risk.
K. Prepare and submit Action Submittals required by individual Specification Sections.
   1. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
   2. Number of Copies: Submit at least eight copies of Product Data, unless otherwise indicated.
      a. Designer will return all but three copies.
      b. Retain or duplicate sufficient copies for inclusion in Operation and Maintenance Manuals.
   3. Shop Drawings: Prepare Project-specific information, drawn accurately to scale.
      a. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal of Designer's CAD Drawings is otherwise permitted.
   5. Sheet Size: At least 8-1/2 by 11 inches but no larger than size of project drawings.
   7. Number of Copies: Two opaque (bond) copies of each submittal. Designer will return one copy.
   8. Manufacturers and Materials Suppliers List: Submit three copies of manufacturers and materials suppliers list within 20 days of Contract Award, unless otherwise indicated. Designer will return two copies.
   10. Subcontract List: Submit within 20 days of Contract Award three copies of list of proposed subcontractors. Designer will return two copies. Subcontract list to include all tiers of subcontractors.

L. Contractor's Review and Approval: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents.
   1. Note corrections and field dimensions.
   2. Mark with approval stamp before submitting to Designer.

M. Designer's Action: Designer will not review submittals that do not bear Contractor's approval stamp and will return them without action.
   1. Designer will review each submittal, make marks to indicate corrections or modifications required, and return it.
   2. Designer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:
      a. Furnish as Submitted
      b. Furnish as Corrected: Incorporate comments marked on or attached to submittal.
      c. Revise and Resubmit: Major items of the submittal do not comply, requiring a resubmittal.

N. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.

O. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

P. The Contractor is responsible for compliance with the Contract Documents, dimensions, details, coordination, and satisfactory performance of materials and equipment provided and installed.

3.17 PRODUCT REQUIREMENTS

A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
   1. Basis-of-Design Product: Item identified by manufacturer's product name, make, and model number, used to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, dimensions, and other characteristics for purposes of evaluating comparable products of other named manufacturers.
   2. Comparable Product: Product that is listed in the Contract Documents, or added by Addendum, and demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified or basis-of-design product.
   3. Owner-preferred Alternate Product: Product that is listed in the Contract Documents, and for which an Alternate Bid price is submitted. When an Alternate Bid item is accepted in the Contract, no substitutions will be allowed.
   4. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor after award of Contract.
   5. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.

B. Comparable Product Requests: Submit three copies of each request for consideration, at least 10 days prior to receipt of bids, for products not listed in the Contract Documents. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
   1. Documentation: Show compliance with requirements for Comparable Products and the following, as applicable:
      a. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed product.
      b. Detailed comparison of significant qualities of proposed product with those of the Work specified. Significant qualities may include attributes such as performance,

weight, size, durability, visual effect, and specific features and requirements indicated.

c. Product Data, including drawings and descriptions of products and fabrication and installation procedures.

2. Designer's Action: If necessary, Designer will request additional information or documentation for evaluation. Designer will notify Contractor of approval or rejection of proposed comparable product request.
   a. Form of Approval: Addition of the item to the list of Comparable Products by Addendum, prior to receipt of bids.
   b. Use product specified if Designer cannot make a decision on use of a comparable product request within time allocated.

C. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.
   1. Provide products complete with accessories, trim, finish, fasteners, features, options, and other items needed for a complete installation and indicated use and effect, and as required or recommended by the manufacturer for a complete installation, whether or not specifically indicated on the drawings or specifications.
   2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
   3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
   4. Where products are accompanied by the term "as selected," Designer will make selection.
   5. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.

D. Product Selection Procedures:
   1. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
   2. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
   3. Basis-of-Design Product: Where Specifications name a product and include a list of manufacturers, provide the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named.

E. Responsibility of the Contractor: The responsibility for determining dimensions, utility requirements, fitting of work with other trades, sequencing and coordination of work, for Product Substitutions and Comparable Products rests solely with the Contractor.

F. Manufacturer's Warranties: Where specifications require manufacturer's warranties, the provisions of the Contract Documents take precedence over any manufacturer's "standard" warranty provisions, exclusions, etc.
   1. The start of manufacturer's warranties shall be the date of Substantial Completion of the project or phase of the project, notwithstanding any language or exclusion in any document submitted by the contractor or manufacturer.

3.18 CLOSEOUT PROCEDURES

A. Substantial Completion: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
   1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
   2. Complete startup testing of systems.
   3. Submit test records.
   4. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
   5. Complete final cleaning requirements, including touchup painting.
   6. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

7. Submit a written request for inspection for Substantial Completion. On receipt of request, Designer will either proceed with inspection or notify Contractor of unfulfilled requirements.
8. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
9. Results of completed inspection will form the basis of requirements for Final Completion.

B. Final Completion: Before requesting final inspection for determining date of Final Completion, complete the following:
1. Submit certified copy of Designer's Substantial Completion inspection list of items to be completed or corrected (punch list). The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
2. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit documentation of training.
3. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Designer will either proceed with inspection or notify Contractor of unfulfilled requirements.
4. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

C. Cleaning: This Contractor shall provide all systems and equipment in a new and clean condition.
1. Clean all items furnished and installed in accordance with manufacturer’s recommendations.
2. Provide instruction to Owner in proper cleaning of all items provided as part of this Division.
3. Cooperate with General Contractor in cleaning of building.

3.19 OPERATION AND MAINTENANCE MANUALS

A. Submit four complete copies of Operation and Maintenance Manuals to Designer for review prior to request for inspection for Substantial Completion.

B. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain a title page, table of contents, and manual contents.

C. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:
1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name, address, and telephone number of Contractor.
6. Name and address of Architect.
7. Name and address of Engineer.

D. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

E. List of Material Suppliers and Subcontractors: List contact information for each material supplier and subcontractor.

F. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
a. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of

equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.

3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
4. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
   a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
   b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

G. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

H. Descriptions: Include the following: Product name and model number, Manufacturer's name, Equipment identification with serial number of each component, Equipment function, Operating characteristics, Limiting conditions, Performance curves, Engineering data and tests, complete nomenclature and number of replacement parts.

I. Include start-up, break-in, and control procedures; stopping and normal shutdown instructions; routine, normal, seasonal, and weekend operating instructions; and required sequences for electric or electronic systems.

J. Describe the sequence of operation, and diagram controls as installed.

K. List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

L. Provide manufacturers' maintenance documentation including maintenance instructions, drawings and diagrams for maintenance, nomenclature of parts and components, and recommended spare parts for each component part or piece of equipment:

M. Include test and inspection instructions, troubleshooting guide, disassembly instructions, and adjusting instructions that detail essential maintenance procedures:

N. Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

O. Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

P. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

Q. Provide complete approved submittal data with all annotations.

R. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.

3.20 AS-BUILT DOCUMENTS

A. As-built Marked Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings.

1. Mark Record Prints to show the actual installation where installation varies from that shown originally.
2. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up As-built Marked Prints.
3. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
4. Record data as soon as possible after installation.
5. Record and check the markup before enclosing concealed installations.

6. Indicate dimensions to locate underground and concealed conduits and lines from fixed reference points.
7. Indicate burial depth for underground lines.
8. Indicate location of all valves and cross-reference to valve tag list.
9. Mark the Contract Drawings completely and accurately.
    a. Mark record sets with erasable, red-colored pencil.
    b. Note Addendum numbers, Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
10. Maintain As-built Marked Prints in a clean, legible, up-to-date condition in the project office, and available to the Designer for inspection upon request throughout construction.

B. Record Specifications: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Note related Change Orders and As-built Marked Prints where applicable.

3.21 DEMONSTRATION AND TRAINING

A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season. Schedule training with Owner with at least seven days' advance notice.

C. Warranty service: Train Owner in repair and troubleshooting during each warranty service call.

D. For each training session, submit on letterhead name of trainer, date of training, names of Owner’s personnel trained, and systems/equipment trained on.

E. For factory training, documentation to be on letterhead of organization conducting training.

3.22 WARRANTY

A. This Contractor shall guarantee all materials, equipment, workmanship and each and every piece of apparatus which he furnished and which he installs under this contract against defects and failures of any nature for a period of one year from date on which the system is accepted.

B. Apparatus furnished by this Contractor shall be guaranteed to be satisfactory when operated under rated conditions in accordance with manufacturer's instructions and to be of size, function, and capacity specified on drawings or in the specifications.

C. Equipment manufacturers shall warrant equipment furnished for this project for same time span as installing contractors warranty period as set above and elsewhere in these specifications.
1. Warranty start date shall be as established by the Designer. Refer to General Conditions, Supplementary General Conditions, and Division 1 specifications for establishment of warranty start dates.
2. The provisions of the Contract Documents supersede and override any manufacturer’s standard warranty provisions.

D. Upon notice from the Designer or Owner, Contractor shall immediately check system, make necessary repairs or adjustments as required; due to faulty workmanship, materials, faults, operation or equipment, without cost to the Owner, and instruct Owner in proper operation, adjustment, and care of systems.

E. During the one-year warranty period, the Contractor shall be responsible for all preventive maintenance, including routine lubrication, filter changing, inspections, and adjustments.
1. Contractor shall provide all materials, consumables, equipment, supplies, filters, etc. required for preventive maintenance.
2. Perform preventive maintenance in accordance with manufacturer’s recommendations.
3. During preventive maintenance, instruct Owner in proper preventive maintenance procedures.

F. The Contractor shall submit service call tickets, reports, or other documentation of each warranty service call to the Designer.

END OF SECTION 230500

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.2 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
   1. Motor controllers.
   2. Torque, speed, and horsepower requirements of the load.
   3. Ratings and characteristics of supply circuit and required control sequence.
   4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.

B. Comply with NEMA MG 1 unless otherwise indicated.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Energy efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque.
   1. For motors with 2:1 speed ratio, consequent pole, single winding.
   2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Rotor: Random-wound, squirrel cage.

F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

G. Temperature Rise: Match insulation rating.

H. Insulation: Class F.

I. Code Letter Designation:
   1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
   2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
   1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
   2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
   3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.

4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
   1. Permanent-split capacitor.
   2. Split phase.
   3. Capacitor start, inductor run.
   4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230513

SECTION 230516 - EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Metal-bellows expansion joints.
   2. Expansion compensators.
   3. Packed slip expansion joints.
   4. Pipe bends and loops.
   5. Alignment guides and anchors.

1.2 SUBMITTALS

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

B. Delegated-Design Submittal: For each anchor and alignment guide indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and bends.
   2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
   3. Alignment Guide Details: Detail field assembly and attachment to building structure.
   4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

C. Welding certificates.

D. Product certificates.

E. Maintenance data.

1.3 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. Steel Shapes and Plates: AWS D1.1, "Structural Welding Code - Steel."
   2. Welding to Piping: ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 EXPANSION JOINTS

A. Metal-Bellows Expansion Joints: ASTM F 1120, circular-corrugated-bellows type with external tie rods.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
      a. Adsco Manufacturing, LLC.
      b. Anamet, Inc.
      c. Badger Industries.
      d. Expansion Joint Systems, Inc.
      e. Flex-Hose Co., Inc.
      f. Flexicraft Industries.
      g. Flex-Pression, Ltd.
      h. Flex-Weld, Inc.
      i. Hyspan Precision Products, Inc.
      j. Metraflex, Inc.
      k. Piping Technology & Products, Inc.
      l. Proco Products, Inc.
      m. Senior Flexonics, Inc.; Pathway Division.
      n. Tozen America Corp.
      o. Unaflex Inc.
      p. WahlcoMetroflex.
   2. Metal-Bellows Expansion Joints for Copper Piping: Single- or multiple-ply phosphor-bronze bellows, copper pipe end connections, and brass shrouds.
   3. Metal-Bellows Expansion Joints for Stainless-Steel Waterway: Single-ply stainless-steel bellows, stainless-steel-pipe end connections, and steel shroud.
   4. Metal-Bellows Expansion Joints for Steel Piping: Single- or multiple-ply stainless-steel bellows, steel pipe end connections, and carbon-steel shroud.

5. Minimum Pressure Rating: 175 psig, unless otherwise indicated.
6. Configuration: Single- or double-bellows type, unless otherwise indicated.
7. End Connections: Flanged or weld.

B. Expansion Compensators: Double-ply corrugated steel, stainless-steel, or copper-alloy bellows in a housing with internal guides, antitorque device, and removable end clip for positioning.
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   a. Adsco Manufacturing, LLC.
   b. Flexicraft Industries.
   c. Flex-Pression, Ltd.
   d. Flex-Weld, Inc.
   e. Hyspan Precision Products, Inc.
   f. Metraflex, Inc.
   g. Senior Flexonics, Inc.; Pathway Division.
   h. Unaflex Inc.
2. Minimum Pressure Rating: 175 psig, unless otherwise indicated.
3. Configuration for Copper Piping: Two-ply phosphor-bronze or stainless-steel bellows and bronze or stainless-steel shroud.
4. Configuration for Steel Piping: Two-ply stainless-steel bellows and carbon-steel shroud.
5. End Connections for Copper Tubing NPS 2 and Smaller: Solder joint or threaded.
6. End Connections for Copper Tubing NPS 2-1/2 to NPS 4: Solder joint or threaded.
7. End Connections for Steel Pipe NPS 2 and Smaller: Threaded.
8. End Connections for Steel Pipe NPS 2-1/2 to NPS 4: Flanged.

C. Packed Slip Expansion Joints: ASTM F 1007, carbon-steel, packing type designed for repacking under pressure and pressure rated for 250 psig at 400 deg F minimum. Include asbestos-free PTFE packing, compound limit stops, and drip connection if used for steam piping.
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   a. Adsco Manufacturing, LLC.
   b. Advanced Thermal Systems, Inc.
   c. Hyspan Precision Products, Inc.
2. Configuration: Single- and double-joint class.
3. End Connections: Flanged or weld ends to match piping system.

2.2 ALIGNMENT GUIDES

A. Description: Steel, factory fabricated, with bolted two-section outer cylinder and base for alignment of piping and two-section guiding spider for bolting to pipe.
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   a. Adsco Manufacturing, LLC.
   b. Advanced Thermal Systems, Inc.
   c. Flex-Hose Co., Inc.
   d. Flexicraft Industries.
   e. Flex-Weld, Inc.
   f. Hyspan Precision Products, Inc.
   g. Metraflex, Inc.
   h. Piping Technology & Products, Inc.
   i. Senior Flexonics, Inc.; Pathway Division.

2.3 MATERIALS FOR ANCHORS

A. Steel Shapes and Plates: ASTM A 36/A 36M.
B. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex head.
C. Washers: ASTM F 844, steel, plain, flat washers.

D. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, and tension and shear capacities appropriate for application.
   1. Stud: Threaded, zinc-coated carbon steel.
   2. Expansion Plug: Zinc-coated steel.
   3. Washer and Nut: Zinc-coated steel.

E. Concrete: Portland cement mix, 3000 psi minimum. Comply with requirements in Division 03 Section "Cast-in-Place Concrete" for formwork, reinforcement, and concrete.

F. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink, nonmetallic grout; suitable for interior and exterior applications.
   1. Properties: Nonstaining, noncorrosive, and nongaseous.
   2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 EXPANSION-JOINT INSTALLATION

A. Install manufactured, nonmetallic expansion joints according to FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."

B. Install expansion joints of sizes matching size of piping in which they are installed.

C. Install alignment guides to allow expansion and to avoid end-loading and torsional stress.

3.2 PIPE BEND AND LOOP INSTALLATION

A. Install pipe bends and loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.

B. Attach pipe bends and loops to anchors.
   1. Steel Anchors: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
   2. Concrete Anchors: Attach by fasteners. Follow fastener manufacturer's written instructions.

3.3 SWING CONNECTIONS

A. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.

B. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.

C. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

3.4 ALIGNMENT-GUIDE INSTALLATION

A. Install guides on piping adjoining pipe expansion fittings and loops.

B. Attach guides to pipe and secure to building structure.

3.5 ANCHOR INSTALLATION

A. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

B. Fabricate and install steel anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and AWS D1.1.

C. Construct concrete anchors of poured-in-place concrete of dimensions indicated and include embedded fasteners.

D. Install pipe anchors according to expansion-joint manufacturer's written instructions if expansion joints or compensators are indicated.

E. Use grout to form flat bearing surfaces for expansion fittings, guides, and anchors installed on or in concrete.

END OF SECTION 230516

SECTION 230519 - METERS AND GAGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Thermometers.
   2. Gages.
   3. Flowmeters.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.
B. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 SOLAR DIGITAL THERMOMETER

A. Manufacturers: Subject to compliance with requirements, provide product by one of the following: Sika, Miljoco, Weiss, Weksler
B. Case: High impact ABS plastic.
C. Stem: Copper-plated steel, aluminum, or brass for thermowell installation and of length to suit installation.
D. Range: -50ºF to 300 ºF minimum, field switchable between Fahrenheit and Celsius.
E. Accuracy: Greater value of 1º or 1%.
F. Resolution: 0.1º.
G. Recalibration: Internal potentiometer.
H. Power: Bi-directional solar photovoltaic elements.
I. Environmental Conditions
   1. Ambient Temperature: -30ºF to 140 ºF.
   2. Maximum Relative Humidity: 100%.

2.2 BIMETALLIC-ACTUATED DIAL THERMOMETERS

A. Manufacturers: Subject to compliance with requirements, provide product by one of the following: Ernst Gage Co., Marsh Bellofram, Miljoco Corp., NANMAC Corporation, Noshok, Inc., Palmer - Wahl Instruments Inc., REO TEMP Instrument Corporation, Tel-Tru Manufacturing Company, Trerice, H. O. Co., Weiss Instruments, Inc., Weksler Instruments, WIKA Instrument Corporation, Winters Instruments.
B. Description: Direct-mounting, bimetallic-actuated dial thermometers complying with ASME B40.3.
C. Case: Liquid-filled type, stainless steel with 5-inch diameter.
D. Element: Bimetal coil.
E. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
F. Pointer: Red or other dark-color metal.
G. Window: Glass or plastic.
H. Ring: Stainless steel.
I. Connector: Adjustable angle type.
J. Stem: Metal, for thermowell installation and of length to suit installation.
K. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.3 THERMOWELLS

A. Manufacturers: Same as manufacturer of thermometer being used.
B. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer.

2.4 PRESSURE GAGES

A. Manufacturers: Subject to compliance with requirements, provide product by one of the following: AMETEK, Inc., Ernst Gage Co., Eugene Ernst Products Co., KOBOLD Instruments, Inc., Marsh Bellofram, Miljoco Corp., Noshok, Inc., Palmer - Wahl Instruments Inc., REO TEMP Instrument Corporation, Trerice, H. O. Co., Weiss Instruments, Inc., Weksler Instruments Operating Unit, WIKA Instrument Corporation, Winters Instruments.
B. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.
   1. Case: Liquid-filled type, drawn steel or cast aluminum, 6-inch diameter.

2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
6. Pointer: Red or other dark-color metal.
7. Window: Glass or plastic.
8. Ring: Metal or plastic.
9. Accuracy: Grade C, plus or minus 3 percent of middle half scale.
10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
11. Range for Fluids under Pressure: Two times operating pressure.

C. Pressure-Gage Fittings:
1. Valves: NPS 1/4 brass or stainless-steel needle type.
2. Syphons: NPS 1/4 coil of brass tubing with threaded ends.
3. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

PART 3 - EXECUTION

3.1 THERMOMETER APPLICATIONS

A. Install solar powered digital thermometers in piping as shown on Drawings.
B. Install bimetallic-actuated dial thermometers in the following locations on ductwork as shown on Drawings.

3.2 GAGE APPLICATIONS

A. Install pressure gages as shown on Drawings.

3.3 INSTALLATIONS

A. Install direct-mounting thermometers and adjust vertical and tilted positions.
B. Install thermowells with socket extending to center of pipe and in vertical position in piping tees where thermometers are indicated.
C. Duct Thermometer Support Flanges: Install in wall of duct where duct thermometers are indicated. Attach to duct with screws.
D. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.
E. Install needle-valve and snubber fitting in piping for each pressure gage for fluids (except steam).
F. Install needle-valve and syphon fitting in piping for each pressure gage for steam.

3.4 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance for meters, gages, machines, and equipment.

3.5 ADJUSTING

A. Calibrate thermometers according to manufacturer's written instructions, after installation.
B. Adjust faces of meters and gages to proper angle for best visibility.

END OF SECTION 230519

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Steel pipe hangers and supports.
   2. Trapeze pipe hangers.
   3. Metal framing systems.
   4. Thermal-hanger shield inserts.
   5. Fastener systems.
   6. Equipment supports.

1.2 DEFINITIONS

A. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.4 SUBMITTALS

A. Product Data: For the following:
   1. Steel pipe hangers and supports.
   2. Thermal-hanger shield inserts.
   3. Powder-actuated fastener systems.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
   1. Trapeze pipe hangers. Include Product Data for components.
   2. Metal framing systems. Include Product Data for components.
   3. Equipment supports.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Available Manufacturers: B-Line, Fee and Mason, Grinnell, Kindorf, Michigan Hanger, Unistrut, or approved equal.

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.

C. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Available Manufacturers: Carpenter & Paterson, Inc., ERICO/Michigan Hanger Co., PHS Industries, Inc., Pipe Shields, Inc., Rilco Manufacturing Company, Inc., Value Engineered Products, Inc.

C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.

D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.

E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used. Available Manufacturers: Hilti, Inc., ITW Ramset/Red Head, Masterset Fastening Systems, Inc., MKT Fastening, LLC., Powers Fasteners.

B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.Available Manufacturers: B-Line Systems, Inc., Empire Industries, Inc., Hilti, Inc., ITW Ramset/Red Head, MKT Fastening, LLC., Powers Fasteners.

2.7 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.8 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use padded hangers for piping that is subject to scratching.

F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
5. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.

6. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
7. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
8. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.

G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.

H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.

I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
   a. Light (MSS Type 31): 750 lb.
   b. Medium (MSS Type 32): 1500 lb.
   c. Heavy (MSS Type 33): 3000 lb.
8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.

L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
N. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.2 HANGER AND SUPPORT INSTALLATION

A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
    1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
    2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
E. Fastener System Installation:
    1. Install powder-actuated fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
    2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
I. Install lateral bracing with pipe hangers and supports to prevent swaying.
J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
K. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.
M. Insulated Piping: Comply with the following:
    1. Attach clamps and spacers to piping.
        a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
        b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
        c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.
    2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
    4. Shield Dimensions for Pipe: Not less than the following:

a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
b. NPS 4: 12 inches long and 0.06 inch thick.
c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood inserts.
6. Insert Material: Length at least as long as protective shield.
7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.6 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 230529

SECTION 230548 - VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes performance requirements for delegated design of vibration and seismic controls.

1.2 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading: Refer to Structural Drawings for Seismic Design Category, Building Use Group, and Seismic design parameters.

1.3 SUBMITTALS

A. Product Data: For all products provided.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint calculations and details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Welding certificates.

D. Qualification Data: For professional engineer.

E. Field quality-control test reports.

1.4 QUALITY ASSURANCE

A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproved by ICC-ES, or preapproved by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

A. Products shall be selected by engineer providing delegated design services.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Delegated Design Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.2 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment Restraints:

1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inches.
2. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

B. Piping Restraints:

1. Comply with requirements in MSS SP-127.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

F. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

G. Drilled-in Anchors:
1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

3.3 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Division 22 Section "Domestic Water Piping" for piping flexible connections.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.
B. Tests and Inspections:
1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
C. Remove and replace malfunctioning units and retest as specified above.
D. Prepare test and inspection reports, certified by Professional Engineer who provided Delegated Design.

3.5 ADJUSTING

A. Adjust isolators after piping system is at operating weight.
B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
C. Adjust active height of spring isolators.
D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 230548

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Duct labels.
5. Ceiling identification labels.

1.2 SUBMITTAL

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

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch, Stainless steel, 0.025-inch, Aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Red.

C. Background Color: White.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
G. Fasteners: Stainless-steel rivets or self-tapping screws.
H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS
A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

2.4 DUCT LABELS
A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
B. Letter Color: White.
C. Background Color: Black.
D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
G. Fasteners: Stainless-steel rivets or self-tapping screws.
H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

2.5 STENCILLED PAINTED LABELS
A. Material: Spray paint suitable for application on piping, ducts, and equipment, both insulated and uninsulated.
B. Letter color: Black or other color contrasting with background surface.
C. Minimum Label Size: Length and width vary for required label content.
D. Minimum Letter Size: At least 1-1/2 inches high.
E. Contents: As described in this section for piping, ducts, and equipment.

2.6 CEILING IDENTIFICATION LABELS
A. Permanent, self-adhesive ¾” diameter colored labels

PART 3 - EXECUTION

3.1 PREPARATION
A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION
A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "Interior Painting."

B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
   1. Near each valve and control device.
   2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
   3. Near penetrations 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.

3.4 DUCT LABEL INSTALLATION

A. Install [**plastic-laminated**] [**self-adhesive**] duct labels with permanent adhesive or stenciled painted labels on air ducts in the following color codes:
   1. Blue: For cold-air supply ducts.
   2. Yellow: For hot-air supply ducts.
   3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
   4. ASME A13.1 Colors and Designs: For hazardous material exhaust.

B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.5 CEILING IDENTIFICATION LABELS

A. Install ceiling identification labels on ceiling grid below valves, dampers, and other items that require adjustment.

B. Install prior to installation of ceiling tile.

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes TAB to produce design objectives for the following:
   1. Air Systems:
      a. Constant-volume air systems.
      b. Variable-air-volume (VAV) systems.
      c. Multizone systems.
   2. Hydronic Piping Systems:
      a. Constant-flow systems.
      b. Variable flow systems.
   3. HVAC and other equipment quantitative-performance settings, including chillers, boilers, cooling towers, water heaters, air handling units, DX units, heat pumps, pumps, etc.
   4. Kitchen hood airflow balancing.
   5. Existing systems TAB.
   6. Verifying that automatic control devices are functioning properly.
   7. Reporting results of activities and procedures specified in this Section.

1.2 SUBMITTALS

A. Strategies and Procedures Plan: Within 30 days from Contractor's Notice to Proceed, submit 4 copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.

B. Daily Field Data reports: During testing and balancing operations, submit actual field data reports to Engineer daily via fax or email. Daily reports should include actual readings taken and any problems encountered during that day.

C. Certified TAB Reports: Submit four copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.

D. Warranties specified in this Section.

1.3 QUALITY ASSURANCE

A. TAB Firm Qualifications: Engage a TAB firm certified by AABC or NEBB.

B. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
   1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
   2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.

C. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems " or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."

1.4 PROJECT CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

C. TAB will be conducted as a separate contract under the Owner. Refer to Project HVAC Specifications and Drawings for requirements of General Contractor/HVAC Contractor to support TAB operations.

1.5 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

C. [**Convene and conduct a TAB coordination meeting, no more than two weeks prior to starting TAB activities on site. Attendees shall include Owner's representative,**

Engineer, General Contractor, HVAC subcontractor, controls installer, and any others necessary to support TAB activities. Agenda shall include: schedule for TAB activities, support and coordination required, status of deficiencies noted in TAB inspections specified in this Section, and any other items necessary to complete testing and balancing in accordance with this section.]

1.6 WARRANTY

A. National Project Performance Guarantee: Provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:
   1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
   2. Systems are balanced to optimum performance capabilities within design and installation limits.

B. Special Guarantee: Provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:
   1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
   2. Systems are balanced to optimum performance capabilities within design and installation limits.

C. Adjustments: For one year after Owner occupancy, provide the services of a qualified TAB technician upon request of the Designer to take readings and make adjustments as necessary and directed by Designer for comfort conditions.

PART 2 - PRODUCTS/VENDORS

2.1 ACCEPTABLE TAB CONTRACTORS

A. The following TAB agents are acceptable to Owner and Designer for providing TAB services:
   1. Palmetto Air and Water Balance, Inc. (Asheville, Charlotte, Raleigh NC and Greenville, SC)
   2. Watts Services (Morganton, NC)
   3. Hall Technology, Inc. (Leesville, SC)
   4. Test and Balance Corporation (Winston-Salem, NC)
   5. The Phoenix Agency (Winston-Salem, NC)

B. The Designer will consider other TAB agents as acceptable under the following conditions:
   1. Request to consider another TAB agent is received from a Prime Bidder or HVAC Contractor intending to bid the project.
   2. Request to consider another TAB agent is submitted at least 10 days prior to receipt of bids.
   3. Proposed TAB agent is certified per this specification.
   4. Approval for a proposed TAB agent to bid the project will be communicated via Addendum prior to receipt of bids.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
   1. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

B. Examine approved submittal data of HVAC systems and equipment.

C. Examine Project Record Documents described in Division 01 Section "Project Record Documents."

D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine equipment performance data including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.
F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.
G. Examine system and equipment test reports.
H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
J. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
K. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.
L. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.
M. Examine strainers for clean screens and proper perforations.
N. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
O. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
P. Examine system pumps to ensure absence of entrained air in the suction piping.
Q. Examine equipment for installation and for properly operating safety interlocks and controls.
R. Examine automatic temperature system components to verify the following:
    1. Dampers, valves, and other controlled devices are operated by the intended controller.
    2. Dampers and valves are in the position indicated by the controller.
    3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
    4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
    5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
    6. Sensors are located to sense only the intended conditions.
    7. Sequence of operation for control modes is according to the Contract Documents.
    8. Controller set points are set at indicated values.
    9. Interlocked systems are operating.
    10. Changeover from heating to cooling mode occurs according to indicated values.
S. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.
B. Complete system readiness checks and prepare system readiness reports. Verify the following:
    1. Permanent electrical power wiring is complete.
    2. Hydronic systems are filled, clean, water treatment conducted, and free of air.
    3. Automatic temperature-control systems are operational.
    4. Equipment and duct access doors are securely closed.

5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.
9. Systems and equipment are labeled per Project Specifications.

3.3 INSPECTIONS DURING CONSTRUCTION/INSTALLATION

A. SIXTY PERCENT DUCTWORK INSPECTION
1. Notify Designer of inspection schedule at least one week prior to inspection.
2. Inspect installation of HVAC systems when sixty percent of ductwork is installed.
3. Verify general installation of HVAC system, including piping, ducts, valves, dampers, control devices, etc.
4. Verify access to control and balancing devices, including installation of access doors, panels, etc.
5. Report deficiencies in writing within one week of inspection to HVAC contractor, general contractor, and Designer.

B. NINETY PERCENT SYSTEM INSPECTION
1. Notify Designer of inspection schedule at least one week prior to inspection.
2. Inspect installation of HVAC systems when ninety percent of HVAC system is installed.
3. Verify general installation of HVAC system, including piping, ducts, valves, dampers, control devices, etc.
4. Verify access to control and balancing devices, including installation of access doors, panels, etc.
5. Report deficiencies in writing within one week of inspection to HVAC contractor, general contractor, and Designer.

3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.

C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

D. During TAB operations, submit field data to Engineer daily via fax or email. List systems/equipment tested, problems encountered, and deficiencies noted.

E. Witness start-up and tests for all major HVAC equipment. Include copies of test reports, including manufacturer's start-up check lists included in manufacturer's installation instructions, in the Test-and-Balance report.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.

E. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections, trap depth, and functioning.
K. Check for proper sealing of air-handling unit components.
L. Check for proper sealing of air duct system.

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
   1. Measure fan static pressures to determine actual static pressure as follows:
      a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
      b. Measure static pressure directly at the fan outlet or through the flexible connection.
      c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
      d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
   2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
      a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
   3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.
   4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
   5. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
   6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.
B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
   1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
      a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
   2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
C. Measure terminal outlets and inlets without making adjustments.
   1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.
   1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
   2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.7 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a maximum set-point airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.

B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
   1. Set outside-air dampers at minimum, and return- and exhaust-air dampers at a position that simulates full-cooling load.
   2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
   3. Measure total system airflow. Adjust to within indicated airflow.
   4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
   5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow as described for constant-volume air systems.
      a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
   6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.
   7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
   8. Record the final fan performance data.

C. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
   1. Balance systems similar to constant-volume air systems.
   2. Set terminal units and supply fan at full-airflow condition.
   3. Adjust inlet dampers of each terminal unit to indicated airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
   4. Readjust fan airflow for final maximum readings.
   5. Measure operating static pressure at the sensor that controls the supply fan, if one is installed, and verify operation of the static-pressure controller.
   6. Set supply fan at minimum airflow if minimum airflow is indicated. Measure static pressure to verify that it is being maintained by the controller.
   7. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow as described for constant-volume air systems.
      a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.
   8. Measure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.

D. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
   1. Set system at maximum indicated airflow by setting the required number of terminal units at minimum airflow. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.
   2. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.
   3. Set terminal units at full-airflow condition.
   4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to

indicated airflow. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.

5. Adjust terminal units for minimum airflow.
6. Measure static pressure at the sensor.
7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.

3.8 PROCEDURES FOR MULTIZONE SYSTEMS

A. Set unit at full flow through the cooling coil if coil has that capacity.
B. Adjust each zone damper to indicated airflow.

3.9 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
B. Prepare schematic diagrams of systems' "as-built" piping layouts.
C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
   1. Open all manual valves for maximum flow.
   2. Check expansion tank liquid level.
   3. Check makeup-water-station pressure gage for adequate pressure for highest vent.
   4. Check flow-control valves for specified sequence of operation and set at indicated flow.
   5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
   6. Set system controls so automatic valves are wide open to heat exchangers.
   7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
   8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.10 PROCEDURES FOR HYDRONIC SYSTEMS

A. Measure water flow at pumps. Use the following procedures, except for positive-displacement pumps:
   1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
   2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
   3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
   4. Report flow rates that are not within plus or minus 5 percent of design.
B. Set calibrated balancing valves, if installed, at calculated presettings.
C. Measure flow at all stations and adjust, where necessary, to obtain first balance.
   1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
D. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
E. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
   1. Determine the balancing station with the highest percentage over indicated flow.
   2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
   3. Record settings and mark balancing devices.

F. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
G. Measure the differential-pressure control valve settings existing at the conclusions of balancing.

3.11 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.12 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
1. Manufacturer, model, and serial numbers.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.
B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.13 PROCEDURES FOR CHILLERS

A. Balance water flow through each evaporator and condenser to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:
1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
2. If water-cooled chillers, condenser-water entering and leaving temperatures, pressure drop, and water flow.
3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
4. Power factor if factory-installed instrumentation is furnished for measuring kilowatt.
5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatt.
6. Capacity: Calculate in tons of cooling.
7. If air-cooled chillers, verify condenser-fan rotation and record fan and motor data including number of fans and entering- and leaving-air temperatures.

3.14 PROCEDURES FOR COOLING TOWERS

A. Shut off makeup water for the duration of the test, and verify that makeup and blowdown systems are fully operational after tests and before leaving the equipment. Perform the following tests and record the results:
1. Measure condenser-water flow to each cell of the cooling tower.
2. Measure entering- and leaving-water temperatures.
3. Measure wet- and dry-bulb temperatures of entering air.
4. Measure wet- and dry-bulb temperatures of leaving air.
5. Measure condenser-water flow rate recirculating through the cooling tower.
6. Measure cooling tower pump discharge pressure.
7. Adjust water level and feed rate of makeup-water system.

3.15 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.
B. Measure entering- and leaving-air temperatures.
C. Record compressor data.

3.16 PROCEDURES FOR BOILERS, WATER HEATERS, AND OTHER FUEL FIRED EQUIPMENT

A. If hydronic, measure entering- and leaving-water temperatures and water flow.
B. If steam, measure entering-water temperature and flow and leaving steam pressure, temperature, and flow.
C. Record the following data:

1. Equipment drawing designation;
2. Equipment manufacturer, model number, and serial number;
3. Rated input and output;
4. Type of fuel and heat value (calorific value);
5. Other data from the nameplate of the equipment.

D. Record the following measurements:
1. Percent carbon dioxide
2. Stack temperature (flue gas temperature at equipment outlet)
3. Ambient temperature
4. Over-fire draft (inches WG)
5. Gas burner manifold pressure
6. Fuel meter reading (see below)
7. Boiler jacket temperature

E. Fuel meter readings shall be determined as follows:
1. Natural Gas: The objective of this test is to determine gross MBH input.
a. Time the gas meter under each firing rate to determine the CFH (cubic feet per hour) delivered. CFH shall be calculated by the equation: CFH equals U value of timing dial for one rotation times 36,000 divided by time in seconds for one rotation of timing dial.
b. Measure or determine the gas pressure at the gas meter and apply the proper correction factor to the delivered CFH that was measured to determine the equivalent CFH at the rated gas pressure. This shall be determined by the following equations:

F = (UPa + PgO)/(Pa + Pr)

Where F = Correction Factor; Pa = Atmospheric pressure (psi); Pg = Gas pressure at meter (psi); Pr = Rated gas pressure And Rated CFH = Measured CFH x Correction Factor

2. Oil Fired: The oil pressure at the pump shall be measured and recorded. Oil flow rate shall be determined from manufacturer's data and nozzles installed.
3. LP Gas Fired: The burner manifold pressure shall be measured and pressure read at tank, before and after each regulator under system full load conditioning for all gas fired equipment simultaneously. Gas flow rate shall be determined using manufacturers data as applicable.

F. If burners have other than one firing rate, combustion tests shall be made in the following manner:
1. If step-firing (High-Low), readings shall be taken at each step.
2. If modulating, reading shall be taken at high, at low, and at 50 percent firing rate.

G. The following calculations shall be made from the measured data and recorded on the report:
1. Gross Input
2. Net Stack Temperature
3. Percent Excess Air
4. Percent Flue Gas Loss
5. Combustion Efficiency
6. Gross Output (MBH) = Gross Input - Flue Gas Loss

H. Flue gas loss shall be calculated from measured data using industry accepted methods.

3.17 PROCEDURES FOR HEAT-TRANSFER COILS

A. Water Coils: Measure the following data for each coil:
1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.

7. Air pressure drop.
8. For coils with 3-way control valves, adjust bypass ball valve so that flow in bypass mode is the same as flow through the coil.

B. Electric-Heating Coils: Measure the following data for each coil:
1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load and at each incremental stage.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

C. Refrigerant Coils: Measure the following data for each coil:
1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.
5. Refrigerant suction pressure and temperature.

3.18 PROCEDURES FOR TEMPERATURE MEASUREMENTS

A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.

B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.

C. Measure outside-air, wet- and dry-bulb temperatures.

3.19 PROCEDURES FOR SOUND LEVEL TESTING

A. Conduct AABC standard sound tests for all air handlers and fans, and include test results in the Test-and-Balance report. If sound levels are above these listed, adjustments shall be made to bring the sound level within the range set forth.

B. If this cannot be done with the equipment as installed, recommendation shall be made by the Engineer to correct the sound level to within specified range. Additions of sound traps, insulation, isolation mounts, or dampers shall be made by the Mechanical Contractor under the direction of the Engineer at no extra cost.

C. Acceptable maximum sound levels are as follows:
1. Halls and corridor areas: NC30 (40 dba on Scale A)
2. Auditoriums, classrooms and offices NC-25, (35 dba on Scale A)
3. Shop, gymnasium, and multipurpose areas NC40 (50 dba on Scale A).

3.20 PROCEDURES FOR COMMERCIAL KITCHEN HOODS

A. Measure, adjust, and record the airflow of each kitchen hood. For kitchen hoods designed with integral makeup air, measure and adjust the exhaust and makeup airflow. Measure airflow by duct Pitot-tube traverse. If a duct Pitot-tube traverse is not possible, provide an explanation in the report of the reason(s) why and also the reason why the method used was chosen.
1. Install welded test ports in the sides of the exhaust duct for the duct Pitot-tube traverse. Install each test port with a threaded cap that is liquid tight.

B. After balancing is complete, do the following:
1. Measure and record the static pressure at the hood exhaust-duct connection.
2. Measure and record the hood face velocity. Make measurements at multiple points across the face of the hood. Perform measurements at a maximum of 12 inches between points and between any point and the perimeter. Calculate the average of the measurements recorded. Verify that the hood average face velocity complies with the Contract Documents and governing codes.
3. Check the hood for capture and containment of smoke using a smoke emitting device. Observe the smoke pattern. Make adjustments to room airflow patterns to achieve optimum results.

C. Visually inspect the hood exhaust duct throughout its entire length in compliance with authorities having jurisdiction. Begin at the hood connection and end at the point it discharges outdoors. Report findings.
1. Check duct slopes as required.

2. Verify that duct access is installed as required.
3. Verify that point of termination is as required.
4. Verify that duct air velocity is within the range required.
5. Verify that duct is within a fire-rated enclosure.

D. Report deficiencies.

3.21 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
1. Measure and record the operating speed, airflow, and static pressure of each fan.
2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
3. Check the refrigerant charge.
4. Check the condition of filters.
5. Check the condition of coils.
6. Check the operation of the drain pan and condensate drain trap.
7. Check bearings and other lubricated parts for proper lubrication.
8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished.
1. New filters are installed.
2. Coils are clean and fins combed.
3. Drain pans are clean.
4. Fans are clean.
5. Bearings and other parts are properly lubricated.
6. Deficiencies noted in the preconstruction report are corrected.

C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
1. Compare the indicated airflow of the renovated work to the measured fan airflows and determine the new fan, speed, filter, and coil face velocity.
2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
3. If calculations increase or decrease the airflow and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated airflow and water flow rates. If 5 percent or less, equipment adjustments are not required.
4. Air balance each air outlet.

3.22 TEMPERATURE-CONTROL VERIFICATION

A. Verify that controllers are calibrated and commissioned.

B. Check transmitter and controller locations and note conditions that would adversely affect control functions.

C. Record controller settings and note variances between set points and actual measurements.

D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).

E. Check free travel and proper operation of control devices such as damper and valve operators.

F. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water flow measurements. Note the speed of response to input changes.

G. Check the interaction of electrically operated switch transducers.

H. Check the interaction of interlock and lockout systems.

I. Check main control supply-air pressure and observe compressor and dryer operations.

J. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or nongrounded power supply.

K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.23 TOLERANCES

A. Set HVAC system airflow and water flow rates within the following tolerances:
1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 5 to plus 10 percent.
2. Air Outlets and Inlets: 0 to minus 10 percent.

3. Heating-Water Flow Rate: 0 to minus 10 percent.
4. Cooling-Water Flow Rate: 0 to minus 5 percent.

3.24 FINAL REPORT

A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.

B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
1. Include a list of instruments used for procedures, along with proof of calibration.

C. Final Report Contents: In addition to certified field report data, include the following:
1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.

D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
1. Title page.
2. Name and address of TAB firm.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB firm who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:
    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer, type size, and fittings.
14. Notes to explain why certain final data in the body of reports varies from indicated values.
15. Test conditions for fans and pump performance forms including the following:
    a. Settings for outside-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

E. System Diagrams: Include a copy of the design drawings, marked to note as-built/as-installed conditions, indicating the following:
1. Quantities of outside, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Location and position of balancing devices.
8. Actual airflows measured at each grille/diffuser.
9. Inlet and outlet static pressures measured at each air handling unit.

10. Pump inlet and outlet pressures and flow rates.
11. Identification on system diagrams to be cross-referenced to tabulated data.

3.25 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.
C. Opposite season testing: Perform additional testing, inspecting, and adjusting during the opposite season in which initial TAB procedures were performed.
D. In all cases, notify Designer in advance of performing additional tests.

END OF SECTION 230593

SECTION 230700 - HVAC INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes insulation specifications for heating, ventilating and air conditioning piping, ductwork and equipment.

B. Related Sections:

1. Division 21 Section "Fire-Suppression Systems Insulation."
2. Division 22 Section "Plumbing Insulation."
3. Division 23 Section "Metal Ducts" for duct liners.
4. Division 33 Section "Underground Hydronic Energy Distribution" for loose-fill pipe insulation in underground piping outside the building.
5. Division 33 Section "Underground Steam and Condensate Distribution Piping" for loose-fill pipe insulation in underground piping outside the building.

1.2 SUBMITTALS

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

B. Shop Drawings:

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.
8. Detail field application for each equipment type.

C. Field quality-control reports.

1.3 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Materials or accessories containing asbestos will not be accepted.

B. Use composite insulation systems (insulation, jackets, sealants, mastics, and adhesives) that have a flame spread rating of 25 or less and smoke developed rating of 50 or less, with the following exceptions:

1. Pipe insulation which is not located in an air plenum may have a flame spread rating not over 25 and a smoke developed rating no higher than 150.

2.2 INSULATION AND JACKETS

A. Manufacturers: Armacell, Certainteed, Manson, Childers, Dow, Extol, Fibrex, Halstead, H.B. Fuller, Imcoa, Johns Manville, Knauf, Owens-Corning, Partek, Pittsburgh Corning, Rubatex or approved equal.

B. Insulating materials shall be fire retardant, moisture and mildew resistant, and vermin proof. Insulation shall be suitable to receive jackets, adhesives and coatings as indicated.

2.3 FLEXIBLE FIBERGLASS INSULATION:

A. Minimum nominal density of 0.75 lbs. per cu. ft., and thermal conductivity of not more than 0.3 at 75 degrees F, rated for service to 250 degrees F.

B. Foil-scrim-kraft vapor barrier jacket, factory applied to insulation, maximum permeance of .02 perms.

2.4 RIGID FIBERGLASS INSULATION:

A. Minimum nominal density of 3 lbs. per cu. ft., and thermal conductivity of not more than 0.23 at 75 degrees F, minimum compressive strength of 25 PSF at 10% deformation, rated for service to 450 degrees F.

B. Piping: White kraft reinforced foil vapor barrier all service jacket, factory applied to insulation with a self-sealing pressure sensitive adhesive lap, maximum permeance of .02 perms and minimum beach puncture resistance of 50 units.
C. Ductwork: Foil-scrim-kraft vapor barrier jacket, factory applied to insulation, maximum permeance of .02 perms.

2.5 SEMI-RIGID FIBERGLASS INSULATION:
A. Minimum nominal density of 3 lbs. per cu. ft., thermal conductivity of not more than 0.28 at 75 degrees F, minimum compressive strength of 125 PSF at 10% deformation, rated for service to 450 degrees F. Insulation fibers perpendicular to jacket and scored for wrapping cylindrical surfaces.
B. White kraft reinforced foil vapor barrier all service jacket, factory applied to insulation with a maximum permeance of .02 perms and minimum beach puncture resistance of 50 units.

2.6 CALCIUM SILICATE INSULATION:
A. Rigid hydrous calcium silicate, ASTM C533, Type I, minimum dry density of 12.5 lbs. per cu. ft., thermal conductivity of not more than 0.44 at 300 degrees F, maximum water absorption of 90% by volume, minimum compressive strength 140 psi at 5% deformation, rated for service range of 0 degrees F to 1,200 degrees F,. Material to be visually coded or marked to indicate it is asbestos free.

2.7 ELASTOMERIC INSULATION:
A. Flexible closed cell, minimum nominal density of 5.5 lbs. per cu. ft., thermal conductivity of not more than 0.27 at 75 degrees F, minimum compressive strength of 4.5 psi at 25% deformation, maximum water vapor permeability of 0.17 perm inch, maximum water absorption of 6% by weight, rated for service range of -20 degrees F to 220 degrees F on piping and 180 degrees F where adhered to equipment.

2.8 POLYOLEFIN INSULATION:
A. Flexible closed cell, minimum nominal density of 1.5 lbs. per cu. ft., thermal conductivity of not more than 0.24 at 75 degrees F, minimum compressive strength of 5 psi at 25% deformation, maximum water vapor permeability of 0.0 perm inch, maximum water absorption of 0% by weight and volume, rated for service range of -165 degrees F to 210 degrees F.

2.9 PHENOLIC INSULATION:
A. Rigid closed cell, minimum nominal density of 2.2 lbs. per cu. ft., thermal conductivity of not more than 0.13 at 75 degrees F, minimum compressive strength of 31 psi parrallel and 18 psi perpendicular, maximum water vapor permeability 0.117 perm inch, maximum water absorption of .5% by volume, rated for service range of -290 degrees F to 250 degrees F.
B. Kraft reinforced foil vapor barrier laminate all service jacket, factory applied to insulation with a self-sealing pressure sensitive adhesive lap, maximum permeance of .02 perms and minimum beach puncture resistance of 50 units.

2.10 EXTRUDED POLYSTYRENE INSULATION:
A. Rigid closed cell, minimum nominal density of 1.6 lbs. per cu. ft., thermal conductivity of not more than 0.285 at 75 degrees F, minimum compressive strength of 20 psi, maximum water vapor permeability of 1.5 perm inch, maximum water absorption of .5 % by volume, rated for service range of -290 degrees F to 165 degrees F.

2.11 POLYISOCYANURATE INSULATION:
A. Rigid closed cell polyisocyanurate, minimum nominal density of 2.0 ***(3.0. 4.0, 6.0)***lbs. per cu. ft., thermal conductivity of not more than 0.19 at 75 degrees F aged 180 days, minimum compressive strength of 24 ***(50, 80, 140)***psi parallel and 13 ***(40, 65, 130)***psi perpendicular, maximum water vapor permeability of 4 perm inch, maximum water absorption of 2% by volume, rated for service range of -290 degrees F to 300 degrees F.

2.12 CELLULAR GLASS INSULATION:
A. Rigid closed cell, minimum nominal density of 8.5 lbs. per cu. ft., thermal conductivity of not more than 0.36 at 50 degrees F, minimum compressive strength of 100 psi, maximum water vapor permeability of 0.0 perm inch, maximum water absorption of .2% by volume, rated for service range of -450 degrees F to 900 degrees F.

2.13 MINERAL WOOL INSULATION:
A. Rigid preformed mineral fiber, minimum nominal density of 8 lbs. per cu. ft., thermal conductivity of not more than 0.29 at 200 degrees F, minimum compressive strength of 3 psi, maximum wicking of 1%, maximum water adsorption of 1% by volume, rated for service of -120 degrees F to 1200 degrees F.

2.14 FIREPROOFING INSULATION:
A. Mineral fiber with nominal density of 8 lbs. per cu. ft., flame spread index of 25, fuel contribution index of 0, and smoke developed index of 0, thermal conductivity of not more than 0.23 at 75 degrees F, rated for service of -120 degrees F to 1200 degrees F. Use rigid or semi-rigid board for duct insulations.

B. Foil-scrim-polyethylene vapor barrier jacket, factory applied to insulation, maximum permeance of .02 perms.

2.15 PVC FITTING COVERS AND JACKETS:

A. White PVC film, gloss finish one side, semi-gloss other side, FS LP-535D, Composition A, Type II, Grade GU. Ultraviolet inhibited indoor/outdoor grade to be used where exposed to high humidity, ultraviolet radiation, in kitchens or food processing areas or installed outdoors. Jacket thickness to be minimum .02” indoors/.03”outdoors for piping 12” and smaller, .03” indoors/.04” outdoors for piping 15” and larger.

2.16 METAL JACKETS:

A. .016 inch thick aluminum or .010 inch thick stainless steel with safety edge.

2.17 SELF-ADHERING JACKETS:

A. Self-adhering waterproofing membrane consisting of laminated reflective high density aluminum foil, high density waterproof polymer films and 40 mil rubberized adhesive asphalt waterproofing compound with release paper .

2.18 INSULATION INSERTS AND PIPE SHIELDS:

A. Manufacturers: B-Line, Pipe Shields, Value Engineered Products

B. Construct inserts with calcium silicate or polyisocyanurate (service temperatures below 300 degrees F only), minimum 140 psi compressive strength. Piping 12” and larger, supplement with high density 600 psi structural calcium silicate insert. Provide galvanized steel shield. Insert and shield to be minimum 180 degree coverage on bottom supported piping and full 360 degree coverage on clamped piping. On roller mounted piping and piping designed to slide on support, provide additional load distribution steel plate.

C. Where contractor proposes shop/site fabricated inserts and shields, submit schedule of materials, thicknesses, gauges and lengths for each pipe size to demonstrate equivalency to preengineered/premanufactured product described above. On low temperature systems, high density rigid polyisocyanurate may be substituted for calcium silicate provided insert and shield length and shield gauge are increased to compensate for lower insulation compressive strength.

D. Precompressed 20# density molded fiberglass blocks, Hamfab or equal, of the same thickness as adjacent insulation may be substituted for calcium silicate inserts with one 1”x6” block for piping through 2-1/2” and three 1”x6” blocks for piping through 4”. Submit shield schedule to demonstrate equivalency to preengineered/premanufactured product described above.

E. Wood blocks will not be accepted.

2.19 ACCESSORIES

A. All products shall be compatible with surfaces and materials on which they are applied, and be suitable for use at operating temperatures of the systems to which they are applied.

B. Adhesives, sealants, and protective finishes shall be as recommended by insulation manufacturer for applications specified.

C. Insulation bands to be 3/4 inch wide, constructed of aluminum or stainless steel. Minimum thickness to be .015 inch for aluminum and .010 inch for stainless steel.

D. Tack fasteners to be stainless steel ring grooved shank tacks.

E. Staples to be clinch style.

F. Insulating cement to be ANSI/ASTM C195, hydraulic setting mineral wool.

G. Finishing cement to be ASTM C449.

H. Fibrous glass or canvas fabric reinforcing shall have a minimum untreated weight of 6 oz./sq. yd.

I. Bedding compounds to be non-shrinking and permanently flexible.

J. Vapor barrier coatings and tapes to have maximum applied water vapor permeance of .05 perms.

K. Fungicidal water base coating (Foster 40-20 or equal) to be compatible with vapor barrier coating.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install insulation, jackets and accessories in accordance with manufacturers instructions and under ambient temperatures and conditions recommended by manufacturer. Surfaces to be insulated must be clean and dry.

B. Do not insulate systems or equipment which are specified to be pressure tested or inspected, until testing, inspection and any necessary repairs have been successfully completed.

C. Install insulation with smooth and even surfaces. Poorly fitted joints or use of filler in voids will not be accepted. Provide neatly beveled and coated terminations at all nameplates, uninsulated fittings, or at other locations where insulation terminates.

D. Install fabric reinforcing without wrinkles. Overlap seams a minimum of 2 inches.

E. Use full length material (as delivered from manufacturer) wherever possible. Scrap piecing of insulation or pieces cut undersize and stretched to fit will not be accepted.

F. Insulation shall be continuous through sleeves and openings except where fire rated penetration materials require interruption of insulation. Vapor barriers shall be maintained continuous through all penetrations.

G. Provide a complete vapor barrier for insulation on the following systems:
   1. Cold Water Make-Up
   2. Chilled Water
   3. Refrigerant
   4. Glycol/Brine
   5. Insulated Duct
   6. Equipment or piping with a surface temperature below 65 degrees F

3.2 PIPE INSULATION:

A. General:
   1. Install insulation with butt joints and longitudinal seams closed tightly. Provide minimum 2” lap on jacket seams and 2” tape on butt joints, firmly cemented with lap adhesive. Additionally secure with staples along seams and butt joints. Coat staples, longitudinal and transverse seams with vapor barrier mastic on systems requiring vapor barrier.
   2. Install insulation continuous through pipe hangers and supports with hangers and supports on the exterior of insulation. Where a vapor barrier is not required or where roller hangers are not being used, hangers and supports may be attached directly to piping with insulation completely covering hanger or support and jacket sealed at support rod penetration. Where riser clamps are required to be attached directly to piping requiring vapor barrier, extend insulation and vapor barrier jacketing/coating around riser clamp.
   3. Fully insulate all reheat coil piping, fittings and valves (with the exeption of unions) up to coil connection to prevent condensation when coil is inactive during cooling season.

B. Insulation Inserts and Pipe Shields: Provide insulation inserts and pipe shields at all hanger and support locations. Inserts may be omitted on 3/4” and smaller copper piping provided 12” long 22 gauge pipe shields are used.

C. Fittings and Valves: Fittings, valves, unions, flanges, couplings and specialties may be insulated with factory molded or built up insulation of the same thickness as adjoining insulation. Cover insulation with fabric reinforcing and mastic or where temperatures do not exceed 150 degrees, PVC fitting covers. Secure PVC fitting covers with tack fasteners and 1-1/2” band of mastic over ends, throat, seams and penetrations. On systems requiring vapor barrier, use vapor barrier mastic.

D. Mineral Fiber: Secure each 3’ section with three stainless steel bands or five 16 gauge stainless steel or annealed copper tie wires evenly spaced and at ends. Twist wire ends, snip off excess and turn ends over into insulation. Stagger joints where more than one layer is used.

E. Elastomeric and Polyolefin: Where practical, slip insulation on piping during pipe installation when pipe ends are open. Miter cut fittings allowing sufficient length to prevent stretching. Completely seal seams and joints for vapor tight installation. For elastomeric insulation, apply full bed of adhesive to both surfaces. For polyeolefin, seal factory preglued seams with roller and field seams and joints with full bed of hot melt polyolefin glue to both surfaces. Cover elastomeric insulation on systems operating below 40 degrees F with vapor barrier mastic.

F. EXTRUDED POLYSTYRENE AND POLYISOCYANURATE: Secure insulation sections with two wraps of nylon filament tape 9”-12” on center. On single insulation layer systems and on the outer layer of double insulation layer systems, apply a thin coat of elastomeric joint sealant rated for system operating temperatures to all longitudinal and butt insulation joints covering entire face of joint. Allow sealant to fully cure before applying protective covering. For piping service below 0^{o}F, use two layers of insulation with inner and outer butt and longitudinal joints staggered and offset 90 degrees. Where two layers of insulation are used, do not use sealant on the inner layer or adhere the inner layer to the outer layer. Fill voids in factory molded or built-up valve and fitting insulation with foamed in place urethane insulation. Apply vapor stop bead of joint sealant between pipe and insulation on both sides of valves, expansion/contraction joints, flanges, thermometers/gauges, attached vent and drain lines. Insulate attached non-circulated lines, control lines, vents, etc. for a minimum distance of 6” from pipe. Cover insulation with a protective covering of 2 coats of vapor barrier mastic with fabric reinforcing. Do not penetrate protective covering or insulation with mechanical fasteners.

G. PROTECTIVE JACKETS
1. Provide a protective metal jacket for the following insulated piping:_____
2. Lap seams a minimum of 2 inches. Secure with metal bands for end to end joints, and rivets or sheetmetal screws for longitudinal joints. Rivets, screws, and bands to be constructed of the same material as the jacket. Locate seams on bottom for exterior applications.
3. Provide a protective covering of 2 coats of vapor barrier mastic with fibrous glass or canvas fabric reinforcing for the following insulated piping:_____
4. Provide a protective self-adhering jacket for the following insulated piping:
5. Install only when ambient temperature is 60 degrees F or above. Thoroughly clean and dry surfaces. Cut allowing minimum 4” overlap on ends and 6” on longitudinal joints. Align parallel to surface. Remove release paper and press in place. Rub entire surface for full adhesion and sealing at joint overlaps. On exterior applications, provide a bead of compatible caulk along exposed edges.

H. PIPE INSULATION SCHEDULE:
1. Provide insulation on new and existing remodeled piping as indicated in the following schedule:

Service Types	**Insulation**	**Insulation Thickness by Pipe Size**				
		1" and smaller	**1-1/4" to 2"**	**2-1/2" to 4"**	**5" to 6"**	**8" and larger**
Hot Water Heating	Rigid Fiberglass	1.5"	1.5"	1.5"	1.5"	1.5"
Chilled Water Piping	Rigid Fiberglass	1.5"	1.5"	1.5"	1.5"	1.5"
Refrigerant Suction						
>40°F	Elastomeric/Polyol	0.5"	1"	1"	1"	1"
40°F to 20°F	Elastomeric/Polyol	1”	1.5”	1.5”	1.5”	1.5”
20°F to -20°F	Ext Poly/Polyiso	1.5”	2”	2”	2”	2.5”
-20°F to -60°F	Ext Poly/Polyiso	2”	2”	2.5”	2.5”	3”
Cold Water Piping	Rigid Fiberglass	0.5"	0.5"	1"	1"	1"
Cool. Coil Condensate	Rigid Fiberglass	0.5"	0.5"	1"	1"	1"
Low Pressure Steam	Rigid Fiberglass	1.5"	1.5"	2"	2"	3.5"
In Conduits	Mineral Fiber	1.5"	1.5"	2"	2"	3.5"
Low Pressure Cond.	Rigid Fiberglass	1.5"	1.5"	2"	2"	2"
In Conduits	Mineral Fiber	1.5"	1.5"	2"	2"	2"
High Pressure Steam	Rigid Fiberglass	2.5"	2.5"	3"	3.5"	3.5"
In Conduits	Mineral Fiber	2.5"	2.5"	3"	3.5"	3.5"
High Pressure Cond.	Rigid Fiberglass	1.5"	1.5"	2"	2"	3.5"
In Conduits	Mineral Fiber	1.5"	1.5"	2"	2"	3.5
Cond. Pump Disch.	Rigid Fiberglass	1.5"	1.5"	2"	2"	2"
In conduits	Mineral Fiber	1.5"	1.5"	2"	2"	2"
Boiler Feed Piping	Rigid Fiberglass	1.5"	1.5"	2"	2"	2"
Boiler Blow Down	Rigid Fiberglass	1"	1"	1"	1"	1"
Remote Generator Radiator Piping	Rigid Fiberglass	1.5"	1.5"	2"	2"	2"

2. The following piping and fittings are not to be insulated:
   a. Hot water piping inside radiation, convector, or cabinet heater enclosures
   b. Steam Traps
   c. Piping unions for systems not requiring a vapor barrier

3.3 DUCT INSULATION

A. General:
1. Secure flexible duct insulation on sides and bottom of ductwork over 24" wide and all rigid duct insulation with weld pins or speed clips. Space fasteners 18” on center or less as required to prevent sagging for flexible duct insulation. Space fasteners not less than 3” from edge or corner and 12” on center or less for rigid duct insulation. Install weld pins without damage to the interior galvanized surface of the duct. Clip pins back to washer and cover penetrations with tape of same material as jacket. Firmly butt seams and joints and cover with 4” tape of same material as jacket. Seal tape with plastic applicator and secure with staples. All joints, seams, edges and penetrations to be fully vapor sealed.
2. Stop and point insulation around access doors and damper operators to allow operation without disturbing insulation or jacket material.
3. External supply duct insulation is not required where ductwork contains continuous 1” acoustical liner. Provide 4” overlap of external insulation over ends of acoustically lined sections.

B. Protective Coverings:

1. Provide a protective covering of 2 coats of indoor/outdoor vapor barrier mastic with fibrous glass or canvas fabric covering for the following ductwork:_____
2. Provide a protective covering of galvanized or factory painted steel panels with gasketed and caulked joints and seams for the following ductwork:_____
3. Provide a protective self-adhering jacket for the following insulated ductwork:_____
4. Install only when ambient temperature is 60 degrees F or above. Thoroughly clean and dry surfaces. Cut allowing minimum 4” overlap on ends and 6” on longitudinal joints. Align parallel to surface. Remove release paper and press in place. Rub entire surface for full adhesion and sealing at joint overlaps. Provide a bead of compatible caulk along exposed edges.

C. Breeching: Fasten insulation over weld pins and secure with washers. Space fasteners not less than 3” from edge or corner and 12" on center longitudinally and 9" on center in the transverse direction. Clip pins back to washer and cover penetrations with tape of same material as jacket. Firmly butt seams and joints and cover with 4” tape of same material as jacket. Seal tape with plastic applicator and secure with staples.

D. GREASE DUCTS: Strictly adhere to manufacturer’s installation instructions and rating requirements for application of fire-stop insulation. Cover all exhaust ducts serving Type I kitchen hoods with fire-stop insulation from a point prior to penetration of ceiling, wall, floor or concealment through building to termination at outside of building. Extend fire-stop insulation through roof curbs.

E. Duct Insulation Schedule:
1. Provide duct insulation on new and existing remodeled ductwork in the following schedule:

Service	Insulation Type	Insulation Thickness
Outside air ducts	Rigid Fiberglass	2"
Mixed air ducts	Rigid Fiberglass	2"
Exposed supply ducts*	Rigid Fiberglass	2"
Concealed supply and return ducts	Flexible Fiberglass	1-1/2"
Exhaust and relief ducts downstream of motorized backdraft dampers	Rigid Fiberglass	2"
All ducts exposed to weather	Rigid Fiberglass	3"
Exhaust ducts downstream of heat recovery units and dessicant dryers	Rigid Fiberglass	2"
Grease ducts serving Type I Kitchen hoods	Fire-Stop	As Req’d. for Specified Hourly Rating
Heat recovery units other than kitchen hood exhaust	Rigid Fiberglass	1"
Breech. and boiler wind boxes	Fireproofing	3"

* Exposed supply branch ducts located in the space they are serving do not require insulation. Exposed supply main ducts running through spaces they serve shall be insulated as exposed supply ducts scheduled above.

3.4 EQUIPMENT INSULATION

A. GENERAL:Do not insulate over equipment access manholes, fittings, nameplates or ASME stamps. Bevel and seal insulation at these locations.

B. Semi-Rigid Fiberglass: Apply insulation to equipment shells using weld pins, bonding adhesive, banded and wired in place. Fill all joints, seams and depressions with insulating cement to a smooth, even surface. Cover with reinforcing fabric and 2 coats of mastic. Use vapor barrier mastic on systems requiring a vapor barrier.

C. Elastomeric/Polyolefin: Apply full cover coat of adhesive to surface to be insulated, insulation and edge butt joints. Place insulation with edge joints firmly butted pressing to surface for full adhesion. Seal seams and joints vapor tight.

D. REMOVABLE COVERS: Provide insulated easily removable galvanized steel metal boxes for routine service access on the following equipment: _____

E. Provide insulated easily removable elastomeric insulation sections for the following equipment:_____

F. Equipment Insulation Schedule: Provide equipment insulation as follows:

Equipment	Insulation	Thickness Type
Reheat coil casing in exposed supply ducts	Rigid Fiberglass	2"
Reheat coil casing in concealed supply ducts	Flexible Fiberglass	1-1/2"
Generator exhaust pipe and muffler	Calcium Silicate/Fireproofing	3"
Air separators	Semi-Rigid Fiberglass	1.5"
Chilled water compression tanks	Semi-Rigid Fiberglass	1"

Heat exchangers	Semi-Rigid Fiberglass	2"
Condensate receivers	Semi-Rigid Fiberglass	2"
Flash tanks	Semi-Rigid Fiberglass	2"
Blowdown separator	Semi-Rigid Fiberglass	2"
Hot Water Storage tanks	Semi-Rigid Fiberglass	2"
Chiller evaporator shell, suction piping, heads, and water boxes	Elastomeric/Polyolefin	1"
Water cooled condenser shell *	Elastomeric/Polyolefin	1"
Chilled Water Pumps	Elastomeric/Polyolefin	1"
Humidifier separator	Rigid Fiberglass	2"
Air Handling Unit Casings or attached component sections not factory insulated	Rigid Fiberglass	2”

* Condenser shell only needs to be insulated when condenser is city, lake, or river water cooled or when "free cooling" is used.

G. Insulate air handling unit casings, chambers, or plenums (filters, mixing chambers, sound attenuators, etc.) in accordance with requirements of adjacent duct insulation.

END OF SECTION 230700

SECTION 230800 - COMMISSIONING OF HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes commissioning process requirements for HVAC&R systems, assemblies, and equipment.

1.2 DEFINITIONS

A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

B. CxA: Commissioning Authority.

C. HVAC&R: Heating, Ventilating, Air Conditioning, and Refrigeration.

D. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.3 CONTRACTOR'S RESPONSIBILITIES

A. Perform commissioning tests at the direction of the CxA.

B. Attend construction phase controls coordination meeting.

C. Attend testing, adjusting, and balancing review and coordination meeting.

D. Participate in HVAC&R systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.

E. Provide information requested by the CxA for final commissioning documentation.

F. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

1.4 CxA'S RESPONSIBILITIES

A. Provide Project-specific construction checklists and commissioning process test procedures for actual HVAC&R systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.

B. Direct commissioning testing.

C. Verify testing, adjusting, and balancing of Work are complete.

D. Provide test data, inspection reports, and certificates in Systems Manual.

1.5 COMMISSIONING DOCUMENTATION

A. Provide the following information to the CxA for inclusion in the commissioning plan:

1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for HVAC&R systems, assemblies, equipment, and components to be verified and tested.
4. Certificate of readiness, signed by the Contractor, certifying that HVAC&R systems, assemblies, equipment, components, and associated controls are ready for testing.
5. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
6. Certificate of readiness certifying that HVAC&R systems, subsystems, equipment, and associated controls are ready for testing.
7. Test and inspection reports and certificates.
8. Corrective action documents.
9. Verification of testing, adjusting, and balancing reports.

1.6 SUBMITTALS

A. Certificates of readiness.

B. Certificates of completion of installation, prestart, and startup activities.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TESTING PREPARATION

A. Certify that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.

B. Certify that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.
C. Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.
D. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
E. Inspect and verify the position of each device and interlock identified on checklists.
F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.2 TESTING AND BALANCING VERIFICATION

A. Prior to performance of testing and balancing Work, provide copies of reports, sample forms, checklists, and certificates to the CxA.
B. Notify the CxA at least 10 days in advance of testing and balancing Work, and provide access for the CxA to witness testing and balancing Work.
C. Provide technicians, instrumentation, and tools to verify testing and balancing of HVAC&R systems at the direction of the CxA.
    1. The CxA will notify testing and balancing Contractor 10 days in advance of the date of field verification. Notice will not include data points to be verified.
    2. The testing and balancing Contractor shall use the same instruments (by model and serial number) that were used when original data were collected.
    3. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report. For sound pressure readings, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise must be considered.
    4. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

3.3 GENERAL TESTING REQUIREMENTS

A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.
B. Scope of HVAC&R testing shall include entire HVAC&R installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. Testing shall include measuring capacities and effectiveness of operational and control functions.
C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.
D. The CxA along with the HVAC&R Contractor, testing and balancing Contractor, and HVAC&R Instrumentation and Control Contractor shall prepare detailed testing plans, procedures, and checklists for HVAC&R systems, subsystems, and equipment.
E. Tests will be performed using design conditions whenever possible.
F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
G. The CxA may direct that set points be altered when simulating conditions is not practical.
H. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.

I. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.

J. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.4 HVAC&R SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES

A. HVAC&R Instrumentation and Control System Testing: Field testing plans and testing requirements are specified in Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls." Assist the CxA with preparation of testing plans.

B. Pipe system cleaning, flushing, hydrostatic tests, and chemical treatment requirements are specified in Division 23 piping Sections. HVAC&R Contractor shall prepare a pipe system cleaning, flushing, and hydrostatic testing plan. Provide cleaning, flushing, testing, and treating plan and final reports to the CxA. Plan shall include the following:
   1. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to Drawings for each pipe sector, showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.
   2. Description of equipment for flushing operations.
   3. Minimum flushing water velocity.
   4. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.

C. Energy Supply System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of systems and equipment at the direction of the CxA. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.

D. Refrigeration System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of chillers, cooling towers, refrigerant compressors and condensers, heat pumps, and other refrigeration systems. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.

E. HVAC&R Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of air, and hydronic distribution systems; special exhaust; and other distribution systems, including HVAC&R terminal equipment and unitary equipment.

F. Vibration and Sound Tests: Provide technicians, instrumentation, tools, and equipment to test performance of vibration isolation and seismic controls.

END OF SECTION 230800

SECTION 230900 - INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

B. See Division 23 Section "Sequence of Operations for HVAC Controls" for requirements that relate to this Section.

1.2 SUBMITTALS

A. Product Data: For each control device indicated.

B. Shop Drawings:

1. Schematic flow diagrams.
2. Power, signal, and control wiring diagrams.
3. Details of control panel faces.
4. Damper schedule.
5. Valve schedule.
6. DDC System Hardware: Wiring diagrams, schematic floor plans, and schematic control diagrams.
7. Control System Software: Schematic diagrams, written descriptions, and points list.

C. Software and firmware operational documentation.

D. Field quality-control test reports.

E. Operation and maintenance data.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.4 SCOPE OF WORK

A. System Performance: Provide and install sufficient input and output data points, sensors, controllers, wiring, and other components and accessories as required to perform the specified sequences of operation.

B. Additional Data Points: In addition to data points required, provide and install an additional 5% of data points, including wiring as required, to be installed during construction and prior to project completion as directed by the Engineer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 CONTROL SYSTEM

A. Manufacturers:

1. Alerton Inc.
2. Andover Controls Corporation.
3. Automated Logic Corporation.
4. Delta Controls Inc.
5. Honeywell International Inc.; Home & Building Control.
6. Invensys Building Systems.
7. Johnson Controls, Inc.; Controls Group.
8. KMC Controls/Kreuter Manufacturing Company.
9. Siemens Building Technologies, Inc.
10. Trane; Worldwide Applied Systems Group.

B. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed

controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. An operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.

2.3 DDC EQUIPMENT

A. Operator Workstation: PC-based microcomputer with minimum configuration as follows:
1. Motherboard: With 8 integrated USB 2.0 ports, integrated Intel Pro 10/100 (Ethernet), integrated audio, bios, and hardware monitoring.
2. Processor: Intel Pentium 4, 3 GHz.
3. Random-Access Memory: 512 MB.
4. Graphics: Video adapter, minimum 1280 x 1024 pixels, 64-MB video memory, with TV out.
5. Monitor: 17 inches, digital flat panel color.
6. Keyboard: QWERTY, 105 keys in ergonomic shape.
7. Floppy-Disk Drive: 1.44 MB.
8. Hard-Disk Drive: 80 GB.
9. CD-ROM Read/Write Drive: 48x24x48.
10. Mouse: Three button, optical.
11. Uninterruptible Power Supply: 2 kVa.
12. Operating System: Microsoft Windows XP Professional with high-speed Internet access.
13. Printer: Color, ink-jet type as follows:
    a. Print Head: 4800 x 1200 dpi optimized color resolution.
    b. Paper Handling: Minimum of 100 sheets.
    c. Print Speed: Minimum of 17 ppm in black and 12 ppm in color.
    d. Application Software.

B. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.
1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation.
2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
    a. Global communications.
    b. Discrete/digital, analog, and pulse I/O.
    c. Monitoring, controlling, or addressing data points.
    d. Software applications, scheduling, and alarm processing.
    e. Testing and developing control algorithms without disrupting field hardware and controlled environment.

C. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.
1. Units monitor or control each I/O point, process information, and download from or upload to operator workstation or diagnostic terminal unit.
2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
    a. Global communications.
    b. Discrete/digital, analog, and pulse I/O.
    c. Monitoring, controlling, or addressing data points.
3. Local operator interface provides for download from or upload to operator workstation.

D. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.
1. Binary Inputs: Allow monitoring of on-off signals without external power.
2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.

3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation with three-position (on-off-auto) override switches and status lights.
5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA) with status lights, two-position (auto-manual) switch, and manually adjustable potentiometer.
6. Tri-State Outputs: Provide two coordinated binary outputs for control of three-point, floating-type electronic actuators.
7. Universal I/Os: Provide software selectable binary or analog outputs.

E. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:
1. Output ripple of 5.0 mV maximum peak to peak.
2. Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.
3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.

F. Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:
1. Minimum dielectric strength of 1000 V.
2. Maximum response time of 10 nanoseconds.
3. Minimum transverse-mode noise attenuation of 65 dB.
4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.

2.4 UNITARY CONTROLLERS

A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.
1. Configuration: Local keypad and display; diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and 72-hour battery backup.
2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform scheduling with real-time clock. Perform automatic system diagnostics; monitor system and report failures.
3. Enclosure: Dustproof rated for operation at 32 to 120 deg F.

2.5 ANALOG CONTROLLERS

A. Step Controllers: 6- or 10-stage type, with heavy-duty switching rated to handle loads and operated by electric motor.

B. Electric, Outdoor-Reset Controllers: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range, adjustable set point, scale range minus 10 to plus 70 deg F, and single- or double-pole contacts.

C. Electronic Controllers: Wheatstone-bridge-amplifier type, in steel enclosure with provision for remote-resistance readjustment. Identify adjustments on controllers, including proportional band and authority.
1. Single controllers can be integral with control motor if provided with accessible control readjustment potentiometer.

D. Fan-Speed Controllers: Solid-state model providing field-adjustable proportional control of motor speed from maximum to minimum of 55 percent and on-off action below minimum fan speed. Controller shall briefly apply full voltage, when motor is started, to rapidly bring motor up to minimum speed. Equip with filtered circuit to eliminate radio interference.

2.6 TIME CLOCKS

A. Manufacturers:
1. ATC-Diversified Electronics.
2. Grasslin Controls Corporation.

3. Paragon Electric Co., Inc.
4. Precision Multiple Controls, Inc.
5. SSAC Inc.; ABB USA.
6. TCS/Basys Controls.
7. Theben AG - Lumilite Control Technology, Inc.
8. Time Mark Corporation.

B. Solid-state, programmable time control with 8 separate programs each with up to 100 on-off operations; 1-second resolution; lithium battery backup; keyboard interface and manual override; individual on-off-auto switches for each program; 365-day calendar with 20 programmable holidays; choice of fail-safe operation for each program; system fault alarm; and communications package allowing networking of time controls and programming from PC.

2.7 ELECTRONIC SENSORS

A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.

B. Thermistor Temperature Sensors and Transmitters:

1. Manufacturers:
   a. BEC Controls Corporation.
   b. Ebtron, Inc.
   c. Heat-Timer Corporation.
   d. I.T.M. Instruments Inc.
   e. MAMAC Systems, Inc.
   f. RDF Corporation.
2. Accuracy: Plus or minus 0.5 deg F at calibration point.
3. Wire: Twisted, shielded-pair cable.
4. Insertion Elements in Ducts: Single point, 8 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft..
5. Averaging Elements in Ducts: 36 inches long, flexible; use where prone to temperature stratification or where ducts are larger than 10 sq. ft..
6. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches.
7. Room Sensor Cover Construction: Manufacturer's standard locking covers.
   a. Set-Point Adjustment: Exposed.
   b. Set-Point Indication: Exposed.
   c. Thermometer: Concealed.
   d. Color: Insert color from manufacturer's full range.
   e. Orientation: Vertical.
8. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
9. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.

C. RTDs and Transmitters:

1. Manufacturers:
   a. BEC Controls Corporation.
   b. MAMAC Systems, Inc.
   c. RDF Corporation.
2. Accuracy: Plus or minus 0.2 percent at calibration point.
3. Wire: Twisted, shielded-pair cable.
4. Insertion Elements in Ducts: Single point, 8 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft..
5. Averaging Elements in Ducts: 24 feet long, flexible; use where prone to temperature stratification or where ducts are larger than 9 sq. ft.; length as required.
6. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches.
7. Room Sensor Cover Construction: Manufacturer's standard locking covers.
   a. Set-Point Adjustment: Exposed.
   b. Set-Point Indication: Exposed.

c. Thermometer: Concealed.
d. Color: Insert color from manufacturer's full range.
e. Orientation: Vertical.

8. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
9. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.

D. Humidity Sensors: Bulk polymer sensor element.
1. Manufacturers:
a. BEC Controls Corporation.
b. General Eastern Instruments.
c. MAMAC Systems, Inc.
d. ROTRONIC Instrument Corp.
e. TCS/Basys Controls.
f. Vaisala.
2. Accuracy: 2 percent full range with linear output.
3. Room Sensor Range: 20 to 80 percent relative humidity.
4. Room Sensor Cover Construction: Manufacturer's standard locking covers.
a. Set-Point Adjustment: Concealed.
b. Set-Point Indication: Concealed.
c. Thermometer: Concealed.
d. Color:
e. Orientation: Vertical.
5. Duct Sensor: 20 to 80 percent relative humidity range with element guard and mounting plate.
6. Outside-Air Sensor: 20 to 80 percent relative humidity range with mounting enclosure, suitable for operation at outdoor temperatures of minus 22 to plus 185 deg F.
7. Duct and Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.

E. Pressure Transmitters/Transducers:
1. Manufacturers:
a. BEC Controls Corporation.
b. General Eastern Instruments.
c. MAMAC Systems, Inc.
d. ROTRONIC Instrument Corp.
e. TCS/Basys Controls.
f. Vaisala.
2. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
b. Output: 4 to 20 mA.
c. Building Static-Pressure Range: 0- to 0.25-inch wg.
d. Duct Static-Pressure Range: 0- to 5-inch wg.
3. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure; linear output 4 to 20 mA.
4. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure and tested to 300-psig; linear output 4 to 20 mA.
5. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.
6. Pressure Transmitters: Direct acting for gas or liquid service; range suitable for system; linear output 4 to 20 mA.

F. Room Sensor Cover Construction: Manufacturer's standard locking covers.
1. Set-Point Adjustment: Concealed.
2. Set-Point Indication: Concealed.
3. Thermometer: Concealed.

4. Color:
5. Orientation: Vertical.

G. Room sensor accessories include the following:
1. Insulating Bases: For sensors located on exterior walls.
2. Guards: Locking; heavy-duty, transparent Lexan®; mounted on separate base.
3. Adjusting Key: As required for calibration and cover screws.

2.8 STATUS SENSORS

A. Status Inputs for Fans: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg.

B. Status Inputs for Pumps: Differential-pressure switch with pilot-duty rating and with adjustable pressure-differential range of 8 to 60 psig, piped across pump.

C. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.

D. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.

E. Power Monitor: 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4- to 20-mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.

F. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.

G. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.

H. Water-Flow Switches: Bellows-actuated mercury or snap-acting type with pilot-duty rating, stainless-steel or bronze paddle, with appropriate range and differential adjustment, in NEMA 250, Type 1 enclosure.
1. Manufacturers:
a. BEC Controls Corporation.
b. I.T.M. Instruments Inc.

2.9 GAS DETECTION EQUIPMENT

A. Manufacturers:
1. B. W. Technologies.
2. CEA Instruments, Inc.
3. Ebtron, Inc.
4. Gems Sensors Inc.
5. Greystone Energy Systems Inc.
6. Honeywell International Inc.; Home & Building Control.
7. INTEC Controls, Inc.
8. I.T.M. Instruments Inc.
9. MSA Canada Inc.
10. QEL/Quatrosense Environmental Limited.
11. Sauter Controls Corporation.
12. Sensidyne, Inc.
13. TSI Incorporated.
14. Vaisala.
15. Vulcain Inc.

B. Carbon Monoxide Detectors: Single or multichannel, dual-level detectors using solid-state plug-in sensors with a 3-year minimum life; suitable over a temperature range of 32 to 104 deg F; with 2 factory-calibrated alarm levels at 50 and 100 ppm.

C. Carbon Dioxide Sensor and Transmitter: Single detectors using solid-state infrared sensors; suitable over a temperature range of 23 to 130 deg F and calibrated for 0 to 2 percent, with continuous or averaged reading, 4- to 20-mA output;, for wall mounting.

D. Occupancy Sensor: Passive infrared, with time delay, daylight sensor lockout, sensitivity control, and 180-degree field of view with vertical sensing adjustment; for flush mounting.

2.10 THERMOSTATS

A. Manufacturers:

1. Erie Controls.
2. Danfoss Inc.; Air-Conditioning and Refrigeration Div.
3. Heat-Timer Corporation.
4. Sauter Controls Corporation.
5. tekmar Control Systems, Inc.
6. Theben AG - Lumilite Control Technology, Inc.

B. Electric, solid-state, microcomputer-based room thermostat with remote sensor.
1. Automatic switching from heating to cooling.
2. Preferential rate control to minimize overshoot and deviation from set point.
3. Set up for four separate temperatures per day.
4. Instant override of set point for continuous or timed period from 1 hour to 31 days.
5. Short-cycle protection.
6. Programming based on every day of week.
7. Selection features include degree F or degree C display, 12- or 24-hour clock, keyboard disable, remote sensor, and fan on-auto.
8. Battery replacement without program loss.
9. Thermostat display features include the following:
   a. Time of day.
   b. Actual room temperature.
   c. Programmed temperature.
   d. Programmed time.
   e. Duration of timed override.
   f. Day of week.
   g. System mode indications include "heating," "off," "fan auto," and "fan on."

C. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.

D. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch or equivalent solid-state type, with heat anticipator; listed for electrical rating; with concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.
1. Electric Heating Thermostats: Equip with off position on dial wired to break ungrounded conductors.
2. Selector Switch: Integral, manual on-off-auto.

E. Remote-Bulb Thermostats: On-off or modulating type, liquid filled to compensate for changes in ambient temperature; with copper capillary and bulb, unless otherwise indicated.
1. Bulbs in water lines with separate wells of same material as bulb.
2. Bulbs in air ducts with flanges and shields.
3. Averaging Elements: Copper tubing with either single- or multiple-unit elements, extended to cover full width of duct or unit; adequately supported.
4. Scale settings and differential settings are clearly visible and adjustable from front of instrument.
5. On-Off Thermostat: With precision snap switches and with electrical ratings required by application.
6. Modulating Thermostats: Construct so complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.

F. Fire-Protection Thermostats: Listed and labeled by an NRTL acceptable to authorities having jurisdiction; with fixed or adjustable settings to operate at not less than 75 deg F above normal maximum operating temperature, and the following:
1. Reset: Manual.

G. Room Thermostat Cover Construction: Manufacturer's standard locking covers.
1. Set-Point Adjustment: Exposed.
2. Set-Point Indication: Exposed.
3. Thermometer: Concealed.

4. Color: Insert color from manufacturer's full range.
5. Orientation: Vertical.

H. Room thermostat accessories include the following:
1. Insulating Bases: For thermostats located on exterior walls.
2. Thermostat Guards: Locking; heavy-duty, transparent Lexan®; mounted on separate base.
3. Adjusting Key: As required for calibration and cover screws.
4. Set-Point Adjustment: 1/2-inch- diameter, adjustment knob.

I. Immersion Thermostat: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range and adjustable set point.

J. Airstream Thermostats: Two-pipe, fully proportional, single-temperature type; with adjustable set point in middle of range, adjustable throttling range, plug-in test fitting or permanent pressure gage, remote bulb, bimetal rod and tube, or averaging element.

K. Electric, Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic- reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or below set point.
1. Bulb Length: Minimum 20 feet.
2. Quantity: One thermostat for every 20 sq. ft. of coil surface.

L. Electric, High-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic- reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or above set point.
1. Bulb Length: Minimum 20 feet.
2. Quantity: One thermostat for every 20 sq. ft. of coil surface.

M. Heating/Cooling Valve-Top Thermostats: Proportional acting for proportional flow, with molded-rubber diaphragm, remote-bulb liquid-filled element, direct and reverse acting at minimum shutoff pressure of 25 psig, and cast housing with position indicator and adjusting knob.

2.11 HUMIDISTATS

A. Manufacturers:
1. MAMAC Systems, Inc.
2. ROTRONIC Instrument Corp.

B. Duct-Mounting Humidistats: Electric insertion, 2-position type with adjustable, 2 percent throttling range, 20 to 80 percent operating range, and single- or double-pole contacts.

2.12 ACTUATORS

A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
1. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
2. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
3. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
4. Spring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running and breakaway torque of 150 in. x lbf.
5. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
6. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf.

B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
1. Manufacturers:
a. Belimo Aircontrols (USA), Inc.
2. Valves: Size for torque required for valve close off at maximum pump differential pressure.

3. Dampers: Size for running torque calculated as follows:
   a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. of damper.
   b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.
   c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft of damper.
   d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. of damper.
   e. Dampers with 2- to 3-Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque by 1.5.
   f. Dampers with 3- to 4-Inch wg of Pressure Drop or Face Velocities of 2500 to 3000 fpm: Increase running torque by 2.0.
4. Coupling: V-bolt and V-shaped, toothed cradle.
5. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
6. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
7. Power Requirements (Two-Position Spring Return): 24 120 230-V ac.
8. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
9. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
10. Temperature Rating: Minus 22 to plus 122 deg F.
11. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F.
12. Run Time: 12 seconds open, 5 seconds closed.

2.13 CONTROL VALVES

A. Manufacturers:
   1. Danfoss Inc.; Air Conditioning & Refrigeration Div.
   2. Erie Controls.
   3. Hayward Industrial Products, Inc.
   4. Magnatrol Valve Corporation.
   5. Neles-Jamesbury.
   6. Parker Hannifin Corporation; Skinner Valve Division.
   7. Pneuline Controls.
   8. Sauter Controls Corporation.

B. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.

C. Hydronic system globe valves shall have the following characteristics:
   1. NPS 2 and Smaller: Class 125 bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with backseating capacity repackable under pressure.
   2. NPS 2-1/2 and Larger: Class 125 iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.
   3. Internal Construction: Replaceable plugs and stainless-steel or brass seats.
      a. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom.
      b. Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom.
   4. Sizing: 3-psig maximum pressure drop at design flow rate or the following:
      a. Two Position: Line size.
      b. Two-Way Modulating: Either the value specified above or twice the load pressure drop, whichever is more.
      c. Three-Way Modulating: Twice the load pressure drop, but not more than value specified above.
   5. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.
   6. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of total system (pump) head for two-way valves and 100 percent of pressure differential across valve or 100 percent of total system (pump) head.

D. Butterfly Valves: 200-psig, 150-psig maximum pressure differential, ASTM A 126 cast-iron or ASTM A 536 ductile-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals.
   1. Body Style: Wafer Lug Grooved.
   2. Disc Type: Nickel-plated ductile iron Aluminum bronze Elastomer-coated ductile iron Epoxy-coated ductile iron.
   3. Sizing: 1-psig maximum pressure drop at design flow rate.

E. Terminal Unit Control Valves: Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends.
   1. Rating: Class 125 for service at 125 psig and 250 deg F operating conditions.
   2. Sizing: 3-psig maximum pressure drop at design flow rate, to close against pump shutoff head.
   3. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.

F. Self-Contained Control Valves: Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends.
   1. Rating: Class 125 for service at 125 psig and 250 deg F operating conditions.
   2. Thermostatic Operator: Wax Liquid-filled integral remote sensor with integral remote adjustable dial.

2.14 DAMPERS

A. Manufacturers:
   1. Air Balance Inc.
   2. Don Park Inc.; Autodamp Div.
   3. TAMCO (T. A. Morrison & Co. Inc.).
   4. United Enertech Corp.
   5. Vent Products Company, Inc.

B. Dampers: AMCA-rated, opposed-blade design; 0.108-inch- minimum thick, galvanized-steel or 0.125-inch- minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch- thick galvanized steel with maximum blade width of 8 inches and length of 48 inches.
   1. Secure blades to 1/2-inch- diameter, zinc-plated axles using zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
   2. Operating Temperature Range: From minus 40 to plus 200 deg F.
   3. Edge Seals, Standard Pressure Applications: Closed-cell neoprene.
   4. Edge Seals, Low-Leakage Applications: Use inflatable blade edging or replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less than 10 cfm per sq. ft. of damper area, at differential pressure of 4-inch wg when damper is held by torque of 50 in. x lbf; when tested according to AMCA 500D.

2.15 CONTROL CABLE

A. Electronic and fiber-optic cables for control wiring are specified in Division 27 Section "Communications Horizontal Cabling."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches above the floor.
   1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

B. Install guards on thermostats in the following locations:
   1. Entrances.
   2. Public areas.
   3. Gymnasiums.
   4. Where indicated.

C. Install automatic dampers according to Division 23 Section "Air Duct Accessories."

D. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.

E. Install labels and nameplates to identify control components according to Division 23 Section "Identification for HVAC Piping and Equipment."
F. Install hydronic instrument wells, valves, and other accessories according to Division 23 Section "Hydronic Piping."
G. Install refrigerant instrument wells, valves, and other accessories according to Division 23 Section "Refrigerant Piping."
H. Install duct volume-control dampers according to Division 23 Sections specifying air ducts.
I. Install electronic and fiber-optic cables according to Division 27 Section "Communications Horizontal Cabling."

3.2 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. Install raceways, boxes, and cabinets according to Division 26 Section "Raceway and Boxes for Electrical Systems."
B. Install building wire and cable according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
C. Install signal and communication cable according to Division 27 Section "Communications Horizontal Cabling."
    1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
    2. Install exposed cable in raceway.
    3. Install concealed cable in raceway.
    4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
    5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
    6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
    7. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.
    8. Do not attach control panels directly to equipment, ducts, or piping.
D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.
E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
B. Perform the following field tests and inspections and prepare test reports:
    1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
    2. Test and adjust controls and safeties.
    3. Test calibration of controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
    4. Test each point through its full operating range to verify that safety and operating control set points are as required.
    5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
    6. Test each system for compliance with sequence of operation.
    7. Test software and hardware interlocks.
C. DDC Verification:
    1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
    2. Check instruments for proper location and accessibility.
    3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
    4. Check instrument tubing for proper fittings, slope, material, and support.

5. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
6. Check temperature instruments and material and length of sensing elements.
7. Check control valves. Verify that they are in correct direction.
8. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.
9. Check DDC system as follows:
    a. Verify that DDC controller power supply is from emergency power supply, if applicable.
    b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
    c. Verify that spare I/O capacity has been provided.
    d. Verify that DDC controllers are protected from power supply surges.

D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 230900

SECTION 230993 - SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes control sequences for HVAC systems, subsystems, and equipment.

B. See Division 23 Section "Instrumentation and Control for HVAC" for control equipment and devices and for submittal requirements.

1.2 HEATING CONTROL SEQUENCES

1.3 AIR-HANDLING-UNIT CONTROL SEQUENCES

A. Start and Stop Supply Fan(s):

1. Enable: Freeze Protection:
   a. Input Device: Duct-mounted averaging element thermostat, located before supply fan.
   b. Output Device: Hard wired through motor starter; DDC system alarm.
   c. Action: Allow start if duct temperature is above 37 deg F; signal alarm if fan fails to start as commanded.
2. Enable: High-Temperature Protection:
   a. Input Device: Duct-mounted thermostat, located in return air.
   b. Output Device: Hard wired through motor starter; DDC system alarm.
   c. Action: Allow start if duct temperature is below 300 deg F.
3. Enable: Smoke Control:
   a. Input Device: Duct-mounted smoke detector, located in return air.
   b. Output Device: Hard wired through motor starter; DDC system alarm.
   c. Action: Allow start if duct is free of products of combustion.
4. Initiate: Occupied Time Schedule:
   a. Input Device: DDC system time schedule.
   b. Output Device: Binary output to motor starter.
   c. Action: Energize fan(s).
5. Initiate: Unoccupied Time Schedule:
   a. Input Device: DDC system demand.
   b. Output Device: Binary output to motor starter.
   c. Action: Energize fan(s).
6. Unoccupied Ventilation:
   a. Input Device: DDC system time schedule and output.
   b. Output Device: DDC system binary output to motor starter.
   c. Action: Cycle fan(s) during unoccupied periods.
7. Display: Supply-fan on-off indication.

B. Supply Fan(s) Variable-Volume Control:

1. Occupied Time Schedule:
   a. Input Device: DDC system time schedule.
   b. Output Device: Binary output.
   c. Action: Enable control.
2. Volume Control:
   a. Input Device: Differential-pressure switch sensing supply-duct static pressure referenced to conditioned-space static pressure.
   b. Output Device: DDC system analog output to modulating damper actuator. Set inlet guide vanes to closed position when fan is stopped.
   c. Action: Maintain constant supply-duct static pressure.
3. Volume Control:
   a. Input Device: Differential-pressure switch sensing supply-duct static pressure referenced to conditioned-space static pressure.
   b. Output Device: DDC system analog output to motor speed controller. Set variable-speed drive to minimum speed when fan is stopped.
   c. Action: Maintain constant supply-duct static pressure.
4. High Pressure:
   a. Input Device: Static-pressure transmitter sensing supply-duct static pressure referenced to static pressure outside the duct.

b. Output Device: DDC system binary output to alarm panel.
c. Action: Stop fan and signal alarm when static pressure rises above excessive-static-pressure set point.

5. Display:
a. Supply-fan-discharge static-pressure indication.
b. Supply-fan-discharge static-pressure set point.
c. Supply-fan airflow rate.
d. Supply-fan speed.

C. Start and Stop Return Fan(s):
1. Initiate: Occupied Time Schedule:
a. Input Device: DDC system time schedule.
b. Output Device: Binary output to motor starter.
c. Action: Energize fans when supply fans are energized.
2. Initiate: Unoccupied Time Schedule:
a. Input Device: DDC system demand.
b. Output Device: Binary output to motor starter.
c. Action: Energize fans when supply fans are energized.
3. Unoccupied Ventilation:
a. Input Device: DDC system time schedule and output.
b. Output Device: DDC system binary output to motor starter.
c. Action: Cycle fan(s) during unoccupied periods.
4. Display: Return-fan on-off indication.

D. Return Fan(s) Variable-Volume Control:
1. Occupied Time Schedule:
a. Input Device: DDC system time schedule.
b. Output Device: Binary output.
c. Action: Enable control.
2. Volume Control:
a. Input Device: Differential-pressure switch sensing building static pressure referenced to outdoor static pressure.
b. Output Device: DDC system analog output to modulating damper actuator. Set inlet guide vanes to closed position when fan is stopped.
c. Action: Maintain constant building static pressure.
3. Volume Control:
a. Input Device: Differential-pressure switch sensing building static pressure referenced to outdoor static pressure.
b. Output Device: DDC system analog output to motor speed controller. Set variable-speed drive to minimum speed when fan is stopped.
c. Action: Maintain constant building static pressure.
4. Display:
a. Return-air static-pressure indication.
b. Return-air static-pressure set point.
c. Return-fan airflow rate.
d. Return-fan speed.
e. Building static-pressure indication.
f. Building static-pressure set point.

E. Return Fan(s) Variable-Volume Control:
1. Occupied Time Schedule:
a. Input Device: DDC system time schedule.
b. Output Device: Binary output.
c. Action: Enable control.
2. Volume Control:
a. Input Device: Differential-pressure switch sensing building static pressure referenced to outdoor static pressure.
b. Output Device: DDC system analog output to modulating damper actuator. Set inlet guide vanes to closed position when fan is stopped.

c. Action: Maintain constant building static pressure.

3. Volume Control:
   a. Input Device: Differential-pressure switch sensing building static pressure referenced to outdoor static pressure.
   b. Output Device: DDC system analog output to motor speed controller. Set variable-speed drive to minimum speed when fan is stopped.
   c. Action: Maintain constant building static pressure.
4. Display:
   a. Return-fan-discharge static-pressure indication.
   b. Return-fan-discharge static-pressure set point.
   c. Return-fan airflow rate.
   d. Return-fan speed.

F. Mixed-Air Control:
1. Occupied Time Schedule:
   a. Input Device: DDC system time schedule.
   b. Output Device: DDC system output.
   c. Action: Enable control.
2. Minimum Position:
   a. Input Device: DDC system time schedule.
   b. Output Device: DDC system analog output to modulating damper actuator(s).
   c. Action: Open outdoor-air dampers to minimum position.
3. Heating Reset:
   a. Input Device: DDC system software.
   b. Output Device: DDC system analog output to modulating damper actuator(s).
   c. Action: Set outdoor-air dampers to minimum position.
4. Mixed-Air Temperature:
   a. Input Device: Electronic temperature sensor.
   b. Output Device: DDC system analog output to modulating damper actuator(s).
   c. Action: Modulate outdoor-, return-, and relief-air dampers to maintain air temperature set point of 55 deg F.
5. Cooling Reset:
   a. Input Device: Outdoor- and return-air, duct-mounted electronic temperature sensors.
   b. Output Device: DDC system analog output to damper actuator(s).
   c. Action: Set outdoor-air dampers to minimum position when outdoor-air enthalpy exceeds return-air enthalpy.
6. Unoccupied Time Schedule:
   a. Input Device: DDC system time schedule.
   b. Output Device: DDC system analog output to modulating damper actuator(s).
   c. Action: Position outdoor- and relief-air dampers closed and return-air dampers open.
7. Display:
   a. Mixed-air-temperature indication.
   b. Mixed-air-temperature set point.
   c. Mixed-air damper position.

G. Filters: During occupied periods, when fan is running, differential air-pressure transmitters exist.
1. Occupied Time Schedule:
   a. Input Device: DDC system time schedule.
   b. Output Device: DDC system output.
   c. Action: Enable control.
2. Differential Pressure:
   a. Input Device: Differential-pressure switches.
   b. Output Device: DDC system alarm.
   c. Action: Signal alarm on low- and high-pressure conditions.
3. Display:

a. Filter air-pressure-drop indication.
b. Filter low-air-pressure set point.
c. Filter high-air-pressure set point.

H. Coordination of Air-Handling Unit Sequences: Ensure that preheat, mixed-air, heating-coil, and cooling-coil controls have common inputs and do not overlap in function.

I. Operator Station Display: Indicate the following on operator workstation display terminal:
1. DDC system graphic.
2. DDC system on-off indication.
3. DDC system occupied/unoccupied mode.
4. Outdoor-air-temperature indication.
5. Supply-fan on-off indication.
6. Supply-fan-discharge static-pressure indication.
7. Supply-fan-discharge static-pressure set point.
8. Supply-fan airflow rate.
9. Supply-fan [**inlet vane position**] [**speed**].
10. Return-fan on-off indication.
11. Return-air static-pressure indication.
12. Return-air static-pressure set point.
13. Return-fan airflow rate.
14. Return-fan [**inlet vane position**] [**speed**].
15. Building static-pressure indication.
16. Building static-pressure set point.
17. Preheat-coil air-temperature indication.
18. Preheat-coil air-temperature set point.
19. Preheat-coil pump operation indication.
20. Preheat-coil control-valve position.
21. Mixed-air-temperature indication.
22. Mixed-air-temperature set point.
23. Mixed-air damper position.
24. Relative humidity indication.
25. Relative humidity set point.
26. Relative humidity control-valve position.
27. Filter air-pressure-drop indication.
28. Filter low-air-pressure set point.
29. Filter high-air-pressure set point.
30. Fan-discharge air-temperature indication.
31. Fan-discharge air-temperature set point.
32. Heating-coil air-temperature indication.
33. Heating-coil air-temperature set point.
34. Heating-coil pump operation indication.
35. Heating-coil control-valve position.
36. Cooling-coil air-temperature indication.
37. Cooling-coil air-temperature set point.
38. Cooling-coil control-valve position.
39. Room temperature indication.
40. Room temperature set point.

1.4 VENTILATION SEQUENCES

A. Combustion-Air, Makeup Unit Control, Electric: Start fan when served appliance burner starts; room thermostat sequences stages of heating.

B. Combustion-Air, Makeup Unit Control, Hydronic: Start fan when served appliance burner starts; room thermostat [**cycles**] [**modulates**] control valve.

C. Gravity Roof Ventilator: [**Occupancy sensor**] [**Room thermostat**] opens dampers.

D. Exhaust Fan: [**Occupancy sensor**] [**Interlock with light switch**] [**Room thermostat**] cycles fan.

E. Kitchen Exhaust Fan: Occupancy sensor starts fan and energizes makeup air unit.

PART 2 - PRODUCTS (Not Applicable)
PART 3 - EXECUTION (Not Applicable)
END OF SECTION 230993

SECTION 231123 - FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Pipes, tubes, and fittings.
2. Piping specialties.
3. Piping and tubing joining materials.
4. Valves.
5. Pressure regulators.

1.2 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:
1. Piping and Valves: 100 psig minimum unless otherwise indicated.
2. Service Regulators: 100 psig minimum unless otherwise indicated.

B. Natural-Gas System Pressure within Buildings: More than 0.5 psig but not more than 2 psig.

C. Natural-Gas System Pressures within Buildings: Two pressure ranges. Primary pressure is more than 0.5 psig but not more than 2 psig, and is reduced to secondary pressure of 0.5 psig or less.

D. Delegated Design: Design restraints and anchors for natural-gas piping and equipment, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.3 SUBMITTALS

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

B. Shop Drawings: For facility natural-gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

C. Delegated-Design Submittal: For natural-gas piping and equipment indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Detail fabrication and assembly of seismic restraints.
2. Design Calculations: Calculate requirements for selecting seismic restraints.

D. Welding certificates.

E. Field quality-control reports.

F. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

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

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
4. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.

B. Corrugated, Stainless-Steel Tubing: Comply with ANSI/IAS LC 1.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. OmegaFlex, Inc.
   b. Parker Hannifin Corporation; Parflex Division.
   c. Titeflex.
   d. Tru-Flex Metal Hose Corp.
2. Tubing: ASTM A 240/A 240M, corrugated, Series 300 stainless steel.
3. Coating: PE with flame retardant.
   a. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
      1) Flame-Spread Index: 25 or less.
      2) Smoke-Developed Index: 50 or less.
4. Fittings: Copper-alloy mechanical fittings with ends made to fit and listed for use with corrugated stainless-steel tubing and capable of metal-to-metal seal without gaskets. Include brazing socket or threaded ends complying with ASME B1.20.1.
5. Striker Plates: Steel, designed to protect tubing from penetrations.
6. Manifolds: Malleable iron or steel with factory-applied protective coating. Threaded connections shall comply with ASME B1.20.1 for pipe inlet and corrugated tubing outlets.
7. Operating-Pressure Rating: 5 psig.

C. Annealed-Temper Copper Tube: Comply with ASTM B 88, Type K.
1. Copper Fittings: ASME B16.22, wrought copper, and streamlined pattern.
2. Flare Fittings: Comply with ASME B16.26 and SAE J513.
   a. Copper fittings with long nuts.
   b. Metal-to-metal compression seal without gasket.
   c. Dryseal threads complying with ASME B1.20.3.
3. Protective Coating for Underground Tubing: Factory-applied, extruded PE a minimum of 0.022 inch thick.

D. PE Pipe: ASTM D 2513, SDR 11.
1. PE Fittings: ASTM D 2683, socket-fusion type or ASTM D 3261, butt-fusion type with dimensions matching PE pipe.
2. PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D 2513, SDR 11; and steel pipe complying with ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
3. Anodeless Service-Line Risers: Factory fabricated and leak tested.
   a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet.
   b. Casing: Steel pipe complying with ASTM A 53/A 53M, Schedule 40, black steel, Type E or S, Grade B, with corrosion-protective coating covering. Vent casing aboveground.
   c. Aboveground Portion: PE transition fitting.
   d. Outlet shall be threaded or suitable for welded connection.
   e. Tracer wire connection.
   f. Ultraviolet shield.
   g. Stake supports with factory finish to match steel pipe casing or carrier pipe.
4. Transition Service-Line Risers: Factory fabricated and leak tested.
   a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet connected to steel pipe complying with ASTM A 53/A 53M, Schedule 40, Type E or S, Grade B, with corrosion-protective coating for aboveground outlet.
   b. Outlet shall be threaded or suitable for welded connection.
   c. Bridging sleeve over mechanical coupling.
   d. Factory-connected anode.
   e. Tracer wire connection.
   f. Ultraviolet shield.
   g. Stake supports with factory finish to match steel pipe casing or carrier pipe.

2.2 PIPING SPECIALTIES

A. Appliance Flexible Connectors:
1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
4. Corrugated stainless-steel tubing with polymer coating.
5. Operating-Pressure Rating: 0.5 psig.
6. End Fittings: Zinc-coated steel.
7. Threaded Ends: Comply with ASME B1.20.1.
8. Maximum Length: 72 inches

B. Quick-Disconnect Devices: Comply with ANSI Z21.41.
1. Copper-alloy convenience outlet and matching plug connector.
2. Nitrile seals.
3. Hand operated with automatic shutoff when disconnected.
4. For indoor or outdoor applications.
5. Adjustable, retractable restraining cable.

C. Y-Pattern Strainers:
1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

D. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.3 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.4 MANUAL GAS SHUTOFF VALVES

A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.

B. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.
1. CWP Rating: 125 psig.
2. Threaded Ends: Comply with ASME B1.20.1.
3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.

C. One-Piece, Bronze Ball Valve with Bronze Trim: MSS SP-110.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. BrassCraft Manufacturing Company; a Masco company.
b. Conbraco Industries, Inc.; Apollo Div.
c. Lyall, R. W. & Company, Inc.
d. McDonald, A. Y. Mfg. Co.
e. Perfection Corporation; a subsidiary of American Meter Company.

2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated brass.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Separate packnut with adjustable-stem packing threaded ends.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. BrassCraft Manufacturing Company; a Masco company.
   b. Conbraco Industries, Inc.; Apollo Div.
   c. Lyall, R. W. & Company, Inc.
   d. McDonald, A. Y. Mfg. Co.
   e. Perfection Corporation; a subsidiary of American Meter Company.
2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

E. Two-Piece, Regular-Port Bronze Ball Valves with Bronze Trim: MSS SP-110.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. BrassCraft Manufacturing Company; a Masco company.
   b. Conbraco Industries, Inc.; Apollo Div.
   c. Lyall, R. W. & Company, Inc.
   d. McDonald, A. Y. Mfg. Co.
   e. Perfection Corporation; a subsidiary of American Meter Company.
2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

F. Bronze Plug Valves: MSS SP-78.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Lee Brass Company.
   b. McDonald, A. Y. Mfg. Co.
2. Body: Bronze, complying with ASTM B 584.
3. Plug: Bronze.

4. Ends: Threaded, socket, as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Operator: Square head or lug type with tamperproof feature where indicated.
6. Pressure Class: 125 psig.
7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

G. PE Ball Valves: Comply with ASME B16.40.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Kerotest Manufacturing Corp.
   b. Lyall, R. W. & Company, Inc.
   c. Perfection Corporation; a subsidiary of American Meter Company.
2. Body: PE.
3. Ball: PE.
4. Stem: Acetal.
5. Seats and Seals: Nitrile.
6. Ends: Plain or fusible to match piping.
7. CWP Rating: 80 psig.
8. Operating Temperature: Minus 20 to plus 140 deg F.
9. Operator: Nut or flat head for key operation.
10. Include plastic valve extension.
11. Include tamperproof locking feature for valves where indicated on Drawings.

H. Valve Boxes:
1. Cast-iron, two-section box.
2. Top section with cover with "GAS" lettering.
3. Bottom section with base to fit over valve and barrel a minimum of 5 inches in diameter.
4. Adjustable cast-iron extensions of length required for depth of bury.
5. Include tee-handle, steel operating wrench with socket end fitting valve nut or flat head, and with stem of length required to operate valve.

2.5 MOTORIZED GAS VALVES

A. Electrically Operated Valves: Comply with UL 429.
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   a. ASCO Power Technologies, LP; Division of Emerson.
   b. Dungs, Karl, Inc.
   c. Eclipse Combustion, Inc.
   d. Goyen Valve Corp.; Tyco Environmental Systems.
   e. Magnatrol Valve Corporation.
   f. Parker Hannifin Corporation; Climate & Industrial Controls Group; Skinner Valve Div.
   g. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
2. Pilot operated.
3. Body: Brass or aluminum.
4. Seats and Disc: Nitrile rubber.
5. Springs and Valve Trim: Stainless steel.
6. 120-V ac, 60 Hz, Class B, continuous-duty molded coil, and replaceable.
7. NEMA ICS 6, Type 4, coil enclosure.
8. Normally closed.
9. Visual position indicator.

2.6 EARTHQUAKE VALVES

A. Earthquake Valves: Comply with ASCE 25.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Vanguard Valves, Inc.

2. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction.
3. Maximum Operating Pressure: 5 psig.
4. Cast-aluminum body with nickel-plated chrome steel internal parts.
5. Nitrile-rubber valve washer.
6. Sight windows for visual indication of valve position.
7. Threaded end connections complying with ASME B1.20.1.
8. Wall mounting bracket with bubble level indicator.

B. Earthquake Valves: Comply with ASCE 25.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Pacific Seismic Products, Inc.
2. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction.
3. Maximum Operating Pressure: 7 psig.
4. Cast-aluminum body with stainless-steel internal parts.
5. Nitrile-rubber, reset-stem o-ring seal.
6. Valve position, open or closed, indicator.
7. Composition valve seat with clapper held by spring or magnet locking mechanism.
8. Level indicator.
9. End Connections: Threaded for valves NPS 2 and smaller.

2.7 PRESSURE REGULATORS

A. General Requirements:
1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller.

B. Line Pressure Regulators: Comply with ANSI Z21.80.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Actaris.
   b. American Meter Company.
   c. Eclipse Combustion, Inc.
   d. Fisher Control Valves and Regulators; Division of Emerson Process Management.
   e. Invensys.
   f. Maxitrol Company.
   g. Richards Industries; Jordan Valve Div.
2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 2 psig.

C. Appliance Pressure Regulators: Comply with ANSI Z21.18.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Canadian Meter Company Inc.
   b. Eaton Corporation; Controls Div.

c. Harper Wyman Co.
d. Maxitrol Company.
e. SCP, Inc.

2. Body and Diaphragm Case: Die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber.
6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
9. Maximum Inlet Pressure: 2 psig.

2.8 DIELECTRIC UNIONS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Capitol Manufacturing Company.
2. Central Plastics Company.
3. Hart Industries International, Inc.
4. McDonald, A. Y. Mfg. Co.
5. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
6. Wilkins; Zurn Plumbing Products Group.

B. Minimum Operating-Pressure Rating: 150 psig.
C. Combination fitting of copper alloy and ferrous materials.
D. Insulating materials suitable for natural gas.
E. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

2.9 SLEEVES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

2.10 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Advance Products & Systems, Inc.
b. Calpico Inc.
c. Metraflex Company (The).
d. Pipeline Seal and Insulator, Inc.
2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe and sleeve.
3. Pressure Plates: Carbon steel.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one nut and bolt for each sealing element.

2.11 LABELING AND IDENTIFYING

A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

PART 3 - EXECUTION

3.1 OUTDOOR PIPING INSTALLATION

A. Comply with NFPA 54 for installation and purging of natural-gas piping.

B. Install underground, natural-gas piping buried at least 36 inches below finished grade. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.
   1. If natural-gas piping is installed less than 36 inches below finished grade, install it in containment conduit.
C. Install underground, PE, natural-gas piping according to ASTM D 2774.
D. Steel Piping with Protective Coating:
   1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
   2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
   3. Replace pipe having damaged PE coating with new pipe.
E. Copper Tubing with Protective Coating:
   1. Apply joint cover kits over tubing to cover, seal, and protect joints.
   2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
F. Install fittings for changes in direction and branch connections.
G. Exterior-Wall Pipe Penetrations: Seal penetrations using steel or cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
H. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
I. Install pressure gage downstream from each service regulator. Pressure gages are specified in Division 23 Section "Meters and Gages for HVAC Piping."

3.2 INDOOR PIPING INSTALLATION

A. Comply with NFPA 54 for installation and purging of natural-gas piping.
B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
G. Locate valves for easy access.
H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
I. Install piping free of sags and bends.
J. Install fittings for changes in direction and branch connections.
K. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
L. Verify final equipment locations for roughing-in.
M. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
N. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
   1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3

inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

O. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

P. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.

Q. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

R. Connect branch piping from top or side of horizontal piping.

S. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment.

T. Do not use natural-gas piping as grounding electrode.

U. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

V. Install pressure gage downstream from each line regulator. Pressure gages are specified in Division 23 Section "Meters and Gages for HVAC Piping."

3.3 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing or copper connector.

B. Install underground valves with valve boxes.

C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

D. Install earthquake valves aboveground outside buildings according to listing.

E. Install anode for metallic valves in underground PE piping.

3.4 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints:

1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
2. Cut threads full and clean using sharp dies.
3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints:

1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
2. Bevel plain ends of steel pipe.
3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.

F. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.

G. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.5 HANGER AND SUPPORT INSTALLATION

A. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.

3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.

B. Install hangers for horizontal, corrugated stainless-steel tubing with the following maximum spacing and minimum rod sizes:
1. NPS 3/8: Maximum span, 48 inches; minimum rod size, 3/8 inch.
2. NPS 1/2: Maximum span, 72 inches; minimum rod size, 3/8 inch.
3. NPS 3/4 and Larger: Maximum span, 96 inches; minimum rod size, 3/8 inch.

3.6 CONNECTIONS

A. Connect to utility's gas main according to utility's procedures and requirements.
B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.
C. Install piping adjacent to appliances to allow service and maintenance of appliances.
D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.7 LABELING AND IDENTIFYING

A. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for piping and valve identification.Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.8 FIELD QUALITY CONTROL

A. Test, inspect, and purge natural gas according to NFPA 54 and authorities having jurisdiction.
B. Natural-gas piping will be considered defective if it does not pass tests and inspections.
C. Prepare test and inspection reports.

3.9 OUTDOOR PIPING SCHEDULE

A. Underground natural-gas piping shall be one of the following:
1. PE pipe and fittings joined by heat fusion; service-line risers with tracer wire terminated in an accessible location.
2. Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.
3. Annealed-temper copper tube with wrought-copper fittings and brazed joints. Coat pipe and fittings with protective coating for copper tubing.

B. Aboveground natural-gas piping shall be one of the following:
1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with wrought-steel fittings and welded joints.
3. Annealed-temper copper tube with wrought-copper fittings and brazed joints.

C. Branch Piping in Cast-in-Place Concrete to Single Appliance: Annealed-temper copper tube with wrought-copper fittings and brazed joints. Install piping embedded in concrete with no joints in concrete.
D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

3.10 INDOOR PIPING SCHEDULE

A. Aboveground, branch piping NPS 1 and smaller shall be one of the following:
1. Corrugated stainless-steel tubing with mechanical fittings having socket or threaded ends to match adjacent piping.
2. Annealed-temper copper tube with wrought-copper fittings and brazed joints.
3. Steel pipe with malleable-iron fittings and threaded joints.

B. Aboveground, distribution piping shall be one of the following:
1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with wrought-steel fittings and welded joints.

C. Underground, below building, piping shall be one of the following:
1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with wrought-steel fittings and welded joints.

D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.
E. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

3.11 UNDERGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Connections to Existing Gas Piping: Use valve and fitting assemblies made for tapping utility's gas mains and listed by an NRTL.
B. Underground: Bronze plug valves.

3.12 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Valves for pipe sizes NPS 2 and smaller at service meter shall be one of the following:
   1. One-piece, bronze ball valve with bronze trim.
   2. Two-piece, full-port, bronze ball valves with bronze trim.
   3. Bronze plug valve.
B. Distribution piping valves for pipe sizes NPS 2 and smaller shall be one of the following:
   1. One-piece, bronze ball valve with bronze trim.
   2. Two-piece, full-port, bronze ball valves with bronze trim.
   3. Bronze plug valve.
C. Valves in branch piping for single appliance shall be one of the following:
   1. One-piece, bronze ball valve with bronze trim.
   2. Two-piece, full-port, bronze ball valves with bronze trim.
   3. Bronze plug valve.

END OF SECTION 231123

SECTION 232300 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes refrigerant piping used for air-conditioning applications.

1.2 PERFORMANCE REQUIREMENTS

A. Line Test Pressure for Refrigerant:
   1. Suction Lines for Air-Conditioning Applications: Per Manufacturer's Suggestions
   2. Suction Lines for Heat-Pump Applications: Per Manufacturer's Suggestions
   3. Hot-Gas and Liquid Lines: Per Manufacturer's Suggestions

1.3 SUBMITTALS

A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop based on manufacturer's test data.

B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.
   1. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.

C. Field quality-control test reports.

D. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."

B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.5 PRODUCT STORAGE AND HANDLING

A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B 88, Type K or L.

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.

E. Brazing Filler Metals: AWS A5.8.

F. Flexible Connectors:
   1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
   2. End Connections: Socket ends.
   3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch-long assembly.
   4. Pressure Rating: Factory test at minimum 500 psig.
   5. Maximum Operating Temperature: 250 deg F.

2.2 VALVES AND SPECIALTIES

A. Service Valves:
   1. Body: Forged brass with brass cap including key end to remove core.
   2. Core: Removable ball-type check valve with stainless-steel spring.
   3. Seat: Polytetrafluoroethylene.
   4. End Connections: Copper spring.
   5. Working Pressure Rating: 500 psig.

B. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.
   1. Body and Bonnet: Plated steel.
   2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
   3. Seat: Polytetrafluoroethylene.

4. End Connections: Threaded.
5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and coil with voltage as required.
6. Working Pressure Rating: 400 psig.
7. Maximum Operating Temperature: 240 deg F.
8. Manual operator.

C. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
2. Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Seat Disc: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Working Pressure Rating: 400 psig.
6. Maximum Operating Temperature: 240 deg F.

D. Thermostatic Expansion Valves: Comply with ARI 750.
1. Body, Bonnet, and Seal Cap: Forged brass or steel.
2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Packing and Gaskets: Non-asbestos.
4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
5. Suction Temperature: 40 deg F.
6. Superheat: Adjustable.
7. Reverse-flow option (for heat-pump applications).
8. End Connections: Socket, flare, or threaded union.
9. Working Pressure Rating: 700 psig.

E. Straight-Type Strainers:
1. Body: Welded steel with corrosion-resistant coating.
2. Screen: 100-mesh stainless steel.
3. End Connections: Socket or flare.
4. Working Pressure Rating: 500 psig.
5. Maximum Operating Temperature: 275 deg F.

F. Angle-Type Strainers:
1. Body: Forged brass or cast bronze.
2. Drain Plug: Brass hex plug.
3. Screen: 100-mesh monel.
4. End Connections: Socket or flare.
5. Working Pressure Rating: 500 psig.
6. Maximum Operating Temperature: 275 deg F.

G. Moisture/Liquid Indicators:
1. Body: Forged brass.
2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
3. Indicator: Color coded to show moisture content in ppm.
4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
5. End Connections: Socket or flare.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 240 deg F.

H. Replaceable-Core Filter Dryers: Comply with ARI 730.
1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated alumina.
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
7. Maximum Pressure Loss: 2 psig.

8. Rated Flow:
9. Working Pressure Rating: 500 psig.
10. Maximum Operating Temperature: 240 deg F.

I. Permanent Filter Dryers: Comply with ARI 730.
1. Body and Cover: Painted-steel shell.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated alumina.
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
7. Maximum Pressure Loss: 2 psig.
8. Rated Flow:
9. Working Pressure Rating: 500 psig.
10. Maximum Operating Temperature: 240 deg F.

J. Liquid Accumulators: Comply with ARI 495.
1. Body: Welded steel with corrosion-resistant coating.
2. End Connections: Socket or threaded.
3. Working Pressure Rating: 500 psig.
4. Maximum Operating Temperature: 275 deg F.

2.3 REFRIGERANTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Atofina Chemicals, Inc.
2. DuPont Company; Fluorochemicals Div.
3. Honeywell, Inc.; Genetron Refrigerants.
4. INEOS Fluor Americas LLC.

B. ASHRAE 34, R-22: Monochlorodifluoromethane.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Suction Lines NPS 1-1/2 and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.

B. Suction Lines NPS 2 to NPS 4 for Conventional Air-Conditioning Applications: Copper, Type L, drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.

C. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.

D. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with soldered joints.

E. Safety-Relief-Valve Discharge Piping:
1. NPS 1-1/2 and Smaller: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.
2. NPS 2 to NPS 3: Copper, Type K, annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
3. NPS 4: Copper, Type ACR K L, drawn-temper tubing and wrought-copper fittings with soldered joints.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved by Designer.

B. Install refrigerant piping according to ASHRAE 15.

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
F. Install piping adjacent to machines to allow service and maintenance.
G. Install piping free of sags and bends.
H. Install fittings for changes in direction and branch connections.
I. Select system components with pressure rating equal to or greater than system operating pressure.
J. Refer to Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls" for solenoid valve controllers, control wiring, and sequence of operation.
K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Division 08 Section "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
M. Install refrigerant piping in protective conduit where installed belowground.
N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
O. Slope refrigerant piping as follows:
    1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
    2. Install horizontal suction lines with a uniform slope downward to compressor.
    3. Install traps and double risers to entrain oil in vertical runs.
    4. Liquid lines may be installed level.
P. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
Q. Install pipe sleeves at penetrations in exterior walls and floor assemblies.
R. Seal penetrations through fire and smoke barriers according to Division 07 Section "Penetration Firestopping."
S. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
T. Install sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.
U. Seal pipe penetrations through exterior walls according to Division 07 Section "Joint Sealants" for materials and methods.
V. Identify refrigerant piping and valves according to Division 23 Section "Identification for HVAC Piping and Equipment."

3.3 PIPE JOINT CONSTRUCTION

A. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."
B. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
    1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
    2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

3.4 HANGERS AND SUPPORTS

A. Hanger, support, and anchor products are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
B. Install the following pipe attachments:
    1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
    2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.

3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:
1. NPS 1/2: Maximum span, 60 inches; minimum rod size, 1/4 inch.
2. NPS 5/8: Maximum span, 60 inches; minimum rod size, 1/4 inch.
3. NPS 1: Maximum span, 72 inches; minimum rod size, 1/4 inch.
4. NPS 1-1/4: Maximum span, 96 inches; minimum rod size, 3/8 inch.
5. NPS 1-1/2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
6. NPS 2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
7. NPS 2-1/2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
8. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
9. NPS 4: Maximum span, 12 feet; minimum rod size, 1/2 inch.

D. Support multifloor vertical runs at least at each floor.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:
1. Comply with ASME B31.5, Chapter VI.
2. Test refrigerant piping and specialties. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.
a. Fill system with nitrogen to the required test pressure.
b. System shall maintain test pressure at the manifold gage throughout duration of test.
c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.6 SYSTEM CHARGING

A. Charge system using the following procedures:
1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
4. Charge system with a new filter-dryer core in charging line.

3.7 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.

B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.

D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
1. Open shutoff valves in condenser water circuit.
2. Verify that compressor oil level is correct.
3. Open compressor suction and discharge valves.
4. Open refrigerant valves except bypass valves that are used for other purposes.
5. Check open compressor-motor alignment and verify lubrication for motors and bearings.

E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 232300

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Rectangular ducts and fittings.
2. Round ducts and fittings.
3. Sheet metal materials.
4. Sealants and gaskets.
5. Hangers and supports.
6. Seismic-restraint devices.

B. Related Sections:
1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Division 23 Section "Nonmetal Ducts" for fibrous-glass ducts, thermoset fiber-reinforced plastic ducts, thermoplastic ducts, PVC ducts, and concrete ducts.
3. Division 23 Section "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.
4. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 PERFORMANCE REQUIREMENTS

A. Construct all ductwork to be free from vibration, chatter, objectionable pulsations and leakage under specified operating conditions.

B. Use material, weight, thickness, gauge, construction and installation methods as outlined in the following SMACNA publications, unless noted otherwise:
1. HVAC Duct Construction Standards, Metal and Flexible, 2nd Edition, 1995
2. HVAC Air Duct Leakage Test Manual, 1st Edition, 1985
3. HVAC Systems - Duct Design, 3rd Edition, 1990
4. Rectangular Industrial Duct Construction Standard, 1st Edition, 1980
5. Round Industrial Duct Construction Standards, 2nd Edition, 1999
6. Thermoplastic Duct (PVC) Construction Manual, 2nd Edition, 1995
7. Round Industrial Duct Construction Standards, 2nd Edition, 1999
8. Rectangular Industrial Duct Construction Standards, 1st Edition, 1980

C. Use products which conform to NFPA 90A, possessing a flame spread rating of not over 25 and a smoke developed rating no higher than 50.

1.3 SUBMITTALS

A. Include manufacturer's data and/or Contractor data for the following:
1. Schedule of duct systems including material of construction, gauge, pressure class, system class, method of reinforcement, joint construction, fitting construction, and support methods, all with details as appropriate.
2. Duct sealant and gasket material.
3. Duct liner including data on thermal conductivity, air friction correction factor, and limitation on temperature and velocity.

B. Welding certificates.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

PART 2 - PRODUCTS

2.1 GENERAL

A. All sheet metal used for construction of duct shall be 24 gauge or heavier except for round and spiral ductwork and spiral duct take-offs 12” and below may be 26 gauge where allowed in SMACNA HVAC Duct Construction Standards, Metal and Flexible, 2nd Edition, 1995.

B. Duct sizes indicated on plans are net inside dimensions; where duct liner is specified, dimensions are net, inside of liner.

2.2 DUCTWORK PRESSURE CLASS

A. Minimum acceptable duct pressure class, for all ductwork except transfer ductwork, is 2 inch W.G. positive or negative, depending on the application. Transfer ductwork minimum acceptable duct pressure class is 1 inch W.G. positive or negative, depending on the application. Duct system pressure classes not indicated on the drawings to be as follows:

Supply duct upstream of VAV boxes	_____ in. calc. S.P.	_____ in. pressure class
Supply duct downstream of VAV terminals	_ in. calc. S.P.	_____ in. pressure class
Transfer ducts	_____ in. calc. S.P.	_____ in. pressure class
Exhaust ducts	_____ in. calc. S.P.	_____ in. pressure class
Return ducts	_____ in. calc. S.P.	_____ in. pressure class
Relief ducts	_____ in. calc. S.P.	_____ in. pressure class
Dust Collection Exhaust	_____ in. calc. S.P.	_____ in. pressure class
Other duct systems	_____ in. calc. S.P.	_____ in. pressure class

2.3 MATERIALS

A. Galvanized Steel Sheet: Use ASTM A 653 galvanized steel sheet of lock forming quality. Galvanized coating to be 1.25 ounces per square foot, both sides of sheet, G90 in accordance with ASTM A90.

B. Uncoated Black Steel Sheet: First quality, soft steel sheet capable of welding or double seaming without fracture.

C. Aluminum Sheet: Use ANSI/ASTM B209 aluminum sheet, alloy 3003H-14, capable of double seaming without fracture.

D. Stainless Steel Sheet: Use ASTM A167, Type 304 or 316 stainless steel sheet as specified, 316L if welded ductwork, with No. 2B finish for concealed work and No. 3 finish for exposed work.

E. Polyvinylchloride Coated Steel Sheet: Use hot-dipped galvanized steel sheet with prime coat and a polyvinyl chloride film on both sides. Thickness of coating to be a minimum of 4 mils on each side. United Sheet Metal Uni-Coat, made by United McGill Co., may be used at contractor's option.

1. Where any duct surface is scratched, marred, or otherwise damaged, paint with PVC aerosol spray.
2. All couplings shall be slip-joint construction with a minimum 2 inches insertion length. Seal all couplings with sealants as specified.

F. PREFABRICATED GREASE DUCTS: Dual wall construction with stainless steel inner liner, insulation and stainless steel (for exposed locations) or aluminized steel (for concealed locations) shell. Furnish all items which form a part of the assembly, including, tee sections, straight sections, elbows, end caps, cleanouts, expansion joints, fan/hood transitions, supports, flashing, counter flashing, and insulated roof thimble where required. Each section shall bear the factory applied Underwriters Laboratories Label.

2.4 HIGH PRESSURE DUCTWORK (Pressure class 3 inch and over)

A. Manufacturers: Ajax, Semco, United Sheet Metal, or approved equal.

B. Machine formed round and/or flat oval spiral lock seam duct constructed of galvanized steel.

~~C.~~ Rectangular high pressure duct using a transverse joint system as manufactured by Ductmate, Nexus, TDC, TDF, or approved equal, may be used at contractor's option. Duct to be flanged, gasketed and sealed.

D. Contractor fabricated ductwork meeting specified construction standards is acceptable with prior approval of Architect/Engineer. Submit construction details, a description of materials to be used, type of service, reinforcing methods, and sealing procedures.

E. Use a perforated inner liner on double wall high-pressure duct. Annular space between inner liner and outer duct to be filled with 1 inch glass fiber insulation.

F. Use cemented slip joints with 2 inch minimum overlap, flanged connections, or welded/brazed connections, unless noted otherwise for special applications. Prime coat welded joints.

G. Provide standard 90 degree conical tee takeoffs except for exhaust at velocities over 2000 feet per minute, use 45° lateral connections; straight taps or bullhead tees are not acceptable.
H. Internal bracing will not be accepted on ductwork below 48 inches.
I. Use turning vanes as specified in Section 23 33 12.
J. Provide bellmouth fittings or expanded fittings at each duct connection to air plenums.
K. Provide pressure relief fittings as indicated on the plans and/or details.
L. Transform duct sizes gradually, not exceeding 15 degrees divergence and 30 degrees convergence.

2.5 LOW PRESSURE DUCTWORK (Maximum 2 inch pressure class)

A. Fabricate and install ductwork in sizes indicated on the drawings and in accordance with SMACNA recommendations, except as modified below.
B. Construct so that all interior surfaces are smooth. Use slip and drive or flanged and bolted construction when fabricating rectangular ductwork. Use spiral lock seam construction when fabricating round spiral ductwork. Sheet metal screws may be used on duct hangers, transverse joints and other SMACNA approved locations if the screw does not extend more than 1/2 inch into the duct.
C. Use elbows and tees with a center line radius to width or diameter ratio of 1.5 wherever space permits. When a shorter radius must be used due to limited space, install single wall sheet metal splitter vanes in accordance with SMACNA publications, Type RE 3. Where space will not allow and the C value of the radius elbow, as given in SMACNA publications, exceeds 0.31, use rectangular elbows with turning vanes as specified in Section 23 33 00. Square throat-radius heel elbows will not be acceptable. Straight taps or bullhead tees are not acceptable.
D. Where rectangular elbows are used, provide turning vanes in accordance with Section 23 33 00.
E. Provide expanded take-offs or 45 degree entry fittings for branch duct connections with branch ductwork airflow velocities greater than 700 fpm. Square edge 90-degree take-off fittings or straight taps will not be accepted.
F. Button punch snaplock construction will not be accepted on aluminum ductwork.
G. Round ducts may be substituted for rectangular ducts if sized in accordance with ASHRAE table of equivalent rectangular and round ducts, with approval of Engineer. No variation of duct configuration or sizes permitted except by written permission of the Architect/Engineer.
H. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.

2.6 KITCHEN HOOD EXHAUST DUCT CONSTRUCTION

A. In concealed locations use minimum 16 gauge black steel or minimum 18 gauge stainless steel with all joints welded liquid tight or prefabricated grease duct, Underwriters Laboratory, Inc listed with aluminized steel shell
B. **Note:** Factory prefabricated duct may still require a 2-hr fire rated enclosure or fire stop insulation where concealed and serving a Type I hood (grease vapors or smoke). As of the date of the updated version of this specification section, grease duct manufacturers do not have a product that is UL listed for grease vapor and smoke application.
C. In exposed areas, use 18 gauge or heavier stainless steel with a number 3 finish and with all joints welded liquid tight or prefabricated Underwriters Laboratory, Inc listed duct with stainless steel shell. Grind and polish all welded joints and seams to a number 3 finish.
D. Provide expanded take-offs for branch duct connections or 45 degree entry fittings. Square edge 90 degree take-off fittings or straight taps will not be accepted.
E. Use elbows and tees with a center line radius to width or diameter ratio of 1.5 wherever space permits shall be used wherever possible. Shorter radius elbows may be used in areas with limited space with prior approval of the Architect/Engineer.
F. No turning vanes may be used in kitchen exhaust duct.
G. Supporting steel and hangers shall not be lighter than the duct gauge.

2.7 DISHWASHER EXHAUST DUCT CONSTRUCTION

A. Fabricate and install ductwork in sizes indicated on the drawings and in accordance with SMACNA recommendations, except as indicated below.

B. Use 18 gauge or heavier stainless steel with all seams and joints welded and ground smooth. In exposed areas, joints and seams to be polished to a #3 finish (minimum).

C. Use elbows and tees as specified for the appropriate duct pressure class.

D. Provide expanded take-offs for branch duct connections or 45 degree entry fittings. Square edge 90 degree take-off fittings or straight taps will not be accepted.

2.8 FUME EXHAUST DUCT CONSTRUCTION

A. Use PVC coated steel or stainless steel duct and fittings. Use stainless steel for all exposed installations below suspended ceilings.

B. Use 316 stainless steel for flanged gasketed connections.

C. Use 18 gauge or heavier 316L stainless steel sheet for externally welded ductwork. Grind and polish joints and seams to a #3 finish minimum.

2.9 DUCT SEALANT

A. Manufacturer: 3M 800, 3M 900, H.B. Fuller/Foster, Hardcast, Hardcast Peal & Seal, Lockformer cold sealant, Mon-Eco Industries, United Sheet Metal, or approved equal. Silicone sealants are not allowed in any type of ductwork installation.

B. Install sealants in strict accordance with manufacturer's recommendations, paying special attention to temperature limitations. Allow sealant to fully cure before pressure testing of ductwork, or before startup of air handling systems.

2.10 GASKETS

A. 2 inch pressure class and lower: Soft neoprene or butyl gaskets in combination with duct sealant for flanged joints.

B. 3 inch pressure class and higher: Butyl gaskets.

C. FUME HOOD EXHAUST; Butyl gaskets.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved by Designer prior to fabrication.

B. Take field measurements to verify duct routing and coordination with all trades prior to fabrication.

C. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

D. Install round ducts in maximum practical lengths.

E. Install ducts with fewest possible joints.

F. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

G. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

H. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

I. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

J. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

K. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

L. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.

M. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

3.2 SEAM AND JOINT SEALING

A. Seal duct seams and joints for duct static-pressure and leakage classes specified in "Performance Requirements" Article, according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 1-2, "Standard Duct Sealing Requirements," unless otherwise indicated.

B. Seal Classes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 1-2, "Standard Duct Sealing Requirements."

3.3 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
   1. Where practical, install concrete inserts before placing concrete.
   2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
   3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
   4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
   5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.4 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."
   1. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
   2. Brace a change of direction longer than 12 feet.

B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install cable restraints on ducts that are suspended with vibration isolators.

E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.

F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.

G. Drilling for and Setting Anchors:
   1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are

encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.

2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.5 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as follows:
   1. Commercial Kitchen Hood Exhaust Ducts: Comply with NFPA 96.
      a. Exposed to View: Type 304, stainless-steel sheet, No. 4 finish.
      b. Concealed: Type 304, stainless-steel sheet, No. 2D finish.
      c. Welded seams and joints.
   2. Dishwasher Hood Exhaust Ducts:
      a. Type 304, stainless-steel sheet.
      b. Exposed to View: No. 4 finish.
      c. Concealed: No. 2D finish.
      d. Welded seams and flanged joints with watertight EPDM gaskets.
   3. Moist Environment Ducts: Aluminum.

B. Intermediate Reinforcement:
   1. Galvanized-Steel Ducts: Galvanized steel.
   2. Stainless-Steel Ducts: Galvanized steel.
   3. Aluminum Ducts: Aluminum or galvanized sheet steel coated with zinc chromate.

C. Elbow Configuration:
   1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
      a. Velocity 1000 fpm or Lower:
         1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
         2) Mitered Type RE 4 without vanes.
      b. Velocity 1000 to 1500 fpm:
         1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
         2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
         3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
      c. Velocity 1500 fpm or Higher:
         1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
         2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
         3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
   2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."
      a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible,"

Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.

b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

D. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."
   a. Rectangular Main to Rectangular Branch: 45-degree entry.
   b. Rectangular Main to Round Branch: Spin in.
2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Saddle taps are permitted in existing duct.
   a. Velocity 1000 fpm or Lower: 90-degree tap.
   b. Velocity 1000 to 1500 fpm: Conical tap.
   c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 233113

SECTION 233116 - NONMETAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Fibrous-glass ducts and fittings.
   2. Phenolic-foam ducts and fittings.

B. Related Sections:
   1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for nonmetal ducts.
   2. Division 23 Section "Metal Ducts" for single- and double-wall, rectangular and round ducts.
   3. Division 23 Section "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.
   4. Division 23 Section "Air Duct Accessories" for dampers, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 SUBMITTALS

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

B. Shop Drawings:
   1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
   2. Duct layout indicating sizes and pressure classes.
   3. Elevation of top of ducts.
   4. Dimensions of main duct runs from building grid lines.
   5. Fittings.
   6. Reinforcement and spacing.
   7. Seam and joint construction.
   8. Penetrations through fire-rated and other partitions.
   9. Equipment installation based on equipment being used on Project.
   10. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
   2. Suspended ceiling components.
   3. Structural members to which duct will be attached.
   4. Size and location of initial access modules for acoustical tile.
   5. Penetrations of smoke barriers and fire-rated construction.
   6. Items penetrating finished ceiling including the following:
      a. Lighting fixtures.
      b. Air outlets and inlets.
      c. Speakers.
      d. Sprinklers.
      e. Access panels.
      f. Perimeter moldings.

1.3 QUALITY ASSURANCE

A. NFPA Compliance:
   1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
   2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

PART 2 - PRODUCTS

2.1 FIBROUS-GLASS DUCTS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. CertainTeed Corporation; Insulation Group.
   2. Johns Manville.

3. Knauf Insulation.
4. Owens Corning.

B. Fibrous-Glass Duct Materials: Resin-bonded fiberglass, faced on the outside surface with fire-resistive FSK vapor retarder and with a smooth fiberglass mat finish on the air-side surface.
1. Duct Board: Factory molded into rectangular boards.
2. Round Duct: Factory molded into straight round duct and smooth fittings.
3. Temperature Limits: 40 to 250 deg F inside ducts; 150 deg F ambient temperature surrounding ducts.
4. Maximum Thermal Conductivity: 0.24 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
5. Moisture Absorption: Not exceeding 5 percent by weight at 120 deg F and 95 percent relative humidity for 96 hours when tested according to ASTM C 1104/C 1104M.
6. Permeability: 0.02 perms maximum when tested according to ASTM E 96/E 96M, Procedure A.
7. Antimicrobial Agent: Compound shall be tested for efficacy by an NRTL, and registered by the EPA for use in HVAC systems.
8. Noise-Reduction Coefficient: 0.65 minimum when tested according to ASTM C 423, Mounting A.
9. Required Markings: EI rating, UL label, and other markings required by UL 181 on each full sheet of duct board.

C. Closure Materials:
1. Pressure-Sensitive Tape: Comply with UL 181A; imprinted by the manufacturer with the coding "181A-P," the manufacturer's name, and a date code.
   a. Tape: Aluminum foil-scrim tape imprinted with listing information.
   b. Minimum Tape Width: 2-1/2 inches; 3 inches for duct board thicker than 1 inch.
   c. Staples: 1/2-inch outward clinching, 2 inches o.c. in tabs, one tab per joint.
   d. Water resistant.
   e. Mold and mildew resistant.
2. Heat-Activated Tape: Comply with UL 181A; imprinted by the manufacturer with the coding "181A-H," the manufacturer's name, and a date code.
   a. Tape: Aluminum foil-scrim tape imprinted with listing information.
   b. Minimum Tape Width: 3 inches.
   c. Heat-Sensitive Imprint: Printed indicator on tape to show proper heating during application has been achieved.
   d. Water resistant.
   e. Mold and mildew resistant.
3. Two-Part Tape Sealing System: Comply with UL 181A; imprinted by the manufacturer with the coding "181A-M," the manufacturer's name, and a date code.
   a. Tape: Woven glass fiber impregnated with mineral gypsum.
   b. Minimum Tape Width: 3 inches.
   c. Sealant: Modified styrene acrylic.
   d. Water resistant.
   e. Mold and mildew resistant.

D. Fabrication:
1. Select joints, seams, transitions, elbows, and branch connections and fabricate according to SMACNA's "Fibrous Glass Duct Construction Standards," Chapter 2, "Specifications and Closure," and Chapter 4, "Fittings and Connections."
2. Fabricate 90-degree mitered elbows to include turning vanes.
3. Reinforcements: Comply with requirements in SMACNA's "Fibrous Glass Duct Construction Standards," Chapter 5, "Reinforcement" for channel- and tie-rod reinforcement materials, spacing, and fabrication.
4. Preformed Round Duct: Comply with NAIMA AH116, "Fibrous Glass Duct Construction Standards," Section VII, "Preformed Round Duct."

2.2 PHENOLIC-FOAM DUCTS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Knauf Insulation.

B. Duct Panel: CFC-free phenolic-foam bonded on both sides with factory-applied 0.001-inch- thick, aluminum foil reinforced with fiberglass scrim.
   1. Maximum Temperature: 158 deg F inside ducts or ambient temperature surrounding ducts.
   2. Maximum Thermal Conductivity: 0.13 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
   3. Permeability: 0.0002 perms maximum when tested according to ASTM E 96/E 96M, Procedure A.
   4. Antimicrobial Agent: Compound shall be tested for efficacy by an NRTL, and registered by the EPA for use in HVAC systems.
   5. Noise-Reduction Coefficient: 0.65 minimum when tested according to ASTM C 423, Mounting A.
   6. Required Markings: UL label and other markings required by UL 181 on each full sheet of duct panel; UL ratings for closure materials.

C. Closure Materials:
   1. V-Groove Adhesive: Silicone.
   2. Pressure-Sensitive Tape: Comply with UL 181A; imprinted by the manufacturer with the coding "181A-P," the manufacturer's name, and a date code.
      a. Tape: Aluminum foil tape imprinted with listing information.
      b. Minimum Tape Width: 3 inches.
      c. Water resistant.
      d. Mold and mildew resistant.
   3. Polymeric Sealing System:
      a. Structural Membrane: Woven glass fiber.
      b. Minimum Tape Width: 3 inches.
      c. Sealant: Water based.
      d. Color: White.
      e. Water resistant.
      f. Mold and mildew resistant.

D. Fabrication:
   1. Fabricate joints, seams, transitions, reinforcement, elbows, branch connections, access doors and panels, and damage repairs according to Knauf Insulation's "Knauf KoolDuct System Design Guide," Section 4, "Duct Construction," and Section 5, "Ductwork System General."
   2. Fabricate 90-degree mitered elbows to include turning vanes.

2.3 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables: ASTM A 603, galvanized steel with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

F. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Install ducts with fewest possible joints.

B. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
C. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
D. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
E. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges. Overlap openings on four sides by at least 1-1/2 inches.
F. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.
G. Protect duct interiors from the moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."
H. Install fibrous-glass ducts and fittings to comply with SMACNA's "Fibrous Glass Duct Construction Standards."
I. Install foam ducts and fittings to comply with Knauf Insulation's "Knauf KoolDuct System Design Guide."

3.2 HANGER AND SUPPORT INSTALLATION

A. Install hangers and supports for fibrous-glass ducts and fittings to comply with SMACNA's "Fibrous Glass Duct Construction Standards," Chapter 6, "Hangers and Supports."
B. Install hangers and supports for phenolic-foam ducts and fittings to comply with Knauf Insulation's "Knauf KoolDuct System Design Guide," Section 5, "Ductwork System General."
C. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
    1. Install concrete inserts before placing concrete.
    2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
    3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
    4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.3 DUCT SCHEDULE

A. Indoor Ducts and Fittings:
    1. Fibrous-Glass Rectangular Ducts and Fittings:
        a. Minimum Flexural Rigidity: EI-475.
        b. Minimum Board Thickness: 1-1/2 inches.
    2. Fibrous-Glass Round Ducts and Fittings:
        a. Minimum Thickness: 1 inch.
    3. Phenolic-Foam Rectangular Ducts and Fittings:
        a. Minimum Panel Thickness: 1-3/32 inches.
        b. Aluminum Cladding: Minimum 0.025 inch thick.
B. Outdoor Duct and Fittings:
    1. Phenolic-Foam Rectangular Ducts and Fittings:
        a. Minimum Panel Thickness: 1-3/32 inches.
        b. Aluminum Cladding: Minimum 0.032 inch thick.
        c. Polymeric Sealing System: Coat ducts, including gang-nail couplings, grip flanges, and couplings.

END OF SECTION 233116

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Manual volume dampers.
3. Control dampers.
4. Fire dampers.
5. Smoke dampers.
6. Flange connectors.
7. Turning vanes.
8. Duct-mounted access doors.
9. Flexible connectors.
10. Flexible ducts.
11. Duct accessory hardware.

1.2 SUBMITTALS

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

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
   a. Special fittings.
   b. Manual volume damper installations.
   c. Control damper installations.
   d. Fire-damper and smoke-damper installations, including sleeves; and duct-mounted access doors.
   e. Wiring Diagrams: For power, signal, and control wiring.

C. Operation and maintenance data.

1.3 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with AMCA 500-D testing for damper rating.

PART 2 - PRODUCTS

2.1 MANUAL VOLUME DAMPERS

A. Manufacturers: Ruskin, Vent Products, Air Balance, or approved equal.

B. Dampers must be constructed in accordance with SMACNA Fig. 2-12, Fig. 2-13, and notes relating to these figures, except as modified below.

C. Reinforce all blades to prevent vibration, flutter, or other noise. Construct dampers in multiple sections with mullions where width is over 48 inches. Use rivets or tack welds to secure individual components; sheet metal screws will not be accepted. Provide operators with locking devices and damper position indicators for each damper; use an elevated platform on insulated ducts. Provide end bearings or bushings for all volume damper rods penetrating ductwork constructed to a 3" w.c. pressure class or above.

2.2 TURNING VANES

A. Manufacturers: Aero Dyne, Anemostat, Barber-Colman, Hart & Cooley, or approved equal.

B. Construct turning vanes and runners for square elbows in accordance with SMACNA Fig. 2-3 and Fig. 2-4 except use only airfoil type vanes. Construct turning vanes for short radius elbows and elbows where one dimension changes in the turn in accordance with SMACNA Fig. 2-5 and Fig. 2-6.

2.3 FIRE DAMPERS

A. Manufacturers: Air Balance, Advanced Air, American Warming and Ventilating, Greenheck, Phillips-Aire, Prefco, Ruskin, Safe-Air or approved equal.

B. STATIC FIRE DAMPERS

1. Static fire damper assemblies must be UL 555 (6^{th} edition) listed and labeled for static applications (where air systems do not operate during a fire) and meet

requirements of NFPA 90A. Damper must be type B curtain type with blades out of the air stream; dampers with blades in the air stream will not be accepted. Damper fire rating to be compatible with the rating of the building assembly in which the damper is used.

C. DYNAMIC FIRE DAMPERS

1. Dynamic fire damper assemblies must be UL 555 (6th edition) listed and labeled for dynamic applications (where air systems operate during a fire) and meet requirements of NFPA 90A. Dampers must be type B curtain type with curtain 100% out of air stream. Dampers larger than 30" by 30" or with velocity rating requirements of 3000 fpm or higher, may be multiblade type with blades located in the airstream. Velocity ratings and static pressure ratings as indicated on the drawings. Damper fire rating to be compatible with the rating of the building assembly in which the damper is used.

2.4 SMOKE DAMPERS AND COMBINATION FIRE/SMOKE DAMPERS

A. Manufacturers: Ruskin, Johnson Controls, Air Balance, Advanced Air, American Warming and Ventilating, Greenheck, Safe-Air, Phillips-Aire, Prefco, or approved equal.

B. Smoke damper assemblies to be UL 555S(4th edition) listed and labeled, and leakage rated at no higher than Class II under UL 555S(4th edition). Unless ratings are indicated elsewhere, dampers should be rated for minimum 2,000 fpm air velocity and 4" static pressure.

C. Combination fire/smoke damper assemblies to be UL 555(6th edition) and UL 555S(4th edition) listed and labeled, and have a fire rating compatible with the rating of the building assembly in which the damper is used, and be leakage rated at no higher than Class II under UL 555S.

D. Provide factory installed electrically operated dampers with linkage arranged so that the damper is closed on loss of power. For electric actuation, provide electric operated dampers with linkage and UL listed operators arranged so that the damper is closed on a loss of power. Where electric actuation is controlled by the DDC system use 0-10 VDC inputs, with stall protection, and with and zero and span adjustments for modulating or 24 VAC for two-position control. All electric actuators will be provided with overload protection to prevent motor from damage when stall condition is encountered. Locate all operators out of the air stream unless large damper size will not allow. Provide form "C" end switches to indicate damper position.

E. Use airfoil shaped damper blades on the following system: List systems where normal duct velocity is 2000 fpm or greater

2.5 ACCESS DOORS

A. Access door to be designed and constructed for the pressure class of the duct in which the door is to be installed. Doors in exposed areas shall be hinged type with cam sash lock. Hinges shall be steel full length continuous piano type. Doors in concealed spaces may be secured in place with cam sash latches. For both hinged and non hinged doors provide sufficient number of camp sash latches to provide air tight seal when door is closed. Do not use hinged doors in concealed spaces if this will restrict access. Use minimum 1" deep 24 gauge galvanized steel double wall access doors with minimum 24 gauge galvanized steel frames. For non-galvanized ductwork, use minimum 1" deep double wall access door with frame that shall use materials of construction identical to adjacent ductwork. Provide double neoprene gasket that shall provide seals from the frame to the door and frame to the duct. When access doors are installed in insulated ductwork or equipment provide insulated doors with insulation equivalent to what is provided for adjacent ductwork or equipment. Access doors constructed with sheet metal screw fasteners will not be accepted.

B. Use insulated, 1-1/2 hour UL 555 listed and labeled access doors in kitchen exhaust ducts.

2.6 FLEXIBLE DUCT

A. Manufacturers: Anco Products, Clevaflex, Thermaflex, Flexmaster or approved equal.

B. Factory fabricated , UL 181 listed as a class 1 duct, and having a flame spread of 25 or less and a smoke developed rating of 50 or under in accordance with NFPA 90A.

C. Suitable for pressures and temperatures involved but not less than a 180°F service temperature and ±2 inch pressure class, depending on the application.
D. Duct to be composed of polyester film, aluminum laminate or woven and coated fiberglass fabric bonded permanently to corrosion resistant coated steel wire helix. Two-ply, laminated, and corrugated aluminum construction may also be used.
E. Where duct is specified to be insulated, provide a minimum 1 inch fiberglass insulation blanket with maximum thermal conductance of 0.23 K (75 degrees F.) and vapor barrier jacket of polyethylene or metalized reinforced film laminate. Maximum perm rating of vapor barrier jacket to be 0.1 perm.

2.7 DUCT LINING

A. Manufacturer: Manville, Owens-Corning, Knauf, or approved equal.
B. 1 inch thick, flexible, mat faced insulation made from inorganic glass fibers bonded with a thermosetting resin with thermal conductivity of .25 Btu inch / hour sq.ft. deg F.
C. Meet erosion testing per UL 181 or ASTM C 1071 for 5000 fpm maximum air velocity. ASTM C 411 maximum operating temperature rating of 250 deg F. ASTM E84 flame spread less than 25 and smoke developed less than 50.
D. Meet requirements of ASTM C 1338 and ASTM G21 for fungi resistance.
E. Install liner using adhesive conforming to ASTM C 916.

2.8 DUCT FLEXIBLE CONNECTIONS

A. Material to be fire retardant, be UL 214 listed, and meet the requirements of NFPA 90A.
B. Connections to be a minimum of 3 inches wide, crimped into metal edging strip, and air tight. Connections to have adequate flexibility and width to allow for thermal expansion/contraction, vibration of connected equipment, and other movement.
C. Use coated glass fiber fabric for all applications. Material for inside applications other than corrosive environments, fume exhaust, or kitchen exhaust to be double coated with neoprene, air and water tight, suitable for temperatures between -10°F and 200°F, and have a nominal weight of 30 ounces per square yard. Material used for outdoor applications other than corrosive environments, fume exhaust, or kitchen exhaust to be double coated with Hypalon¿,air and water tight, suitable for temperatures between -10°F and 250°F, and have a nominal wight of 26 ounces per square yard.
D. For corrosive environments or fume exhaust applications indoors or outdoors, use a material coated with Teflon that is air and water tight, suitable for temperatures between -20°F and 500°F, and has a nominal weight of 14 ounces per square yard.

2.9 SOUND ATTENUATORS

A. Manufacturers: Industrial Acoustics Company, Environmental Elements Corporation, Semco, Dynasonics, United McGill, Rink, or approved equal.
B. Construct of a 22 gauge galvanized steel outer casing, and 26 gauge galvanized, perforated steel inner liner. Seams and joints of outer casing to be air tight.
C. Fill annular space between outer casing and inner liner with acoustic fill that is inert, inorganic, and of a density sufficient to obtain the specified acoustic performance. Material must meet requirements of NFPA 90A with a flame spread index of 25 or less and smoke developed rating of 50 or less.
D. Acoustical and aerodynamic performance is indicated on schedules on the drawings.

2.10 HOODS FOR INTAKE AND EXHAUST

A. Manufacturers: Acme, Ammerman, Carnes, Cook, Greenheck, Louvers and Dampers, Penn, or approved equal.
B. Use low silhouette type hoods or louvered penthouse type hoods with drainable blade louvers, as shown on drawings.
C. Construct hoods of aluminum (mill finish) or galvanized steel with a baked enamel finish; color to be selected by the Architect during the submittal stage.
D. For hoods and louvered penthouses maintain minimum 30 inches from bottom of air intake to finished roof.
E. Provide accessories as shown on drawings.

2.11 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
   1. Install steel volume dampers in steel ducts.
   2. Install aluminum volume dampers in aluminum ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Install fire and smoke dampers according to UL listing.

H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
   1. On both sides of duct coils.
   2. Downstream from manual volume dampers, control dampers, and equipment.
   3. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors; and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
   4. At each change in direction and at maximum 50-foot spacing.
   5. Upstream of turning vanes.
   6. Elsewhere as indicated.

I. Install access doors with swing against duct static pressure.

J. Access Door Sizes:
   1. One-Hand or Inspection Access: 8 by 5 inches.
   2. Two-Hand Access: 12 by 6 inches.
   3. Head and Hand Access: 18 by 10 inches.
   4. Head and Shoulders Access: 21 by 14 inches.
   5. Body Access: 25 by 14 inches.
   6. Body plus Ladder Access: 25 by 17 inches.

K. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

L. Install flexible connectors to connect ducts to equipment.

M. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

N. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.

O. Connect diffusers or light troffer boots to low-pressure ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.

P. Connect flexible ducts to metal ducts with adhesive plus sheet metal screws.

Q. Install duct test holes where required for testing and balancing purposes.

R. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.

END OF SECTION 233300

SECTION 233416 - HVAC FANS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes
   1. Centrifugal Fans
   2. Utility Sets
   3. In-line Centrifugal Fans
   4. Vaneaxial Fans
   5. Cabinet Fans
   6. Power Roof Exhaust Fans
   7. Sidewall Centrifugal Fans
   8. Sidewall Propeller Fans
   9. Ceiling Exhaust Fans
   10. Ceiling Destratification Fans

1.2 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

C. Field quality-control test reports.

D. Operation and maintenance data.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.

C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA 1.

1.4 DESIGN CRITERIA

A. Test and certify all fans in accordance with the applicable AMCA test code.

B. Each fan and motor combination shall be capable of delivering 110% of air quantity scheduled at scheduled static pressure. The motor furnished with the fan shall not operate into the motor service factor when operating under these conditions.

C. Consider drive efficiency in motor selection according to manufacturer's published recommendation or according to AMCA Publication 203, Appendix L.

D. Where inlet and outlet ductwork at any fan is changed from that shown on the drawings, provide any motor, drive and/or wiring changes required due to increased static pressure or baffling necessary to prevent uneven airflow or improve mixing.

E. All internal insulation and other components exposed to the airstream are to meet the flame spread and smoke ratings contained in NFPA 90A.

F. All roof mounted equipment to be provided with curbs or equipment stands in accordance with specifications.

PART 2 - PRODUCTS

2.1 GENERAL

A. Use fan size, class, type, arrangement, and capacity as scheduled.

B. Furnish complete with motors, wheels, drive assemblies, bearings, vibration isolation devices, and accessories required for specified performance and proper operation. All single phase motors to have inherent thermal overload protection.

C. Provide variable pitch sheaves for drives 3 hp and smaller, fixed pitch sheaves for drives 5 hp and larger. Design all drives for 150% of motor rating.

D. Use OSHA approved belt guards that totally enclose the entire drive. Construct guards of expanded metal to allow for ventilation; provide tachometer openings at shaft locations.

E. Statically and dynamically balance all fans so they operate without objectionable noise or vibration.

F. Use AMCA Type A spark resistant construction for all fans handling flammable or grease laden vapors.
G. Provide a corrosion resistant coating on all surfaces exposed to fume and other corrosive exhaust air. Coating to be as scheduled.

2.2 CENTRIFUGAL FANS

A. Basis of Design Product: As shown on Drawings. Equivalent Products by: Barry, Peerless, Buffalo, Carrier, Champion, Chicago Blower, Greenheck, New York Blower, Trane, Twin City, Cook.
B. Construct housing of welded steel with angle iron frame. Use spun or die formed inlet cones to provide a streamlined flow into the wheel. Use airfoil blades welded to spun wheel cones unless otherwise indicated. Bearings to be self-aligning grease packed pillow block type with grease seal and external grease fittings. Provide each fan housing with a capped drain connection and bolted and gasketed access door for inspection of fan wheel.
C. Unless a special coating is scheduled, paint fans with a prime coat after metal cleaning and surface preparation; apply a second coat of paint to all exterior surfaces.
D. Note that welded construction is specified, not lockseam construction.
E. Provide variable inlet vanes with bearing grease fittings extended to an accessible location for fans as scheduled.
F. Provide one inch galvanized mesh inlet screens for fans without inlet ductwork.

2.3 UTILITY SETS

A. Basis of Design Product: As shown on Drawings. Equivalent Products by: ACME, Barry, Champion, Chicago Blower, Cook, Greenheck, New York Blower, Pace, Peerless, Trane, Twin City, or approved equal.
B. Construct housing of welded or lockseam fabricated steel with reinforcing to prevent housing distortion. Design motor supports to hold motor in place and provide drive adjustment. Bearings to be grease lubricated, self-aligning ball bearing type with grease seal. Provide each fan housing with a capped drain connection and bolted and gasketed access door for inspection of fan wheel. Unless a special coating is scheduled, paint fans with a prime coat after metal cleaning and surface preparation. Apply a second coat of paint to all exterior surfaces.
C. Provide weather covers and weather-resistant enamel finish for fans installed outdoors.
D. Provide variable inlet vanes with bearing grease fittings extended to an accessible location for fans as scheduled.
E. Provide one inch galvanized mesh inlet screens for fans without inlet ductwork.

2.4 IN-LINE CENTRIFUGAL FANS

A. Basis of Design Product: As shown on Drawings. Equivalent Products by: Acme, Barry, Cook, Greenheck, New York Blower, Peerless, Penn, Twin City, or approved equal.
B. Construct housing of welded steel with reinforcing to prevent distortion.
C. Furnish with streamlined inlet cones and multiple straightening vanes following the fan wheel to minimize noise and reduce turbulence.
D. Provide each housing with a bolted and gasketed access door for inspection of drive and fan wheel.
E. Use non-overloading airfoil blade fans welded to the wheel cones.
F. Isolate belt drives from airstream with a belt tube.
G. Externally mount motors on an adjustable base.
H. Bearings to be grease lubricated, self-aligning ball bearing type with grease seal and external grease fitting.
I. Unless a special coating is scheduled, paint fans with a prime coat after metal cleaning and surface preparation. Apply a second coat of paint to all exterior surfaces.
J. Design all vertically mounted fans to withstand the vertical thrust loads.
K. Provide variable inlet vanes for fans as scheduled. Vane bearings shall have grease fittings extended to an accessible location.
L. Provide one inch galvanized mesh inlet screens for fans without inlet ductwork.

2.5 VANEAXIAL FANS - CONTROLLABLE IN MOTION

A. Basis of Design Product: As shown on Drawings. Equivalent Products by: Buffalo, Joy, Woods, or approved equal.

B. Construct housing of welded steel with reinforcing to prevent housing distortion.
C. Use cast aluminum airfoil wheel blades and hub.
D. Provide straightening vanes downstream of fan wheel to redirect air flow, minimize noise, and reduce turbulence.
E. Provide each housing with a bolted and gasketed access door for inspection of drive assembly and fan wheel.
F. Bearings to be grease lubricated, self-aligning pillow block ball bearing type with grease seal and grease fitting extended to the exterior of the fan casing.
G. Unless a special coating is scheduled, paint fans with a prime coat after metal cleaning and surface preparation. Apply a second coat of paint to all exterior surfaces.
H. For controllable pitch fans, furnish a pneumatic actuator and a pilot positioner factory mounted, adjusted, and tested in factory. Design actuator and linkage assembly to position vanes uniformly so the fan is unloaded on loss of control air.
I. For belt drive units, provide a belt tube to isolate drives from the airstream. Externally mount motors on an adjustable base.
J. For direct drive units, use totally enclosed air-over motors with not less than Class B insulation. Extend any bearing lubrication points to the outside of the fan casing.
K. Design all vertically mounted fans to withstand static and vertical thrust loads for the application as indicated on the plans.
L. Provide accessories as shown on drawings.

2.6 VANEAXIAL FANS - MANUALLY ADJUSTABLE PITCH

A. Basis of Design Product: As shown on Drawings. Equivalent Products by: Barry, Buffalo, Chicago Blower, Greenheck, Joy, New York Blower, Woods, or approved equal.
B. Construct housing of welded steel with reinforcing to prevent housing distortion.
C. Use cast aluminum airfoil wheel blades and hub.
D. Provide straightening vanes downstream of fan wheel to redirect air flow, minimize noise, and reduce turbulence.
E. Provide each housing with a bolted and gasketed access door for inspection of drive assembly and fan wheel.
F. Bearings to be grease lubricated, self-aligning pillow block ball bearing type with grease seal and grease fitting extended to the exterior of the fan casing.
G. Unless a special coating is scheduled, paint fans with a prime coat after metal cleaning and surface preparation. Apply a second coat of paint to all exterior surfaces.
H. Manually adjustable blades to be secured to hub by means of bolts. Design connection to allow for field adjustment of the blade positions and a means to verify that all blades are in the same position.
I. For belt drive units, provide a belt tube to isolate drives from the airstream. Externally mount motors on an adjustable base.
J. For direct drive units, use totally enclosed air-over motors with not less than Class B insulation. Extend any bearing lubrication points to the outside of the fan casing.
K. Design all vertically mounted fans to withstand static and vertical thrust loads for the application as indicated on the plans.
L. Provide accessories as shown on drawings.

2.7 CABINET FANS

A. Basis of Design Product: As shown on Drawings. Equivalent Products by: Buffalo, Carrier, McQuay, Trane, York, or approved equal.
B. Use double width, double inlet airfoil centrifugal fans unless scheduled otherwise.
C. Construct air tight casing and frame of galvanized or rust inhibited prime coated steel with removable panels to allow access to internal parts.
D. Thermally insulate casing with not less than one inch of glass fiber or other closed cell insulation secured to the casing with waterproof adhesive and/or stic clips; coat the exposed surface to minimize erosion.
E. Bearings to be self-aligning grease packed pillow block type with grease seal; they may be mounted internally or externally but internally mounted bearings must be provided with extended grease lines to a point outside the unit.

F. Provide filter section or a filter rack within fan cabinet suitable for installation of panel filters as scheduled or specified.
G. Provide variable inlet vanes with bearing grease fittings extended to an accessible location for fans as scheduled.

2.8 POWER ROOF EXHAUST FANS

A. Basis of Design Product: As shown on Drawings. Equivalent Products by: Carnes, Greenheck, Penn, Jenn-Air, Cook, ACME, or approved equal.
B. Provide upblast or downblast units, as scheduled, with aluminum housing, non-overloading type centrifugal wheel, inlet cone, factory mounted and wired motor and disconnect switch, and bird screen.
C. Upblast units to have motor, bearings, and drives completely enclosed and isolated from the exhaust air stream with ventilation provided by outside air.
D. Units handling grease laden vapors to be U.L. listed for conveying such vapors, operating continuously at 300 degrees F.

2.9 SIDEWALL CENTRIFUGAL FANS

A. Basis of Design Product: As shown on Drawings. Equivalent Products by: Carnes, Greenheck, Cook, Jenn-Air, ACME, Penn, or approved equal.
B. Dome type with spun aluminum housing, non-overloading centrifugal wheel, factory mounted and wired motor and disconnect switch housed in a separate ventilated compartment, belt or direct drive as scheduled, accessories as scheduled.

2.10 SIDEWALL PROPELLER FANS

2.11 Basis of Design Product: As shown on Drawings. Equivalent Products by: Greenheck, Penn, ACME, Cook.

A. Constructed of steel with angle iron reinforcing and motor support frame, die formed propeller blades with a welded reinforcing gusset on the backside for added rigidity, belt or direct drive as scheduled.
B. Unless a special coating is scheduled, paint fans with a prime coat after metal cleaning and surface preparation; apply a second coat of paint to all exterior surfaces.
C. Provide factory fabricated wall sleeves.
D. Provide accessories as scheduled.

2.12 CEILING EXHAUST FANS

A. Basis of Design Product: As shown on Drawings. Equivalent Products by: Carnes, Greenheck, Penn, Jenn-Air, Cook, ACME.
B. Centrifugal blower wheel, steel housing with acoustical lining, integral exhaust grille, adjustable mounting brackets to allow for any ceiling thickness, permanently lubricated motor, integral junction box with permanently lubricated and thermally protected motor factory wired.
C. Provide wall, eave, or roof discharge assembly, as indicated on the drawings.
D. Provide accessories as scheduled.

2.13 DESTRATIFICATION FANS

A. Basis of Design Product: As shown on Drawings. Equivalent Products by: Emerson-Chromalox, Envirofan, Hunter.
B. U.L. listed, all metal construction, baked enamel finish with factory standard color selected by Architect. Motors to be totally enclosed, impedance protected, single speed, of split capacitor design with permanently lubricated ball bearings.
C. Provide solid state variable speed controls as scheduled.
D. Motors to be reversible for summer/winter operation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install centrifugal fans level and plumb.
B. Support floor-mounting units using restrained spring isolators having a static deflection of 1 inch. Vibration- and seismic-control devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
    1. Secure vibration and seismic controls to concrete bases using anchor bolts cast in concrete base.

C. Install floor-mounting units on concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."
D. Install floor-mounting units on concrete bases designed to withstand, without damage to equipment, the seismic force required by authorities having jurisdiction. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."
E. Support suspended units from structure using threaded steel rods and spring hangers with vertical-limit stops having a static deflection of 1 inch. Vibration-control devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
F. Install units with clearances for service and maintenance.
G. Label fans according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."
B. Install ducts adjacent to fans to allow service and maintenance.
C. Install line-sized piping from scroll drain connection, with trap with seal equal to 1.5 times specified static pressure, to nearest floor drain.
D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:
    1. Verify that shipping, blocking, and bracing are removed.
    2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
    3. Verify that cleaning and adjusting are complete.
    4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
    5. Adjust belt tension.
    6. Adjust damper linkages for proper damper operation.
    7. Verify lubrication for bearings and other moving parts.
    8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
    9. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
    10. Remove and replace malfunctioning units and retest as specified above.
B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION 233416

SECTION 233423 - HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Centrifugal roof ventilators.
   2. Centrifugal wall ventilators.
   3. Ceiling-mounting ventilators.
   4. In-line centrifugal fans.

1.2 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

C. Field quality-control test reports.

D. Operation and maintenance data.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

C. UL Standard: Power ventilators shall comply with UL 705.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL ROOF VENTILATORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
   1. Acme Engineering & Mfg. Corp.
   2. Aerovent; a Twin City Fan Company.
   3. American Coolair Corp.
   4. Ammerman; General Resource Corp.
   5. Breidert Air Products.
   6. Broan Mfg. Co., Inc.
   7. Carnes Company HVAC.
   8. Central Blower Co.
   9. Dayton Electric Manufacturing Co.; a division of W. W. Grainger, Inc.
   10. Delhi Industries Inc.
   11. Greenheck.
   12. Hartzell Fan, Inc.
   13. JencoFan; Div. of Breidert Air Products.
   14. Loren Cook Company.
   15. NuTone Inc.
   16. Penn Ventilation.
   17. Quietaire Corporation.

B. Description: Direct- or belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.

C. Housing: Removable, spun-aluminum, dome top and outlet baffle galvanized steel, mushroom-domed top; square, one-piece, aluminum base with venturi inlet cone.
   1. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.
   2. Camlock fasteners at subbase.

D. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

E. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:
   1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
   2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
   3. Pulleys: Cast-iron, adjustable-pitch motor pulley.

4. Fan and motor isolated from exhaust airstream.

F. Accessories:
1. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted outside fan housing, factory wired through an internal aluminum conduit.
2. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
3. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
4. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.

G. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.
1. Configuration: Built-in raised cant and mounting flange.
2. Overall Height: 12 inches.
3. Sound Curb: Curb with sound-absorbing insulation matrix.
4. Pitch Mounting: Manufacture curb for roof slope.
5. Metal Liner: Galvanized steel.
6. Burglar Bars: 3/4-inch- thick steel bars welded in place to form 6-inch squares.
7. Mounting Pedestal: Galvanized steel with removable access panel.
8. Vented Curb: Unlined with louvered vents in vertical sides.

2.2 CENTRIFUGAL WALL VENTILATORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
1. Acme Engineering & Mfg. Corp.
2. Aerovent; a Twin City Fan Company.
3. American Coolair Corp.
4. Ammerman; General Resource Corp.
5. Breidert Air Products.
6. Broan Mfg. Co., Inc.
7. Carnes Company HVAC.
8. Dayton Electric Manufacturing Co.; a division of W. W. Grainger, Inc.
9. Greenheck.
10. Hartzell Fan, Inc.
11. JencoFan; Div. of Breidert Air Products.
12. Loren Cook Company.
13. NuTone Inc.
14. Penn Ventilation.

B. Description: Direct- or belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and accessories.

C. Housing: Heavy-gage, removable, spun-aluminum, dome top and outlet baffle; venturi inlet cone.

D. Fan Wheel: Aluminum hub and wheel with backward-inclined blades.

E. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:
1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
4. Fan and motor isolated from exhaust airstream.

F. Accessories:
1. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through internal aluminum conduit.
2. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
3. Wall Grille: Ring type for flush mounting.
4. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in wall sleeve; factory set to close when fan stops.

5. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.

2.3 CEILING-MOUNTING VENTILATORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
1. American Coolair Corp.
2. Ammerman; General Resource Corp.
3. Breidert Air Products.
4. Broan Mfg. Co., Inc.
5. Carnes Company HVAC.
6. Dayton Electric Manufacturing Co.; a division of W. W. Grainger, Inc.
7. FloAire.
8. Greenheck.
9. JencoFan; Div. of Breidert Air Products.
10. Loren Cook Company.
11. NuTone Inc.
12. Penn Ventilation.

B. Description: Centrifugal fans designed for installing in ceiling or wall or for concealed in-line applications.

C. Housing: Steel, lined with acoustical insulation.

D. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.

E. Grille: Plastic, louvered grille with flange on intake and thumbscrew attachment to fan housing.

F. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

G. Accessories:
1. Manual Starter Switch: Single-pole rocker switch assembly with cover and pilot light.
2. Time-Delay Switch: Assembly with single-pole rocker switch, timer, and cover plate.
3. Motion Sensor: Motion detector with adjustable shutoff timer.
4. Ceiling Radiation Damper: Fire-rated assembly with ceramic blanket, stainless-steel springs, and fusible link.
5. Filter: Washable aluminum to fit between fan and grille.
6. Isolation: Rubber-in-shear vibration isolators.
7. Manufacturer's standard roof jack or wall cap, and transition fittings.

2.4 IN-LINE CENTRIFUGAL FANS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
1. Acme Engineering & Mfg. Corp.
2. American Coolair Corp.
3. Ammerman; General Resource Corp.
4. Bayley Fans; a division of Lau Industries, Inc.
5. Breidert Air Products.
6. Carnes Company HVAC.
7. FloAire.
8. Greenheck.
9. Hartzell Fan, Inc.
10. JencoFan; Div. of Breidert Air Products.
11. Loren Cook Company.
12. Madison Manufacturing.
13. Penn Ventilation.
14. Quietaire Corporation.

B. Description: In-line, direct-driven centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, motor and disconnect switch, drive assembly, mounting brackets, and accessories.

C. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.
D. Direct-Driven Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing; with wheel, inlet cone, and motor on swing-out service door.
E. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.
F. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.
G. Accessories:
1. Volume-Control Damper: Manually operated with quadrant lock, located in fan outlet.
2. Companion Flanges: For inlet and outlet duct connections.
3. Fan Guards: 1/2- by 1-inch mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
4. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

2.5 MOTORS
A. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
B. Enclosure Type: Totally enclosed, fan cooled.

PART 3 - EXECUTION

3.1 INSTALLATION
A. Install power ventilators level and plumb.
B. Support units using elastomeric mounts having a static deflection of 1 inch. Vibration- and seismic-control devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
1. Secure vibration and seismic controls to concrete bases using anchor bolts cast in concrete base.
C. Install floor-mounting units on concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."
D. Secure roof-mounting fans to roof curbs with cadmium-plated hardware. Refer to Division 07 Section "Roof Accessories" for installation of roof curbs.
E. Ceiling Units: Suspend units from structure; use steel wire or metal straps.
F. Support suspended units from structure using threaded steel rods and elastomeric hangers having a static deflection of 1 inch. Vibration-control devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
G. Install units with clearances for service and maintenance.
H. Label units according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."
I. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."
J. Install ducts adjacent to power ventilators to allow service and maintenance.
K. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
L. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL
A. Perform the following field tests and inspections and prepare test reports:
1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.

4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
10. Shut unit down and reconnect automatic temperature-control operators.
11. Remove and replace malfunctioning units and retest as specified above.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION 233423

SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Round ceiling diffusers.
2. Rectangular and square ceiling diffusers.
3. Louver face diffusers.
4. Linear bar diffusers.
5. Linear slot diffusers.
6. Adjustable bar registers and grilles.
7. Fixed face registers and grilles.
8. Linear bar grilles.

B. Related Sections:
1. Division 23 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
2. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated, include the following:
1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, quantity, model number, size, and accessories furnished.

B. Samples: For each exposed product and for each color and texture specified, if requested.

PART 2 - PRODUCTS

2.1 GENERAL: Basis of Design and Comparable Products as shown on Drawings.

2.2 CEILING DIFFUSERS

A. Round Ceiling Diffuser:
1. Devices shall be specifically designed for variable-air-volume flows.
2. Material: Steel or Aluminum.
3. Finish: Baked enamel, white.
4. Face Style: Three cone.
5. Mounting: Duct connection.
6. Pattern: Fixed.
7. Dampers: Radial opposed blade.

B. Rectangular and Square Ceiling Diffusers:
1. Devices shall be specifically designed for variable-air-volume flows.
2. Material: Steel or Aluminum.
3. Finish: Baked enamel, white.
4. Face Size: As shown on Drawings.
5. Face Style: Three cone.
6. Mounting: As required by ceiling type. Refer to Reflected Ceiling Plans.
7. Pattern: Fixed.
8. Dampers: Radial opposed blade.

C. Louver Face Diffuser:
1. Devices shall be specifically designed for variable-air-volume flows.
2. Material: Steel or Aluminum.
3. Finish: Baked enamel, white.
4. Face Size: As shown on Drawings.
5. Mounting: As required by ceiling type. Refer to Reflected Ceiling Plans.
6. Pattern: Four-way core style.
7. Dampers: Radial opposed blade.
8. Accessories:
a. Square to round neck adaptor.

2.3 CEILING LINEAR SLOT OUTLETS

A. Linear Bar Diffuser:
1. Devices shall be specifically designed for variable-air-volume flows.
2. Material: Steel or Aluminum.
3. Finish: Baked enamel, white.
4. Core Design – See Grille / Diffuser Schedule.
5. Two-Way Deflection Vanes: Extruded construction fixed louvers with removable core.
6. Frame: See Grille / Diffuser Schedule
7. Mounting Frame: See Grille / Diffuser Schedule.
8. Mounting: See Grille / Diffuser Schedule.
9. Damper Type: Adjustable opposed-blade assembly.
10. Accessories: See Grille / Diffuser Schedule.

B. Linear Slot Diffuser:
1. Devices shall be specifically designed for variable-air-volume flows.
2. Material - Shell: Steel or Aluminum, insulated.
3. Material - Pattern Controller and Tees: Aluminum.
4. Finish - Face and Shell: Baked enamel, black.
5. Finish - Pattern Controller: Baked enamel, black.
6. Finish - Tees: Baked enamel, white.
7. Slot Width: See Grille / Diffuser Schedule.
8. Number of Slots: See Grille / Diffuser Schedule.
9. Length: See Grille / Diffuser Schedule.
10. Accessories: See Grille / Diffuser Schedule.

2.4 REGISTERS AND GRILLES

A. Adjustable Bar Register:
1. Material: Steel or Aluminum.
2. Finish: Baked enamel, white.
3. Face Blade Arrangement: See Grille / Diffuser Schedule.
4. Core Construction: Integral.
5. Rear-Blade Arrangement: See Grille / Diffuser Schedule
6. Frame: See Grille / Diffuser Schedule.
7. Mounting Frame: See Grille / Diffuser Schedule.
8. Mounting: See Grille / Diffuser Schedule.
9. Damper Type: Adjustable opposed blade.
10. Accessories:
    a. See Grille / Diffuser Schedule.

B. Adjustable Bar Grille:
1. Material: Steel or Aluminum.
2. Finish: Baked enamel, white.
3. Face Blade Arrangement: See Grille / Diffuser Schedule.
4. Core Construction: Integral.
5. Rear-Blade Arrangement: See Grille / Diffuser Schedule
6. Frame: See Grille / Diffuser Schedule.
7. Mounting Frame: See Grille / Diffuser Schedule.
8. Mounting: See Grille / Diffuser Schedule.
9. Damper Type: Adjustable opposed blade.
10. Accessories:
    a. See Grille / Diffuser Schedule.

C. Fixed Face Register:
1. Material: Steel or Aluminum.
2. Finish: Baked enamel, white.
3. Face Blade Arrangement: See Grille / Diffuser Schedule.
4. Core Construction: Integral.
5. Rear-Blade Arrangement: See Grille / Diffuser Schedule
6. Frame: See Grille / Diffuser Schedule.

7. Mounting Frame: See Grille / Diffuser Schedule.
8. Mounting: See Grille / Diffuser Schedule.
9. Damper Type: Adjustable opposed blade.
10. Accessories:
    a. See Grille / Diffuser Schedule.

D. Fixed Face Grille:
1. Material: Steel or Aluminum.
2. Finish: Baked enamel, white.
3. Face Blade Arrangement: See Grille / Diffuser Schedule.
4. Core Construction: Integral.
5. Rear-Blade Arrangement: See Grille / Diffuser Schedule
6. Frame: See Grille / Diffuser Schedule.
7. Mounting Frame: See Grille / Diffuser Schedule.
8. Mounting: See Grille / Diffuser Schedule.
9. Damper Type: Adjustable opposed blade.
10. Accessories:
    a. See Grille / Diffuser Schedule.

E. Linear Bar Grille:
1. Material: Steel or Aluminum.
2. Finish: Baked enamel, white.
3. Face Blade Arrangement: See Grille / Diffuser Schedule.
4. Core Construction: Integral.
5. Rear-Blade Arrangement: See Grille / Diffuser Schedule
6. Frame: See Grille / Diffuser Schedule.
7. Mounting Frame: See Grille / Diffuser Schedule.
8. Mounting: See Grille / Diffuser Schedule.
9. Damper Type: Adjustable opposed blade.
10. Accessories:
    a. See Grille / Diffuser Schedule.

2.5 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Designer for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.2 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

SECTION 235523 - GAS-FIRED RADIANT HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes gas-fired, tubular infrared and high-intensity infrared radiant heaters.

1.2 SUBMITTALS

A. Product Data: For each type of gas-fired radiant heater indicated. Include rated capacities, operating characteristics, and accessories.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and maintenance data.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.4 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of gas-fired radiant heater that fails in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 TUBULAR INFRARED HEATERS

A. Manufacturers: Basis of Design and comparable products are identified on Drawings.

B. Description: Factory assembled, piped, and wired, and complying with ANSI Z83.20/CSA 2.34.

C. Fuel Type: Design burner for natural or propane gas having characteristics same as those of gas available at Project site.

D. Combustion Tubing: 4-inch- (100-mm-) diameter steel with high-emissivity, high-temperature, corrosion-resistant external finish.

E. Tubing Connections: Stainless-steel couplings or flared joints with stainless-steel draw bolts.

F. Reflector: Polished aluminum, 97 percent minimum reflectivity, with end caps. Shape to control radiation from tubing for uniform intensity at floor level with 100 percent cutoff above centerline of tubing. Provide for rotating reflector or heater around a horizontal axis for minimum 30-degree (0.52-radian) tilt from vertical.

1. Reflector Extension Shields: Same material as reflectors, arranged for fixed connection to lower reflector lip and rigid support to provide 100 percent cutoff of direct radiation from tubing at angles greater than 30 degrees (0.52 radians) from vertical.
2. Include hanger kit.

G. Burner Safety Controls:

1. Gas Control Valve: Single-stage, regulated redundant 24-V ac gas valve containing pilot solenoid valve, electric gas valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff all in one body.
2. Blocked Vent Safety: Differential pressure switch in burner safety circuit to stop burner operation with high discharge or suction pressure.
3. Control Panel Interlock: Stops burner if panel is open.
4. Indicator Lights: Burner-on indicator light.

H. Burner and Emitter Type: Gravity-vented power burner, with the following features:

1. Emitter Tube: 4-inch- (100-mm-) diameter, aluminized or hot-rolled-steel tubing with sight glass for burner and pilot flame observation.
2. Venting: As described on Drawings.
3. Burner/Ignition: Stainless-steel burner cup and head with balanced-rotor draft fan and spark ignition with electronic flame supervision.
4. Combustion-Air Connection: Duct connection for combustion air to be drawn directly from outdoors by burner fan.

I. Capacities and Characteristics: As shown on Drawings.

2.2 CONTROLS

A. Thermostat: Devices and wiring are specified in Division 23 Section "Instrumentation and Control for HVAC."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install and connect gas-fired radiant heaters and associated fuel and vent features and systems according to NFPA 54 CAN/CSA B149.1, applicable local codes and regulations, and manufacturer's written installation instructions.
B. Suspended Units: Suspend from substrate using chain hanger kits and building attachments.
C. Maintain manufacturers' recommended clearances to combustibles.
D. Install piping adjacent to gas-fired radiant heaters to allow service and maintenance.
E. Gas Piping: Comply with Division 23 Sections. Connect gas piping to gas train inlet; provide union with enough clearance for burner removal and service.
F. Vent Connections: Per manufacturer’s recommendations.
G. Electrical Connections: Comply with applicable requirements in Division 26 Sections.
    1. Install electrical devices furnished with heaters but not specified to be factory mounted.
H. Adjust initial temperature set points.
I. Adjust burner and other unit components for optimum heating performance and efficiency.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections: Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION 235523

SECTION 236300 – DUCTLESS MINI-SPLIT SYSTEM A/C UNITS
WALL-MONTED UNITS:

Part 1 – General

1.1 System Description

The Heat Pump system shall be a Mitsubishi Electric split system with Variable Speed Inverter Compressor technology. The system shall consist of a wall mounted indoor section with wired, wall mounted controller and a horizontal discharge, single phase outdoor unit.

1.2 With wired wall mounted controller

System Model Numbers	
Indoor Units	**Outdoor Units**
PKA-A12GA	PUY-A12NHA
PKA-A18GA	PUY-A18NHA
PKA-A24FA	PUY-A24NHA
PKA-A30FA	PUY-A30NHA
PKA-A36FA	PUY-A36NHA

1.3 Quality Assurance

A. The units shall be tested by a Nationally Recognized Testing Laboratory (NRTL) and shall bear the ETL label.

B. All wiring shall be in accordance with the National Electrical Code (N.E.C.).

C. The units shall be rated in accordance with Air-conditioning Refrigeration Institute's (ARI) Standard 210 and bear the ARI Certification label.

D. The units shall be manufactured in a facility registered to ISO 9001 and ISO 14001, which is a set of standards applying to environmental protection set by the International Standard Organization (ISO).

E. A dry air holding charge shall be provided in the indoor section.

F. The outdoor unit shall be pre-charged with R-410a refrigerant for 70 feet of refrigerant tubing.

G. System efficiency shall meet or exceed 13.0 SEER.

1.4 Delivery, Storage and Handling

A. Unit shall be stored and handled according to the manufacturer's recommendations.

B. The wireless controller shall be shipped inside the carton with the indoor unit and able to withstand 105°F storage temperatures and 95% relative humidity without adverse effect.

Part 2 – Warranty

2.01 The units shall have a manufacturer's parts and defects warranty for a period one (1) year from date of installation. The compressor shall have a warranty of 6 years from date of installation. If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of the manufacturer. This warranty does not include labor.

2.02 Manufacturer shall have over 25 years of continuous experience in the U.S. market.

Part 3 Performance

Each system shall perform in accordance to the ratings shown in the table below. Cooling performance shall be based on 80°F DB, 67°F WB (26.7°C DB, 19.4°C WB) for the indoor unit and 95°F DB, 75°F WB (35°C DB, 29.3°C WB) for the outdoor unit.

System Model Number	Cooling Capacity Btu/h	TPW Cooling	SEER	CFM (Hi/Dry)
PKA-18GA	8,000 – 18,000	2.240	14.1	425
PKA-A24FA	12,000 – 24,000	2,650	13.5	705
PKA-A30FA	12,000 – 30,000	4,400	13.0	705
PKA-A36FA	12,000 – 34,200	5,030	13.1	990

TPW = Total Power Watts

Part 4 - Design

4.01 Unit Cabinet

The indoor unit cabinet shall be wall mounted by means of a factory supplied mounting plate, The cabinet shall be formed from high strength molded plastic with front panel access for filter. Cabinet color shall be white – 12,000 and 18,000 Munsell 0.70 8.59/097, 24,000, 30,000, and 36,000 Munsell 3.4Y 7.7/08.
The indoor unit shall be factory assembled, wired and tested. Contained within the unit shall be all factory wiring and internal piping, control circuit board and fan motor.
The unit in conjunction with the wired, wall mounted controller shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant pipes shall be purged with dry nitrogen before shipment from the factory.

4.02Fan

The evaporator fan shall be high performance, double inlet, forward curve, direct drive sirocco fan with a single motor – One for 12,000 and 18,000 and 2 for 24,000, 30,000, and 36,000 The fans shall be statically and dynamically balanced and run on a motor with permanently lubricated bearings. The indoor fan shall have four (4) speeds for 12,000 and 18000: Low, M1, M2, and High and two (2) speeds for 24,000, 30,000, and 36,000: Low, High.

4.03 Vane

There shall be a motorized horizontal vane to automatically direct air flow in a horizontal and downward direction for uniform air distribution. The horizontal vane shall significantly decrease downward air resistance for lower noise levels, and shall close the outlet port when operation is stopped. There shall also be a set of vertical vanes to provide horizontal swing airflow movement selected by remote control.

4.04 Filter

Return air shall be filtered by means of an easily removable washable filter.

4.05 Coil

The evaporator coil shall be of nonferrous construction with pre-coated aluminum strake fins on copper tubing. The multi-angled heat exchanger shall have a modified fin shape that reduces air resistance for a smoother, quieter airflow. All tube joints shall be brazed with PhosCopper or silver alloy. The coils shall be pressure tested at the factory. A condensate pan and drain shall be provided under the coil.

4.06 Electrical

4.06.1 The electrical power of the unit shall be 208 volts or 230 volts, 1 phase, 60 hertz. The system shall be capable of satisfactory operation within voltage limits of 198 volts to 253 volts.

4.06.2 The power to the indoor unit shall have an option of being supplied from the outdoor unit, using Mitsubishi Electric A-Control system or separate power source for indoor and outdoor units.

4.07 Control

4.07.1 The control system shall consist of two (2) microprocessors, one on each indoor and outdoor unit, interconnected by a single non-polar two-wire cable. Field wiring shall run directly from the indoor unit to the wall mounted controller with no splices. For A-Control, a three (3) conductor 14 ga. AWG wire with ground shall provide power feed and bi-directional control transmission between the outdoor and indoor units. Where separate power is supplied to the indoor and outdoor units, a two (2) 20 ga. AWG wire shall be run between the units to provide forbid-directional control communication..

4.07.2 The system shall be capable of automatic restart when power is restored after power interruption. The system shall have self-diagnostics ability, including total hours of compressor run time. Diagnostics codes for indoor and outdoor units shall be displayed on the wired controller panel.

4.07.3 The microprocessor located in the indoor unit shall have the capability of monitoring return air temperature and indoor coil temperature, receiving and processing commands from the wired controller, providing emergency operation and controlling the outdoor unit.

4.07.4 The indoor unit shall be connected to a wall mounted wired controller to perform input functions necessary to operate the system. The wired controller shall have a large multi-language DOT liquid crystal display (LCD) presenting contents in eight (8) different languages, including English, French, Chinese, German, Japanese, Spanish, Russian, and Italian. There shall be a built-in weekly timer with up to eight pattern settings per day. The controller shall consist of an On/Off button, Increase/Decrease Set Temperature buttons, a Cool/Dry/Fan mode selector, a Timer Menu button, a Timer On/Off button, Set Time buttons, a Fan Speed selector, a Vane Position selector, a Louver Swing button, a Ventilation button, a Test Run button, and a Check Mode button. The controller shall have a built-in temperature sensor. Temperature shall be displayed in either Fahrenheit (°F) or Celsius (°C). Temperature changes shall be by increments of 1°F (1°C) with a range of 67°F to 87°F (19°C to 30°C).

4.07.5 The wired controller shall display operating conditions such as set temperature, room temperature, pipe temperatures (i.e. liquid, discharge, indoor and outdoor), compressor operating conditions (including running current, frequency, input voltage, On/Off status and operating time), LEV opening pulses, sub cooling and discharge super heat.

4.07.6 Normal operation of the wired controller shall provide individual system control in which one wired controller and one indoor unit are installed in the same room. The controller shall have the capability of controlling up to a maximum of sixteen systems at a maximum developed control cable distance of 1,500 feet (500 meters).

4.07.7 The control voltage from the wired controller to the indoor unit shall be 12 volts, DC. The control signal between the indoor and outdoor unit shall be pulse signal 24 volts DC. Up to two wired controllers shall be able to be used to control one unit.

4.07.8 Control system shall control the continued operation of the air sweep louvers, as well as provide On/Off and mode switching. The controller shall have the capability to provide sequential starting with up to fifty seconds delay.

Part 5 - Outdoor Unit

5.01 The outdoor unit shall be compatible with the three different types of indoor units (PKA - wall mounted, PCA - ceiling suspending, and PLA - four way ceiling cassette). The connected indoor unit must be of the same capacity as the outdoor unit. Models PUY-A24NHA and PUY-A36NHA shall have the option to connect to two indoor units, within the same confined space, to improve air distribution (total capacity shall be equivalent to outdoor unit). The outdoor unit shall be equipped with a control board that interfaces with the indoor unit to perform all necessary operation functions.

5.02 The outdoor unit shall be capable of operating at 0°F (-18°C) ambient temperature without additional low ambient controls (optional wind baffle may be required).

5.03 The outdoor unit shall be able to operate with a maximum height difference of 100 feet (30 meters) indoor unit to outdoor unit,

5.04 System shall have a maximum refrigerant tubing length of 100 feet (30 meters) for the 12,000 and 18,000 and 165 feet (50 meters) for the 24,000, 30,000 and 36,000 between indoor and outdoor units without the need for line size changes, traps or additional oil.

5.05 Models PUY-A12NHA, PUY-A18NHA, PUY-A24NHA, PUY-A30NHA and PUY-A36NHA shall be pre-charged for a maximum of 70 feet (20 meters) of refrigerant tubing. The outdoor unit shall be completely factory assembled, piped, and wired. Each unit must be test run at the factory.

5.2 Cabinet

The casing shall be constructed from galvanized steel plate, coated with a finished with an electrostatically applied, thermally fused acrylic or polyester powder coating for corrosion protection and have a munsell 3Y 7.8/1.1 finish. The fan grille shall be of ABS plastic.

.5.3 Fan

Models PUY-A12NHA, PUY-A18NHA, PUY-A24NHA, PUY-A30NHA, and PUY-A36NHA shall be furnished with an AC fan motor. The fan motor shall be of aerodynamic design for quiet operation, and the fan motor bearings shall be permanently lubricated. The outdoor unit shall have horizontal discharge airflow. The fan shall be mounted in front of the coil, pulling air across it from the rear and dispelling it through the front. The fan shall be provided with a raised guard to prevent contact with moving parts.

5.4 Coil

The L shaped condenser coil shall be of copper tubing with flat aluminum fins to reduce debris build up. The coil shall be protected with an integral metal guard. Refrigerant flow from the condenser shall be controlled by means of linear expansion valve (LEV) metering orifice. The LEV shall be control by a microprocessor controlled step motor.

5.5 Compressor

The compressor for models PUY-A12NHA, PUY-A18NHA, PUY-A24NHA, PUY-A30NHA and PUY-A36NHA shall be a DC rotary compressor with Variable Compressor Speed Inverter Technology. The compressor shall be driven by inverter circuit to control compressor speed. The compressor speed shall dynamically vary to match the room load for significantly increasing the efficiency of the system which results in vast energy savings. To prevent liquid from accumulating in the compressor during the off cycle, a minimal amount of current shall be intermittently applied to the compressor motor to maintain enough heat. The outdoor unit shall have an accumulator and high pressure safety switch. The compressor shall be mounted to avoid the transmission of vibration.

5.6 Electrical

The electrical power of the unit shall be 208volts or 230 volts, 1 phase, 60 hertz. The unit shall be capable of satisfactory operation within voltage limits of 198 volts to 253 volts. The outdoor unit shall be controlled by the microprocessor located in the indoor unit.
The control signal between the indoor unit and the outdoor unit shall be pulse signal 24 volts DC. The unit shall have Pulse Amplitude Modulation circuit to utilize 98% of input power supply.

CEILING CASSETTE MONTED UNITS:

Capacity Range: 2 to 3.5 Tons Nominal

Mitsubishi Model Number: PLA (Ceiling Cassette) Air Conditioner series – Wired wall mounted controller (approved equals by Sanyo and Daikan)

Part 1 – General

1.1 System Description

The Air Conditioner system shall be a Mitsubishi Electric split system with Variable Speed Inverter Compressor technology. The system shall consist of a ceiling cassette indoor section and shall include a four (4) way grill with integral return and with wired, wall mounted controller and a horizontal discharge, single phase outdoor unit.

1.2 With wired wall mounted controller

System Model Numbers	
Indoor Units	**Outdoor Units**
PLA-A12AA	PUY-A12NHA
PLA-A18AA	PUY-A18NHA
PLA-A24AA	PUY-A24NHA
PLA-A30AA	PUY-A30NHA
PLA-A36AA	PUY-A36NHA
PLA-A42AA	PUY-A42NHA

Quality Assurance

A. The units shall be tested by a Nationally Recognized Testing Laboratory (NRTL) and shall bear the ETL label.

B. All wiring shall be in accordance with the National Electrical Code (N.E.C.).

C. The units shall be rated in accordance with Air-conditioning Refrigeration Institute's (ARI) Standard 210 and bear the ARI Certification label.

D. The units shall be manufactured in a facility registered to ISO 9001 and ISO 14001, which is a set of standards applying to environmental protection set by the International Standard Organization (ISO).

E. A dry air holding charge shall be provided in the indoor section.

F. The outdoor unit shall be pre-charged with R-410a refrigerant for 70 feet of refrigerant tubing.- PUY42NHA for 100 feet (30 meters) of refrigerant tubing

G. System efficiency shall meet or exceed 13.0 SEER.

1.01 **Delivery, Storage and Handling**

A. Unit shall be stored and handled according to the manufacturer's recommendations.
B. The wireless controller shall be shipped inside the carton with the indoor unit and able to withstand 105°F storage temperatures and 95% relative humidity without adverse effect.

Part 2 – Warranty

2.01 The units shall have a manufacturer's parts and defects warranty for a period one (1) year from date of installation. The compressor shall have a warranty of 6 years from date of installation. If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of the manufacturer. This warranty does not include labor.

2.02 Manufacturer shall have over 25 years of continuous experience in the U.S. market.

Part 3 Performance

Each system shall perform in accordance to the ratings shown in the table below. Cooling performance shall be based on 80°F DB, 67°F WB (26.7°C DB, 19.4°C WB) for the indoor unit and 95°F DB, 75°F WB (35°C DB, 29.3°C WB) for the outdoor unit.

System Model Number	Cooling Capacity Btu/h	TPW Cooling	SEER	CFM (Hi/Dry)
PLA-12AA	6,000 – 12,000	1,260	13.0	490
PLA-18AA	8,000 – 18,000	1,870	13.2	530
PLA-A24AA	12,000 – 24,000	2,500	13.4	530
PLA-A30AA	12,000 – 30,000	4,100	13.0	530
PLA-A36AA	12,000 – 35,000	4,510	13.1	990
PLA-A42AA	18,000 – 42,000	4,820	13.1	990

TPW = Total Power Watts

Part 4 - Design

4.01 Unit Cabinet

The indoor unit cabinet shall be a cassette design that recesses into the ceiling. :

1. Space saving ceiling recessed.

2. The cabinet panel shall have provisions for a field installed filtered outside air intake.

3. Branch ducting shall be allowed from cabinet.

4. Four way grill shall be fixed to bottom of cabinet allowing, two, three or four way blow. Grill assembly color shall be white – Munsell 0.70 8.59/097

5. The indoor unit shall be factory assembled, wired and tested. Contained within the unit shall be all factory wiring and internal piping, control circuit board and fan motor.

6. The unit in conjunction with the wired, wall mounted controller shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant pipes shall be purged with dry nitrogen before shipment from the factory.

4.02 Fan

The evaporator fan shall be high performance, direct drive turbo fan with a single motor. The fan shall be statically and dynamically balanced and run on a motor with permanently lubricated bearings. The indoor fan shall consist of four (4) speeds: Low, M1, M2, and Hi.

4.03 Vane

There shall be four (4) motorized vanes to automatically direct air flow in a downward direction for uniform air distribution. The vanes shall significantly decrease downward air resistance for lower noise levels, and shall close the outlet ports when operation is stopped.

4.04 Filter

Return air shall be filtered by means of an easily removable filter.

4.05 Coil

The evaporator coil shall be of nonferrous construction with pre-coated aluminum strake fins on copper tubing. The multi-angled heat exchanger shall have a modified fin shape that reduces air resistance for a smoother, quieter airflow. All tube joints shall be brazed with PhosCopper or silver alloy. The coils shall be pressure tested at the factory. A condensate pan and drain shall be provided under the coil.

4.06 Electrical

The electrical power of the unit shall be 208 volts or 230 volts, 1 phase, 60 hertz. The system shall be capable of satisfactory operation within voltage limits of 198 volts to 253 volts. The power to the indoor unit shall have an option of being supplied from the outdoor unit, using Mitsubishi Electric A-Control system or separate power source for indoor and outdoor units.

4.07 Control

4.07.1 The control system shall consist of two (2) microprocessors, one on each indoor and outdoor unit, interconnected by a single non-polar two-wire cable. Field wiring shall run directly from the indoor unit to the wall mounted controller with no splices.
4.07.2 For A-Control, a three (3) conductor 14 ga. AWG wire with ground shall provide power feed and bi-directional control transmission between the outdoor and indoor units. Where separate power is supplied to the indoor and outdoor units, a two (2) 20 ga. AWG wire shall be run between the units to provide forbid-directional control communication.
4.07.3 The system shall be capable of automatic restart when power is restored after power interruption. The system shall have self-diagnostics ability, including total hours of compressor run time. Diagnostics codes for indoor and outdoor units shall be displayed on the wired controller panel.

4.07.4 The microprocessor located in the indoor unit shall have the capability of monitoring return air temperature and indoor coil temperature, receiving and processing commands from the wired controller, providing emergency operation and controlling the outdoor unit.

4.07.5 The indoor unit shall be connected to a wall mounted wired controller to perform input functions necessary to operate the system. The wired controller shall have a large multi-language DOT liquid crystal display (LCD) presenting contents in eight (8) different languages, including English, French, Chinese, German, Japanese, Spanish, Russian, and Italian. There shall be a built-in weekly timer with up to eight pattern settings per day.

4.07.6 The controller shall consist of an On/Off button, Increase/Decrease Set Temperature buttons, a Heat/Auto/Cool/Dry/Fan mode selector, a Timer Menu button, a Timer On/Off button, Set Time buttons, a Fan Speed selector, a Vane Position selector, a Louver Swing button, a Ventilation button, a Test Run button, and a Check Mode button. The controller shall have a built-in temperature sensor. Temperature shall be displayed in either Fahrenheit (°F) or Celsius (°C). Temperature changes shall be by increments of 1°F (1°C) with a range of 67°F to 87°F (19°C to 30°C).

4.07.7 The wired controller shall display operating conditions such as set temperature, room temperature, pipe temperatures (i.e. liquid, discharge, indoor and outdoor), compressor operating conditions (including running current, frequency, input voltage, On/Off status and operating time), LEV opening pulses, sub cooling and discharge super heat.

4.07.8 Normal operation of the wired controller shall provide individual system control in which one wired controller and one indoor unit are installed in the same room. The controller shall have the capability of controlling up to a maximum of sixteen systems at a maximum developed control cable distance of 1,500 feet (500 meters).

4.07.9 The control voltage from the wired controller to the indoor unit shall be 12 volts, DC. The control signal between the indoor and outdoor unit shall be pulse signal 24 volts DC. Up to two wired controllers shall be able to be used to control one unit.

4.07.10 Control system shall control the continued operation of the air sweep louvers, as well as provide On/Off and mode switching. The controller shall have the capability to provide sequential starting with up to fifty seconds delay.

Part 5 - Outdoor Unit

5.01 The outdoor unit shall be compatible with the three different types of indoor units (PKA - wall mounted, PCA - ceiling suspending, and PLA - four way ceiling cassette). The connected indoor unit must be of the same capacity as the outdoor unit.

5.02 Models PUY-A24NHA and PUY-A36NHA shall have the option to connect to two indoor units, within the same confined space, to improve air distribution (total capacity shall be equivalent to outdoor unit).

5.03 The outdoor unit shall be equipped with a control board that interfaces with the indoor unit to perform all necessary operation functions.

5.04 The outdoor unit shall be capable of operating at 0°F (-18°C) ambient temperature without additional low ambient controls (optional wind baffle may be required). The outdoor unit shall be able to operate with a maximum height difference of 100 feet (30 meters) between indoor and outdoor units.

5.05 System shall have a maximum refrigerant tubing length of 100 feet (30 meters) for the 12,000 amd 18,000 and 165 feet (50 meters) for the 24,000, 30,000, 36,000, and 42,000 BTU/h units between indoor and outdoor units without the need for line size changes, traps or additional oil.

5.06 Models PUY-A12NHA PUY-A18NHA PUY-A24NHA, PUY-A30NHA and PUY-A36NHA shall be pre-charged for a maximum of 70 feet (20 meters) of refrigerant tubing. – the PUY-A42NHA shall be pre-charged for a maximum of 100 feet (30 meters) of refrigerant tubing

5.07 The outdoor unit shall be completely factory assembled, piped, and wired. Each unit must be test run at the factory.

5.2 Cabinet

The casing shall be constructed from galvanized steel plate, coated with a finished with an electrostatically applied, thermally fused acrylic or polyester powder coating for corrosion protection and have a munsell 3Y 7.8/1.1 finish. The fan grille shall be of ABS plastic.

5.3 Fan

Models PUY-A12NHA PUY-A18NHA, PUY-A24NHA, PUY-A30NHA, and PUY-A36NHA shall be furnished with an AC fan motor. Model PUY-A42NHA shall have two (2) DC fan motors The fan motor shall be of aerodynamic design for quiet operation, and the fan motor bearings shall be permanently lubricated. The outdoor unit shall have horizontal discharge airflow. The fan shall be mounted in front of the coil, pulling air across it from the rear and dispelling it

through the front. The fan shall be provided with a raised guard to prevent contact with moving parts.

5.4 Coil

The L shaped condenser coil shall be of copper tubing with flat aluminum fins to reduce debris build up. The coil shall be protected with an integral metal guard. Refrigerant flow from the condenser shall be controlled by means of linear expansion valve (LEV) metering orifice. The LEV shall be control by a microprocessor controlled step motor.

5.5 Compressor

The compressor for models PUY-A12NHA PUY-A18NHA, PUY-A24NHA, PUY-A30NHA and PUY-A36NHA shall be a DC rotary compressor with Variable Compressor Speed Inverter Technology. . The compressor for model PUY-A42NHA shall be a scroll compressor with variable speed inverter technology The compressor shall be driven by inverter circuit to control compressor speed. The compressor speed shall dynamically vary to match the room load for significantly increasing the efficiency of the system which results in vast energy savings. To prevent liquid from accumulating in the compressor during the off cycle, a minimal amount of current shall be intermittently applied to the compressor motor to maintain enough heat. The outdoor unit shall have an accumulator and high pressure safety switch. The compressor shall be mounted to avoid the transmission of vibration.

5.6 Electrical

The electrical power of the unit shall be 208volts or 230 volts, 1 phase, 60 hertz. The unit shall be capable of satisfactory operation within voltage limits of 198 volts to 253 volts. The outdoor unit shall be controlled by the microprocessor located in the indoor unit.
The control signal between the indoor unit and the outdoor unit shall be pulse signal 24 volts DC. The unit shall have Pulse Amplitude Modulation circuit to utilize 98% of input power supply.

DEDICATED OUTDOOR AIR UNITS (PACKAGED)

1. GENERAL
   1.1. SECTION INCLUDES
      1.1.1. Packaged outdoor air unit.
      1.1.2. Dehumidification/Cooling.
      1.1.3. Heating.
      1.1.4. Electrical Ratings and Connections
      1.1.5. Unit Controls
      1.1.6. Roof curb
      1.1.7. Execution
   1.2. REFERENCES
      1.2.1. ANSI/AHRI Standard 920 (I-P) 2020 - “Performance Rating of Direct-Expansion Dedicated Outdoor Air System Units”
      1.2.2. ANSI/ASHRAE 15-2019 - “Safety Standard for Refrigeration Systems”
      1.2.3. ANSI/ASHRAE/IES 90.1-2022 – “Energy Standard for New Buildings Except Low-Rise Residential Buildings”
      1.2.4. Safety of Household And Similar Electrical Appliances, Part 1: General Requirements [UL60335-1:2016 Ed.6] and [CSA C22.2#60335-1:2016 Ed.2]
      1.2.5. Household and Similar Electrical Appliances – Safety - Part 2 - 40: Particular Requirements for Electrical Heat Pumps, Air-Conditioners, and Dehumidifiers [UL 60335-2-40:2022 Ed.4] and [CSA C22.2#60335-2-40:2022 Ed.4]
      1.2.6. ANSI Z83.4-2017/CSA 3.7-2017 – “Non-recirculating direct gas-fired heating and forced ventilation appliances for commercial and industrial application”; ANSI Z83.8-2016/ CSA 2.6-2016 – “Gas unit heaters, gas packaged heaters, gas utility heaters, and gas-fired duct furnaces”
      1.2.7. ANSI/NFPA 70 - National Electric Code (2008 – 2023, varies by State)
      1.2.8. International Fuel Gas Code (2021)
      1.2.9. NFPA 90 A (2024) – “Standard for the Installation of Air-Conditioning and Ventilating Systems”; NFPA 90B (2024) – “Standard for the Installation of Warm Air Heating and Air-Conditioning Systems”
   1.3. SUBMITTALS
      1.3.1. Submit unit performance data including capacity, nominal and operating performance.
      1.3.2. Submit Mechanical Specifications for unit and accessories describing construction, components, and options.
      1.3.3. Submit drawings indicating overall dimensions as well as installation, operation and services clearances. Indicate lift points and recommendations and center of gravity. Indicate unit shipping, installation and operating weights including dimensions.
      1.3.4. Submit data on electrical requirements and connection points. Include recommended wire and fuse sizes or MCA, sequence of operation, safety and start-up instructions.
      1.3.5. Drawings submitted for approval shall be accompanied by a copy of the purchase agreement between the Contractor and an authorized service representative of the manufacturer for check, test and start up and first year

service.

1.4. DELIVERY, STORAGE and HANDLING
  1.4.1. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
  1.4.2. Protect units from physical damage. Leave factory shipping covers in place until installation.
  1.4.3. Units to be secured via base rail tie-down locations.
1.5. WARRANTY
  1.5.1. Provide parts warranty extending either 12-months from date of unit start-up or a maximum of 18-months from unit ship date.
  1.5.2. Provide twenty-five-year heat exchanger limited warranty from unit ship date.
  1.5.3. 5-year compressor warranty for units 25 tons and below.
  1.5.4. OPTION: The manufacturer shall furnish an alternative price for:
    1.5.4.1. Extended 5-year compressor warranty for units above 25 tons.
    1.5.4.2. Extended parts and labor by manufacturer to be provided to the owner for a period up to 5 years.
1.6. MAINTENANCE SERVICE
  1.6.1. Furnish complete parts and labor service and maintenance of packaged outdoor air units for 1 year from Date of Substantial Completion.
  1.6.2. Must have twenty factory-certified and factory-trained technicians within a four-hour radius of the jobsite.
1.7. REGULATORY REQUIREMENTS
  1.7.1. Unit shall conform to the appropriate standards listed in Section 103 as well as be listed and labeled by a Nationally Recognized Testing Laboratory (NRTL) for compliance with the following applicable standards.
  1.7.2. Household and Similar Electrical Appliances – Safety - Part 2 - 40: Particular Requirements for Electrical Heat Pumps, Air-Conditioners, and Dehumidifiers [UL 60335-2-40:2022 Ed.4] and [CSA C22.2#60335-2-40:2022 Ed.4]
  1.7.3. ANSI Z83.4-2017/CSA 3.7-2017 – “Non-recirculating direct gas-fired heating and forced ventilation appliances for commercial and industrial application”; ANSI Z83.8-2016/ CSA 2.6-2016 – “Gas unit heaters, gas packaged heaters, gas utility heaters, and gas-fired duct furnaces”
  1.7.4. In the event the unit is not approved by an NRTL for compliance with the appropriate standards, the manufacturer shall, at manufacturer’s expense, provide for a field certification and labeling of unit by an NRTL to the appropriate standards. Manufacturer shall, at manufacturer’s cost, complete any and all modifications required by NRTL prior to certification and field labeling. Manufacturer shall include coverage of all modifications in unit warranty.
1.8. EXTRA MATERIALS
  1.8.1. Provide one set of filters.

2. PRODUCTS
2.1. SUMMARY
  2.1.1. The contractor shall furnish and install packaged outdoor air unit(s) as

shown and scheduled on the contract documents. The unit(s) shall be installed in accordance with this specification and perform at the specified conditions as scheduled.

2.1.2. APPROVED MANUFACTURERS

2.1.2.1. Trane: Horizon™ Model OA (Packaged Outdoor Air Unit)

2.1.2.2. Substitutions: [submission for substitution is required a minimum of 10 working days prior to bid date] as indicated under the general and/or supplemental conditions of these specifications. Bidding contractor shall be responsible for electrical and mechanical and structural modifications required when substituting a product other than the specified product. It shall be the responsibility of the bidding contractor to make the specifier aware of any modifications. As built drawing changes is the responsibility of the contractor submitting the substitution. [In California, the contractor is responsible for re-submittal under Title20 of California Law.]

2.2. GENERAL UNIT DESCRIPTION

2.2.1. Unit(s) furnished and installed shall be packaged outdoor air unit(s) as scheduled on contract documents and described in these specifications. Unit(s) shall be designed for dehumidification, cooling and/or heating of 100% Outdoor Air. For dehumidification and cooling modes the evaporator temperature or supply air dewpoint shall be monitored, reported at unit controller. Compressor controls shall modulate capacity to maintain evaporator leaving set point for dehumidification mode. Hot Gas Bypass shall not be used to control compressor capacity. Compressor Hot Gas Reheat (HGRH) shall be factory installed. To prevent rehydration of evaporator condensate the reheat coil face shall be located a minimum of 6” downstream from the leaving face of the evaporator coil. Heating system shall include modulating controls. Compressor on-off only or primary heating on-off only controls shall not be acceptable control strategies.

2.2.2. Unit(s) shall have labels, decals, and/or tags to aid in the service of the unit and indicate caution areas.

2.2.3. Unit discharge airflow configuration shall be:

2.2.3.1. Vertical discharge thru unit base.

2.3. CABINET

2.3.1. Cabinet panels: 2” double-wall foamed panel with thermal break construction throughout the indoor section of unit to provide nonporous, cleanable interior surfaces. All interior seams exposed to airflow shall be sealed.

2.3.2. Insulation: 2” polyurethane foam metal encapsulated with no exposed edges. Initial R value of 6.6 per inch of thickness.

2.3.3. Cabinet base shall be double wall construction designed to prevent trapping or ponding of water within the unit base. Cabinet floor shall be insulated with 2” double-wall foamed panel with thermal break construction throughout the indoor section of unit to provide nonporous, cleanable interior surfaces. All interior seams exposed to airflow shall be sealed. Insulation shall not be applied to underside of unit base.

2.3.4. Cabinet Base Rails: Side base rails shall include openings for forklift and/or tie-down and lift access. To protect unit base from fork damage side rails shall include removable heavy gauge fork pockets.

2.3.5. Shipping anchors attach to and/or through unit base rails. Straps over unit shall not be used to secure unit for shipping.

2.3.6. Cabinet material interior and base rails: shall be G-90 zinc-coated galvanized steel. Material gauge shall be a minimum of 14-gauge for base rails, 16-gauge for structural members and 22-gauge for access doors and cabinet panels.

2.3.7. Exterior Corrosion Protection: Exterior cabinet panels shall be a base coat of G-90 galvanized steel with both exterior and interior surfaces cleaned, phosphatized, and finished with a weather-resistant baked enamel finish. Unit's surface shall be in compliance with ASTM B117 salt spray testing at a minimum of 672-hour duration.

2.3.8. Cabinet construction shall provide hinged panels providing easy access for all parts requiring routine service.

2.3.9. Cabinet top cover shall be one-piece construction or where seams exist, it shall be double-hemmed and gasket-sealed.

2.3.10. Hinged Access Panels: Water- and air-tight hinged access panels shall provide access to all areas requiring routine service including air filters, heating section, electrical and control cabinet sections, optional ERV and power exhaust fan section, supply air fan section, evaporator and reheat coil sections. Insulated doors shall be constructed to allow the access door to open in either direction or be removed without removal of a hinge.

2.3.10.1. Latches with locking hasp or tool operated closure devices shall be factory installed on all hinged access panels.

2.3.11. Drain Pan material shall be Type 304 Stainless steel drain and constructed to slope in two directions to ensure positive drainage with corners exposed to standing water and drain fittings welded liquid tight to prevent leaks. Pan shall have a minimum depth of 2" and be fully insulated by no less than 1" of R-6.6 insulation.

2.3.12. Provide openings on either side of unit or thru the base for power, control, and gas connections.

2.3.13. Cabinet shall include optional interior liner constructed of Type 304 stainless steel with sealed seams.

2.3.14. Air inlet hood shall be factory installed and shall not require field assembly. Hood shall include 2" thick removable aluminum mesh mist eliminators sized for a velocity not to exceed 500 FPM at maximum unit rated airflow. Service access shall be hinged and held in place with thumb latches that shall not require tools for service access.

2.3.15. Unit shall be equipped with a 6" filter rack upstream of the evaporator. Frame shall be field-adjustable to match any filter combination specified in the following section.

2.4. AIR FILTERS

3. Unit inlet hood shall include 2" thick aluminum mesh removable mist eliminators with hinged access cover. Inlet velocity shall not exceed 500 FPM.

4. Evaporator Inlet shall include a full complement of pleated media air filters. Filters shall be:
   4.1. 2” deep MERV 8

4.2. DAMPERS
   4.2.1. Unit shall include a motor operated outdoor air damper constructed of galvanized steel.
   4.2.2. Damper blades shall be v-groove design with rubber edge seals designed not to exceed a 4 CFM/SQ FT leakage rate exceeding ASHRAE 90.1 damper leakage requirements. Airfoil design Class 1A rated dampers are optional.
   4.2.3. Damper actuator shall be factory mounted and wired sealed spring return and either two-position or fully modulating.
   4.2.4. Dampers air velocity shall not exceed 2000 fpm.
   4.2.5. OPTIONAL Return Air damper shall be of same material, construction, and leakage rate as outdoor air damper. Return air damper actuator shall be factory mounted and wired sealed spring fully modulating and operate based on outdoor air damper feedback signal to properly regulate RA airflow.

4.3. DEHUMIDIFICATION/COOLING
   4.3.1. Compressors

4.4. All units shall have direct drive, scroll type compressors.

4.5. Optional Digital Scroll Compressor
   4.5.1. Circuit One
   4.5.2. Circuit One and Circuit Two

4.6. Motor shall be suction gas-cooled and shall have a voltage utilization range of plus or minus 10 percent of unit nameplate voltage.

4.7. Internal overloads shall be provided with the scroll compressors.

4.8. Each compressor shall have a crankcase heater or equivalent to minimize the amount of liquid refrigerant present in the oil sump during off cycles.

4.9. Each compressor shall be mounted on rubber vibration isolators, to reduce the transmission of noise.

4.10. Provide each unit with <<CIRCUIT_AMOUNT>> hermetically sealed refrigerant circuit(s) factory-supplied completely piped with liquid line filter-drier, liquid line charging port, suction and liquid line pressure ports, sight glass, and thermal expansion valve.

4.11. Provide each circuit with automatic reset high and low pressure and high temperature switches for safety control.

5. COILS

5.1. Evaporator, Condenser and Hot Gas Reheat coils shall be constructed with copper tubes mechanically bonded to configured aluminum plate fins.

5.2. Coils shall be factory leak tested in accordance ANSI/ASHRAE 15-1992 at a minimum pressure of 500 PSIG.

5.3. The condenser coil shall have a fin designed for ease of cleaning.

5.4. Evaporator coil shall include (six / four) rows of cooling interlaced for superior sensible and latent cooling with a maximum of 14 FPI for ease of cleaning.

5.5. Reheat coil shall be fully integrated into the supply airstream and be capable of delivering design supply air temperature.

5.6. To prevent re-hydration of condensate from evaporator coil, the evaporator coil face and the hot gas reheat coil face shall be separated by a minimum of six inches.

6. CONDENSER SECTION
   6.1. Outdoor Fans: Shall be direct drive vertical discharge design with low-noise corrosion resistant glass reinforced polypropylene props, powder coated wire discharge guards and electro-plated motor mounting brackets.
   6.2. Fans shall be statically and dynamically balanced.
7. COMPRESSOR CAPACITY CONTROL
   7.1. (Mechanical Control: shall be equipped with Refrigerant Capacity Control (RCC) on the lead circuit to modulate compressor capacity during Dehumidification or Cooling modes to prevent evaporator frosting or freezing. RCC shall be (standard mechanical). Hot gas bypass shall not be an acceptable compressor capacity control strategy. The RCC setpoint is factory set, and field adjustable, to maintain desired suction pressure and compressor discharge pressure.
      7.1.1. Electronic Control: (Requires Digital Scroll Compressor or Variable Speed Compressor be selected in compressor section of this specification.) Compressor output capacity shall be controlled by the Main Control Module. (refer to unit control and sequence sections of this specification)
8. FANS AND MOTORS
   8.8.1. Indoor fan shall be direct drive plenum fan, factory installed and wired to on-board Variable Frequency Drive and shall be equipped with slide out service access.
   8.8.2. All fan motors shall be premium efficiency ODP and meet the U.S. Energy Policy Act of 2005/10 (EPACT).
   8.8.3. All fan motors shall either be permanently lubricated and/ or have internal thermal overload protection.
   8.8.4. Outdoor fans shall be direct drive with premium efficiency motors, statically and dynamically balanced, draw through in the vertical discharge position with either internal or external thermal protection. .
   8.8.5. Provide shafts constructed of solid hot rolled steel, ground and polished, with keyway, and protectively coated with lubricating oil.
9. HEATING
   9.8.1. Modulating Indirect Gas Fired Heating System
      9.8.1.1. Completely assembled and factory installed heating system shall be in the primary heating position located beneath the indoor fan assembly and be integral to unit and approved for use downstream from refrigerant cooling coils in units mounted outdoors. Threaded gas connection shall terminate at field provided manual shut-off valve. Provide capability for sidewall gas piping.
      9.8.1.2. Heaters shall include high turn-down burners firing into individual stainless-steel tubular heat exchangers. Heat exchangers shall be constructed of type 439 stainless steel and be a high efficiency dimpled tubular design capable of draining internal condensate. Units with multiple heaters shall include one fully modulating high turndown heater with additional on-off heater sections. Total heater turndown shall be

based on heater gas input capacity 5:1 when ≤150 MBH or a minimum of 10:1 when >150 MBH.

9.8.1.3. Heater outdoor air inlet shall be hooded and include internal baffle system to prevent rain blow thru. To prevent recirculation of flue gas and to prevent flue gas condensate from draining onto and obstructing the heater air inlet the inlet shall be hooded and shall be located a minimum of 8” beneath the flue outlet. Inlet hood shall include bird screen.

9.8.1.4. Heater flue outlet(s) shall include hooded outlet with wire cloth all constructed of Type 430 stainless steel. Hooded outlet shall be sealed to prevent flue gas recirculation.

9.8.1.5. Gas Burner Safety Controls: Provide safety controls for the proving of combustion air prior to ignition, continuous air proving monitoring following ignition and continuous electronic flame supervision.

9.8.1.6. Unit controls shall monitor heat output and shall discontinue all heating attempts and or unit operation in the event the heating section fails to ignite or fails to maintain programmed supply air temperature/time.

9.8.1.7. Inducer fan shall be direct drive high pressure centrifugal type with two speeds and shall include built- in thermal overload protection.

9.8.1.8. Limit controls: High temperature automatic reset limits shall be located on blower wall and in indoor fan chamber to shut off gas flow in the event of excessive temperatures resulting from restricted indoor airflow, or loss of indoor airflow.

9.8.1.9. Flame roll-out safeties shall provide continuous monitoring of proper burner operation.

10. ELECTRICAL RATINGS AND CONNECTIONS

10.8.1. All high voltage power components such as fuses, switches and contactors shall include a service personnel protection barrier or shall be a listed as touch-safe design.

10.8.2. Field wiring access to be provided thru unit base into isolated enclosure with removable cover.

10.8.3. Power wiring to be single point connection.

10.8.4. Wiring internal to the unit shall be colored and labeled for identification.

10.8.5. Unit shall be factory wired to field wiring terminal block mounted in isolated enclosure.

10.8.6. Factory wired main power disconnect and overcurrent device shall be rated for total unit connected power

10.8.7. Unit SCCR rating shall be a minimum of 5kA

10.8.8. Optional unit SCCR rating shall be a minimum of 65kA

10.8.9. Factory wired Voltage/Phase monitor shall be included as standard. In the event of any of the following, the units will be shut down and a fault code will be stored in the monitor for the most recent 25 faults. Upon correction of the fault condition the unit will reset and restart automatically.

10.8.9.1. Phase Unbalance Protection: Factory set 3%

10.8.9.2. Over/Under/Brown Out Voltage Protection: +/-10% of nameplate

voltage

10.8.9.3. Phase Loss/Reversal

10.8.10. Factory to mount and wire optional 115-volt convenience outlet. Field wiring of convenience outlet not acceptable.

10.8.11. All low voltage field wiring connections shall be made at factory installed low voltage terminal strip.

11. UNIT CONTROLS

11.8.1. Main Unit Controller (MCM) shall be a microprocessor based controller with resident control logic. Controller program logic shall include

11.8.1.1. Include single program with field selectable

11.8.1.1.1. Discharge Air control with unit conditioning modes enabled based on outdoor air conditions and controlled to maintain discharge air setpoints.

11.8.2. MCM shall:

11.8.2.1. Prevent simultaneous operation of any conditioning modes.

11.8.2.2. Accept separate setpoints for Occupied and Unoccupied states.

11.8.2.3. Call for Dehumidification based on dew point setpoints. When no call for Dehumidification is present MCM shall control calls for Cooling, Heating and Economizer modes based on sensible or enthalpy temperature setpoints. MCM shall have onboard clock and scheduling function for occupancy.

11.8.2.4. Include non-volatile memory to retain all programmed values without the use of a battery, in the event of a power failure.

11.8.2.5. Enable HGRH dehumidification and cooling modes and control modulation to maintain (discharge air temperature / space temperature).

11.8.2.6. Unit shall include minimum discharge air control.

11.8.3. MCM Touch Screen shall include full color display and shall be (factory installed in unit control compartment / field mounted remote from unit and field wired up to a maximum of 300 ft.) and provide a full list of points included in the MCM. The display shall provide a list and history of all unit alarms.

11.8.4. System Sensors shall include: Factory installed and wired Outdoor Air Temperature, Outdoor Air Humidity and Evaporator Leaving Air Temperature and factory furnished, field installed Discharge Air Temperature.

11.8.4.1. Economizer Option includes Return Air Temperature and Humidity sensor

11.8.5. System controls shall include:

11.8.5.1. Anti-cycle timing.

11.8.5.2. Minimum compressor run/off-times.

11.8.6. Optional Smoke Detectors to sense (Return Air / Discharge Air / Return and Discharge Air) stream(s) shall be factory installed and wired.

12. REFRIGERANT DETECTION SYSTEM (RDS)

12.8.1. Systems with refrigerant classified as A2L shall include RDS.

12.8.2. RDS shall engage mitigation measures at 12% of LFL.
12.8.3. Mitigation will continue for 5 minutes once the alarm is cleared.
12.8.4. Detection of refrigerant leak(s) in the airstream shall:
12.8.4.1. De-energize compressors, UV Lights, heaters, and fan motors, excluding Indoor Fan Motor(s).
12.8.4.2. Run indoor fan motor(s) at minimum Hz.
12.8.4.3. For building comfort, to avoid freezing or overheating the space, the damper command will not change, and the unit will still provide full dilution of any leaked refrigerant.
12.8.4.3.1. Except for units with 2 position dampers and no return duct. In which case the damper shall be commanded open.
12.8.4.4. 24VAC status terminal will energize on OAUTS.
12.8.5. Detection of refrigerant leak(s) in a non-airstream compartment shall:
12.8.5.1. De-energize all loads including: compressors, motors and heaters.
12.8.5.2. Energize the mechanical ventilation fans internal to the unit.
12.8.6. E-stop shall be given priority control of the unit over that of the RDS.

13. ROOF CURB
13.8.1. Contractor shall provide factory supplied 14” tall roof curb, 18 gauge perimeter made of zinc coated steel with supply and return air gasketing and wood nailer strips. Ship knocked down and provided with instructions for easy assembly.
13.8.2. Curb shall be manufactured in accordance with the National Roofing Contractors Association guidelines.
13.9. B.13 EXECUTION
14. EXAMINATION
14.8.1. Contractor shall verify that roof is ready to receive work and opening dimensions are as <<OPENING_VERIFICATION_TYPE>>.
14.8.2. Contractor shall verify that proper power supply adequate to supply the unit.
15. INSTALLATION
15.8.1. Contractor shall install in accordance with manufacturer's instructions.
15.8.2. Mount units on factory-built roof mounting frame providing watertight enclosure to protect ductwork and utility services. Install roof mounting curb level.
16. MANUFACTURER'S FIELD SERVICES
16.8.1. Unit start-up and commissioning shall be completed by a Factory-trained and factory-certified technician.
16.8.2. Manufacturer must have twenty factory-authorized and factory-trained technicians within a 50-mile radius of job site.
16.8.3. The contractor shall furnish manufacturer complete submittal wiring diagrams of the package unit as applicable for field maintenance and service.
17. END OF SECTION

SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes split-system air-conditioning and heat pump units consisting of separate evaporator-fan and compressor-condenser components. Units are designed for exposed or concealed mounting, and may be connected to ducts.

1.2 SUBMITTALS

A. Product Data: For each unit indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

B. Operation and maintenance data.

C. LEED Submittals:

1. Credit EA 4: Manufacturers' product data for refrigerants, including printed statement that refrigerants are free of HCFCs.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Energy-Efficiency Ratio: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."

C. Coefficient of Performance: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."

D. Units shall be designed to operate with HCFC-free refrigerants.

1.4 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace split-system air-conditioning units that fail in materials and workmanship within five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Carrier Air Conditioning; Div. of Carrier Corp.
2. Evcon Industries, Inc.
3. First Co.
4. Friedrich Air Conditioning Company.
5. Koldwave, Inc.
6. Lennox Industries Inc.
7. Mitsubishi Electric Sales Canada, Inc.
8. Mitsubishi Electronics America, Inc.; HVAC Division.
9. Mitsubishi Heavy Industries America, Inc.; Air-Conditioning & Refrigeration Division, Inc.
10. Sanyo Fisher (U.S.A.) Corp.
11. Tadiran Electronic Industries Inc.; Appliance Division.
12. Trane Co. (The); Unitary Products Group.
13. York International Corp.

2.2 EVAPORATOR-FAN UNIT

A. Concealed Unit Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.

1. Insulation: Faced, glass-fiber duct liner.
2. Drain Pans: Galvanized steel, with connection for drain; insulated.

B. Floor-Mounting, Unit Cabinet: Enameled steel with removable panels on front and ends.

1. Discharge Grille: Steel with surface-mounted frame.
2. Insulation: Faced, glass-fiber, duct liner.
3. Drain Pans: Galvanized steel, with connection for drain; insulated.

C. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with thermal-expansion valve.

D. Water Coil: Copper-tube water coil, with mechanically bonded aluminum fins spaced no closer than 0.1 inch; leak tested to 300 psig underwater; and having a 2-position control valve.
E. Electric Coil: Helical, nickel-chrome, electric-resistance heating elements with refractory ceramic support bushings; automatic-reset thermal cutout; built-in magnetic contactors; manual-reset thermal cutout; airflow proving device; and one-time fuses in terminal box for overcurrent protection.
F. Evaporator Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
G. Fan Motor: Multispeed.
H. Filters: 1 inch thick, in fiberboard frames.

2.3 AIR-COOLED, COMPRESSOR-CONDENSER UNIT

A. Casing steel, finished with baked enamel, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
B. Compressor: Hermetically sealed reciprocating type with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor..
   1. Refrigerant Charge: R-410A.
C. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with liquid subcooler.
D. Heat Pump Components: Reversing valve and low-temperature air cut-off thermostat.
E. Fan: Aluminum-propeller type, directly connected to motor.
F. Motor: Permanently lubricated, with integral thermal-overload protection.
G. Low Ambient Kit: Permits operation down to 45 deg F.
H. Mounting Base: Polyethylene.

2.4 ACCESSORIES

A. Thermostat: Low voltage with subbase to control compressor and evaporator fan.
B. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.
C. Additional Monitoring:
   1. Monitor constant and variable motor loads.
   2. Monitor variable frequency drive operation.
   3. Monitor economizer cycle.
   4. Monitor cooling load.
   5. Monitor air distribution static pressure and ventilation air volumes.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
B. Install ground-mounted, compressor-condenser components on 4-inch- thick, reinforced concrete base; 4 inches larger on each side than unit. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete." Coordinate anchor installation with concrete base.
C. Install ground-mounted, compressor-condenser components on polyethylene mounting base.
D. Install roof-mounted, compressor-condenser components on equipment supports specified in Division 23 Section "Common Work Results for HVAC." Anchor units to supports with removable, cadmium-plated fasteners.
E. Install compressor-condenser components on restrained, spring isolators with a minimum static deflection of 1 inch. Refer to Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

3.2 CONNECTIONS

A. Connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

B. Connect supply and return water coil with shutoff-duty valve and union or flange on the supply connection and with throttling-duty valve and union or flange on the return connection.
C. Connect supply and return condenser connections with shutoff-duty valve and union or flange on the supply connection and with throttling-duty valve and union or flange on the return connection.
D. Install piping adjacent to unit to allow service and maintenance.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
B. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
C. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new components, and retest.
D. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION 238126

SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
1. General provisions.
2. Scope.
3. Permits and Fees.
4. Visit to Job Site.
5. Workmanship.
6. Drawings and Specifications.
7. Tests.
8. Allowance for added work.
9. Incidental construction work.
10. Access Doors.
11. Supervision.
12. Electrical work by others.
13. Existing facilities, utilities, etc.
14. Adaptation of work to existing conditions.
15. Renovations/alterations.
16. Submittal procedures.
17. Product requirements.
18. Closeout procedures.
19. Operation and Maintenance Manuals.
20. As-built Documents.
21. Demonstration and Training.
22. Warranty.

PART 2 - NOT APPLICABLE

PART 3 - EXECUTION

3.1 GENERAL PROVISIONS

A. This Contractor's attention is directed to the requirements of Instructions to Bidders, General Conditions and Supplementary General Conditions as bound in the specifications which apply in full to the ELECTRICAL work.

B. Where the requirements of this Division conflict with other articles in these Specifications, the Contractor shall utilize the more stringent method.

3.2 SCOPE

A. Provide all labor, materials, tools, equipment, and transportation, and perform all operations necessary for and reasonably incidental to proper execution and completion of

all "ELECTRICAL" work, whether specifically mentioned or not, all as indicated, specified herein, and/or implied thereby to carry out the apparent intent thereof.

B. These drawings may be superseded by later revised or detailed drawings, specifications, or sketches prepared by the Designer, as needed for clarification, and this Contractor shall conform to all reasonable coordination requests.

C. All items not specifically mentioned in the specifications or noted on the drawings, but which obviously are required to make the working installation complete, shall be included automatically.

D. For projects which are bid or awarded as Single Prime contracts, organization of the Specifications into divisions, sections, and articles, and arrangement of the Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be done by any trade, unless specifically shown or noted otherwise.

E. All work to be per current National Electric Code and relative NFPA Sections.

3.3 PERMITS AND FEES

A. This Contractor shall secure all permits required for the completion of this contract. He shall obtain and deliver to the Owner all certificates of inspection issued by the authorities having jurisdiction.

3.4 VISIT TO JOB SITE

A. Before submitting a bid, this Contractor shall visit the job site for the purpose of thoroughly examining the site and conditions under which the work must be performed.

B. The submission of a bona fide bid will be construed to mean that this Contractor understands and is satisfied with conditions under which the contract must be fulfilled.

C. No extra compensation will be allowed for situations arising from failure of this Contractor to be thoroughly familiar with site conditions, including charges and requirements for connection to utilities as shown for this project.

3.5 WORKMANSHIP

A. Workmanship in the fabrication, preparation, and installation of materials and equipment shall conform to the best standards of practice of the trades involved.

B. Work shall be performed by experienced and skilled mechanics under the supervision of a competent foreman.

C. Substandard workmanship will be cause for rejection of work and replacement by Contractor.

D. The Contractor shall reimburse the Designer for all costs incurred by the Designer due to Contractor’s substandard or non-conforming work.

3.6 DRAWINGS AND SPECIFICATIONS

A. The drawings show the location and arrangement of fixtures, piping, and equipment, together with details of connections of certain principal items.

B. The layout shown shall be followed as closely as circumstances will permit, but this Contractor shall lay out his work so as to avoid conflict with other Contractors and trades, and to avoid any unnecessary cutting or damage to walls, floors, and supporting structural members.

C. This Contractor shall carefully and accurately locate all sleeves and install at the proper time all necessary hangers, inserts, etc., which will be required for the completion of his work, and shall be solely responsible for the accurate and proper location of above items.

D. This Contractor shall refer to architectural, mechanical, and electrical drawings and shall cooperate fully with other Contractors and trades while installing piping, fixtures, and other equipment because of close space limits.
   1. In case of conflict, notify Designer before proceeding with installation.
   2. Refer to architectural drawings for exact building dimensions and location of partition walls, doors, chases, etc.
   3. ELECTRICAL drawings are not to be scaled for such dimensions.

E. The drawings and specifications complement each other and together are intended to give a complete description of the work.
   1. Any item of equipment or note of work to be done as shown on plans and not mentioned in the specifications, or mentioned in specifications and not shown in plans, shall be furnished the same as if mentioned or shown in both places.
   2. If conflicts exist, then the most stringent method shown or described shall apply.

F. Any switches, controls, or equipment included in this contract work (drawings and/or specifications) that are not specifically shown on drawings shall be located for convenient use and access.

G. Contractor shall coordinate all equipment arrangement and lay-out in field prior to beginning any actual installation of his work.

H. If Contractor notes any discrepancy, omission, or conflict found in plans or specifications, he shall call to the immediate attention of the Designer, prior to receipt of bids.

I. It is the intention that piping, air ducts and light fixtures are designed and laid out to clear each other.
   1. It shall be the responsibility of this Contractor to coordinate his work with that of other trades to avoid any such conflicts.
   2. Any conflicts that occur after work of one trade is installed and was not prior coordinated shall be relocated or rearranged at the total expense of this Contractor, as directed by Designer.
   3. Any conflicts that cannot be corrected in field by relocation or elevation changes shall be reported to the Designer in writing prior to any installation.

J. The drawings are not intended to show each and every complete or accurate detail.
   1. The figures and writing on drawings shall be taken instead of scaling.
   2. It is this Contractor's responsibility to comply with the evident intent for centering and symmetric arrangement.
   3. This Contractor shall take and be responsible for all field measurements.

4. Exact locations and relations are to be defined in the field and shall be satisfactory to the Designer.

K. Because of the small scale of ELECTRICAL drawings it is not possible to indicate all offsets, fittings, and accessories which may be required.
1. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings and accessories that may be required to meet the conditions.

3.7 TESTS

A. The Designer reserves the right to conduct acceptance tests of all equipment, piping, or any other work furnished under these specifications to determine the fulfillment of special requirements.
1. Such tests shall be conducted in the presence of authorized representatives of the Contractor, Owner, Engineer, and Architect at such time as the Designer may designate.
2. This Contractor shall perform all tests, bear cost of same and make adjustments of equipment and wiring as may be deemed necessary by the Designer.

3.8 ALLOWANCE FOR ADDED WORK

A. Before proceeding with any work for which compensation may be claimed or the Owner may claim credit, a detailed estimate shall first be submitted and approved in writing.
1. No claim for addition to the contract sum will be valid unless so ordered and approved by the Owner and Designer, prior to start of work.
2. Any conflicts corrected by relocation or elevation changes do not constitute extra work.

3.9 INCIDENTAL CONSTRUCTION WORK

A. All blocking for openings for piping in concrete floors, masonry walls or partitions shall be provided by this Contractor.
1. This Contractor shall do all cutting and fitting of his work and of other work that may be required to make the several parts come together properly and to fit his work to receive or be received by the work of other Contractors as shown upon, or reasonably implied by the drawings and specifications.
2. He shall properly complete and finish up his work after other Contractors have finished as the Designer may direct.

B. All excavating required for the installation of this system shall be done by this Contractor.
1. Backfill shall be accomplished as specified in appropriate section of specifications.

C. Chases are prohibited in masonry walls which are not to be plastered or paneled.
1. Set piping, blocking, carriers, etc. indicated to be concealed before walls are constructed in order that walls may be constructed around them.
2. This Contractor shall furnish all sleeves in floors, beams, walls, etc., for each such penetration as needed for installing his work and installation of sleeves by General Contractor.

D. Unless otherwise noted, the General Contractor will provide openings and lintels as new construction progresses, but this Contractor shall fully designate his requirements prior to construction.
   1. Failure to furnish his requirements prior to building construction and failure to coordinate his work with the building construction shall make this Contractor responsible for removing, replacing and painting building construction as required for installation of his work.

3.10 ACCESS DOORS

A. Provide and install access doors in walls, ceilings, etc. as required for access to junction boxes, terminal cabinets, controls, and other devices requiring access in ceilings, chases, soffits, etc.

B. Access doors in non-fire rated walls or ceilings shall be as follows:
   1. Nominal 24” x 24” minimum size.
   2. 16-gage steel frame with 14-gage door panel and galvanized steel drywall bead.
   3. Flush style with provision to conceal flange with drywall cement.
   4. Double-acting concealed spring hinges to allow opening to 175 degrees.
   5. Flush, Allen-head operated with steel cam.
   6. Gray prime-painted steel, for painting to match adjacent finished surfaces.
   7. Basis of Design: Milcor Style DW; Comparable Products by Karp, Elmdor, Acudor.

C. Access doors in fire-rated walls or ceilings shall be as follows:
   1. Nominal 24” x 24” minimum size.
   2. UL 1-1/2 hour, Class B fire rating.
   3. Prime-painted stainless steel: 16-gage frame with 20-gage door panel, for painting to match adjacent finished surfaces.
   4. 2” mineral fiber insulation between inner and outer panel.
   5. Continuous hinge, steel with stainless steel pin.
   6. Self-closing and self-latching panel closer.
   7. Flush mounted paddle latch and locking system with flush, key-operated cylinder lock with two keys.
   8. Basis of Design: Milcor Style UFR; Comparable Products by Karp, Elmdor, Acudor.

3.11 SUPERVISION

A. This Contractor shall have in charge of the work at all times during construction a thoroughly competent foreman with extensive experience in the work to be performed under this contract.
   1. Anyone deemed not capable by the Designer shall be replaced immediately upon request, and after satisfactory foreman has been assigned, he shall not be withdrawn without the written consent of the Designer.

3.12 ELECTRICAL WORK BY OTHERS

A. Refer to the drawings for the details of locations of circuit breakers, junction boxes, disconnect switches, conduits and slack wire required where this contractor's electrical work terminates and electrical work by others begins.

B. The Electrical Contractor shall furnish and install all power circuits for equipment furnished by others.

C. In Mechanical Rooms the wiring by the Electrical Contractor shall generally terminate in a power wiring gutter, line side of disconnect switches or starters, junction box, or electrical panel.
   1. From these points power wiring to the equipment furnished by the ELECTRICAL Contractor shall generally be by the ELECTRICAL Contractor.
   2. Power wiring to mechanical equipment outside equipment rooms will generally be run by the Electrical Contractor to line side of a disconnect switch or junction box in the vicinity (within 3'-0") of the ELECTRICAL equipment.
   3. Power wiring from that point to the equipment will be by the ELECTRICAL Contractor.

D. ELECTRICAL Contractor is to refer to the drawings for location and type of service connections to be provided under the electrical contract.
   1. Where service disconnect switches are required and not furnished as part of the equipment, they shall be furnished and installed by contractor that furnishes the equipment, unless indicated otherwise.
   2. Other Contractors shall furnish and install conduit, boxes, wiring and all items of control for equipment they furnish or Owner furnished equipment, unless specifically shown on electrical drawings.

3.13 EXISTING FACILITIES

A. In existing facilities, disruption of operations must be kept to a minimum and coordinated with Owner.
   1. Work in existing buildings must be cleaned up daily immediately after finishing that portion of work and equipment left in order for Owner to continue operations.
   2. When it is necessary to interrupt utility services in the fulfillment of this contract, such interruptions shall be kept to a minimum and coordinated with Owner.
   3. Once work has begun, it shall be pursued diligently until completed.

B. Every precaution shall be taken to prevent damage to existing underground lines and structures and public utilities.
   1. Damage to existing water and sewer lines, culverts, service connections, underground cables, and similar surface and sub-surface structures shall be at the risk of this Contractor, whether or not locations thereof are shown on plans, and the repairing of such damage shall be by this Contractor and shall be completed without delay.
   2. Compensation for such repairs shall be based on normal and reasonable costs.

C. The locations of any existing underground utilities that are shown are in an approximate way only and have not been independently verified by the Owner or its representative.
   1. The Contractor shall determine the exact location of all existing utilities before commencing work, and agrees to be fully responsible for any and all damages which might be occasioned by the Contractor’s failure to exactly locate and preserve any and all underground utilities.

3.14 ADAPTATION OF WORK TO EXISTING CONDITIONS

A. It is reasonably implied that this Contractor shall furnish all labor and materials to provide Owner with a new and satisfactory system in these facilities.
   1. Contractor is to include necessary work for adaptation of equipment to conditions that may be found to produce conflicts during construction.
   2. When any such conditions are encountered, this Contractor is to consult with Designer and then modify installation as directed without additional costs, and to include any incidental materials required.

3.15 RENOVATIONS/ALTERATIONS

A. Before any work is started in existing building, ELECTRICAL Contractor shall make a thorough survey with Designer and a representative of the Owner of building in which alterations occur and areas which are anticipated routes of access, and furnish a report, signed by all three to Designer. This report shall list by rooms and spaces:
   1. Existing conditions and types of resilient flooring, doors, windows, wall and other surfaces not required to be altered throughout and affected areas of building.
   2. Existence and conditions and operation of items such as ELECTRICAL fixtures, water heaters, valves, etc., required by drawings to be either reused for relocated, or both.
   3. Any discrepancies between drawings and existing conditions at site.
   4. Areas for working space, materials storage and routes of access to areas within buildings where alterations occur and which have been agreed upon by Contractor and Designer.

B. Any items required by drawings to be either reused or relocated or both, found during this survey to be nonexistent, or in opinion of Designer and Owner's representative, to be in such condition that their use is impossible or impractical, shall be removed and a proposal submitted by Contractor to replace with new items in accordance with specifications which will be furnished by Designer.

C. Re-Survey: Fifteen days before expected partial or final inspection date, Contractor, Designer, Owner's representative, together shall make a thorough re-survey of the areas of buildings involved.
   1. They shall furnish a report on conditions then existing, of ELECTRICAL fixtures, equipment, etc. as compared with conditions of same as noted in first condition survey report.
   2. Re-survey report shall also list any damage caused by this Contractor to such flooring and other surfaces, despite protection measures; and, will form basis for determining extent of repair work required of this Contractor to restore damage caused by Contractor's workmen in executing work of this Contract.

3.16 SUBMITTAL PROCEDURES

A. Coordinate preparation and processing of submittals with performance of construction activities.
   1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.

2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
3. Designer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

B. Contractor approval: Affix review stamp to cover sheet, with initials and date of Contractor's approval of submittals.
1. By submitting Shop Drawings, Product Data, Samples and similar submittals, this Contractor represents that the Contractor has determined and verified materials, field measurements and field construction criteria and details related thereto, or will do so, and has checked and coordinated the information contained within such submittals with the requirements of the Work, the Contract Documents and the Work of other trades.

C. Comply with requirements in Division 01 Sections for list of submittals and time requirements for scheduled performance of related construction activities.

D. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows.
1. Time for review shall commence on Designer's receipt of submittal.
2. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
3. Allow 21 days for initial review of each submittal.
   a. Allow additional time if coordination with subsequent submittals is required.
   b. Designer will advise Contractor when a submittal being processed must be delayed for coordination.
4. Allow 15 days for review of each resubmittal.

E. Identification: Identify submittals as required in Division 01 sections.

F. Deviations: Highlight, encircle, or otherwise specifically identify deviations from the Contract Documents on submittals.
1. Summarize deviations on transmittal or List of Deviations included with submittal.

G. Coordinate first paragraph and subparagraph below with office policy. Marking numerous copies of submittals can be time consuming.

H. Transmittal: Package each submittal individually and appropriately for transmittal and handling.
1. Transmit each submittal using a transmittal form.
2. Designer will discard submittals received from sources other than Contractor.

I. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked "Furnish as Submitted" or "Furnish as Corrected."
4. Where submittals contain specific questions or comments, provide a separate sheet with specific answers to each question or comment.

J. At Contractor's written request, copies of Designer's CAD files will be provided to Contractor for Contractor's use in connection with Project, subject to the following conditions:
   1. Allow 21 days from Designer's receipt of written request for CAD files for delivery of files
   2. Files will be delivered via email or compact disc.
   3. Files will be delivered without RN&M Title Blocks, standard details, schedules, etc.
   4. CAD files provided for Contractor's use are not to be construed as the Contract Documents. Use of CAD files for submittals or other uses are at the Contractor's risk.

K. Prepare and submit Action Submittals required by individual Specification Sections.
   1. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
   2. Number of Copies: Submit at least eight copies of Product Data, unless otherwise indicated.
      a. Designer will return all but three copies.
      b. Retain or duplicate sufficient copies for inclusion in Operation and Maintenance Manuals.
   3. Shop Drawings: Prepare Project-specific information, drawn accurately to scale.
      a. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal of Designer's CAD Drawings is otherwise permitted.
   4. Revise subparagraph below to establish a standard sheet size and format.
   5. Sheet Size: At least 8-1/2 by 11 inches but no larger than size of project drawings.
   6. Subparagraph below assumes Architect and Contractor will make copies from opaque print.
   7. Number of Copies: Two opaque (bond) copies of each submittal. Designer will return one copy.
   8. Manufacturers and Materials Suppliers List: Submit three copies of manufacturers and materials suppliers list within 20 days of Contract Award, unless otherwise indicated. Designer will return two copies.
   9. If needed, combine subcontract list in paragraph below with product list above. Subcontract list is required by AIA Document A201 to be submitted as soon as practical after award of the Contract.
   10. Subcontract List: Submit within 20 days of Contract Award three copies of list of proposed subcontractors. Designer will return two copies. Subcontract list to include all tiers of subcontractors.

L. Contractor's Review and Approval: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents.
   1. Note corrections and field dimensions.
   2. Mark with approval stamp before submitting to Designer.

M. Designer's Action: Designer will not review submittals that do not bear Contractor's approval stamp and will return them without action.
   1. Designer will review each submittal, make marks to indicate corrections or modifications required, and return it.
   2. Designer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:
      a. Furnish as Submitted
      b. Furnish as Corrected: Incorporate comments marked on or attached to submittal.

c. Revise and Resubmit: Major items of the submittal do not comply, requiring a resubmittal.

N. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.

O. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

P. The Contractor is responsible for compliance with the Contract Documents, dimensions, details, coordination, and satisfactory performance of materials and equipment provided and installed.

3.17 PRODUCT REQUIREMENTS

A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
1. Basis-of-Design Product: Item identified by manufacturer's product name, make, and model number, used to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, dimensions, and other characteristics for purposes of evaluating comparable products of other named manufacturers.
2. Comparable Product: Product that is listed in the Contract Documents, or added by Addendum, and demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified or basis-of-design product.
3. Owner-preferred Alternate Product: Product that is listed in the Contract Documents, and for which an Alternate Bid price is submitted. When an Alternate Bid item is accepted in the Contract, no substitutions will be allowed.
4. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor after award of Contract.
5. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.

B. Comparable Product Requests: Submit three copies of each request for consideration, at least 10 days prior to receipt of bids, for products not listed in the Contract Documents. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
1. Documentation: Show compliance with requirements for Comparable Products and the following, as applicable:
a. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed product.
b. Detailed comparison of significant qualities of proposed product with those of the Work specified. Significant qualities may include attributes such as

performance, weight, size, durability, visual effect, and specific features and requirements indicated.

c. Product Data, including drawings and descriptions of products and fabrication and installation procedures.

2. Designer's Action: If necessary, Designer will request additional information or documentation for evaluation. Designer will notify Contractor of approval or rejection of proposed comparable product request.
   a. Form of Approval: Addition of the item to the list of Comparable Products by Addendum, prior to receipt of bids.
   b. Use product specified if Designer cannot make a decision on use of a comparable product request within time allocated.

C. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.
   1. Provide products complete with accessories, trim, finish, fasteners, features, options, and other items needed for a complete installation and indicated use and effect, and as required or recommended by the manufacturer for a complete installation, whether or not specifically indicated on the drawings or specifications.
   2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
   3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
   4. Where products are accompanied by the term "as selected," Designer will make selection.
   5. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.

D. Product Selection Procedures:
   1. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
   2. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
   3. Basis-of-Design Product: Where Specifications name a product and include a list of manufacturers, provide the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named.

E. Responsibility of the Contractor: The responsibility for determining dimensions, utility requirements, fitting of work with other trades, sequencing and coordination of work, for Product Substitutions and Comparable Products rests solely with the Contractor.

F. Manufacturer's Warranties: Where specifications require manufacturer's warranties, the provisions of the Contract Documents take precedence over any manufacturer's "standard" warranty provisions, exclusions, etc.
   1. The start of manufacturer's warranties shall be the date of Substantial Completion of the project or phase of the project, notwithstanding any language or exclusion in any document submitted by the contractor or manufacturer.

3.18 CLOSEOUT PROCEDURES

A. Substantial Completion: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
   1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
   2. Complete startup testing of systems.
   3. Submit test records.
   4. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
   5. Complete final cleaning requirements, including touchup painting.
   6. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
   7. Submit a written request for inspection for Substantial Completion. On receipt of request, Designer will either proceed with inspection or notify Contractor of unfulfilled requirements.
   8. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
   9. Results of completed inspection will form the basis of requirements for Final Completion.

B. Final Completion: Before requesting final inspection for determining date of Final Completion, complete the following:
   1. Submit certified copy of Designer's Substantial Completion inspection list of items to be completed or corrected (punch list). The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
   2. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit documentation of training.
   3. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Designer will either proceed with inspection or notify Contractor of unfulfilled requirements.
   4. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

C. Cleaning: This Contractor shall provide all systems and equipment in a new and clean condition.
   1. Clean all items furnished and installed in accordance with manufacturer’s recommendations.
   2. Provide instruction to Owner in proper cleaning of all items provided as part of this Division.
   3. Cooperate with General Contractor in cleaning of building.

3.19 OPERATION AND MAINTENANCE MANUALS

A. Submit four complete copies of Operation and Maintenance Manuals to Designer for review prior to request for inspection for Substantial Completion.

B. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain a title page, table of contents, and manual contents.

C. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:
   1. Subject matter included in manual.
   2. Name and address of Project.
   3. Name and address of Owner.
   4. Date of submittal.
   5. Name, address, and telephone number of Contractor.
   6. Name and address of Architect.
   7. Name and address of Engineer.

D. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

E. List of Material Suppliers and Subcontractors: List contact information for each material supplier and subcontractor.

F. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
   1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
      a. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
   2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
   3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
   4. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
      a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
      b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

G. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

H. Descriptions: Include the following: Product name and model number, Manufacturer's name, Equipment identification with serial number of each component, Equipment function, Operating characteristics, Limiting conditions, Performance curves, Engineering data and tests, Complete nomenclature and number of replacement parts.

I. Include start-up, break-in, and control procedures; stopping and normal shutdown instructions; routine, normal, seasonal, and weekend operating instructions; and required sequences for electric or electronic systems.

J. Describe the sequence of operation, and diagram controls as installed.

K. List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

L. Provide manufacturers' maintenance documentation including maintenance instructions, drawings and diagrams for maintenance, nomenclature of parts and components, and recommended spare parts for each component part or piece of equipment:

M. Include test and inspection instructions, troubleshooting guide, disassembly instructions, and adjusting instructions that detail essential maintenance procedures:

N. Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

O. Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

P. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

Q. Provide complete approved submittal data with all annotations.

R. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.

3.20 AS-BUILT DOCUMENTS

A. As-built Marked Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings.
   1. Mark Record Prints to show the actual installation where installation varies from that shown originally.
   2. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up As-built Marked Prints.
   3. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
   4. Record data as soon as possible after installation.
   5. Record and check the markup before enclosing concealed installations.
   6. Indicate dimensions to locate underground and concealed conduits and lines from fixed reference points.
   7. Indicate burial depth for underground lines.
   8. Indicate location of all valves and cross-reference to valve tag list.

9. Mark the Contract Drawings completely and accurately.
   a. Mark record sets with erasable, red-colored pencil.
   b. Note Addendum numbers, Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
10. Maintain As-built Marked Prints in a clean, legible, up-to-date condition in the project office, and available to the Designer for inspection upon request throughout construction.
11.
12. In first paragraph and subparagraphs below, architects may want to delete titleblock information from CAD files provided to Contractor. See Evaluations. Consult Owner for format required.

B. Record Specifications: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
   1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
   2. Note related Change Orders and As-built Marked Prints where applicable.

3.21 DEMONSTRATION AND TRAINING

A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season. Schedule training with Owner with at least seven days' advance notice.

C. Warranty service: Train Owner in repair and troubleshooting during each warranty service call.

D. For each training session, submit on letterhead name of trainer, date of training, names of Owner’s personnel trained, and systems/equipment trained on.

E. For factory training, documentation to be on letterhead of organization conducting training.

3.22 WARRANTY

A. This Contractor shall guarantee all materials, equipment, workmanship and each and every piece of apparatus which he furnished and which he installs under this contract against defects and failures of any nature for a period of one year from date on which the system is accepted.

B. Apparatus furnished by this Contractor shall be guaranteed to be satisfactory when operated under rated conditions in accordance with manufacturer's instructions and to be of size, function, and capacity specified on drawings or in the specifications.

C. Equipment manufacturers shall warrant equipment furnished for this project for same time span as installing contractors warranty period as set above and elsewhere in these specifications.

1. Warranty start date shall be as established by the Designer. Refer to General Conditions, Supplementary General Conditions, and Division 1 specifications for establishment of warranty start dates.
2. The provisions of the Contract Documents supersede and override any manufacturer's standard warranty provisions.

D. Upon notice from the Designer or Owner, Contractor shall immediately check system, make necessary repairs or adjustments as required; due to faulty workmanship, materials, faults, operation or equipment, without cost to the Owner, and instruct Owner in proper operation, adjustment, and care of systems.

E. During the one-year warranty period, the Contractor shall be responsible for all preventive maintenance, including routine lubrication, filter changing, inspections, and adjustments.
1. Contractor shall provide all materials, consumables, equipment, supplies, etc. required for preventive maintenance.
2. Perform preventive maintenance in accordance with manufacturer's recommendations.
3. During preventive maintenance, instruct Owner in proper preventive maintenance procedures.

F. The Contractor shall submit service call tickets, reports, or other documentation of each warranty service call to the Designer.

END OF SECTION 220500

SECTION 260100 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes through-penetration firestop systems for penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items.

1.2 PERFORMANCE REQUIREMENTS

A. General: For penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.

B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per ASTM E 814 or UL 1479:

1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
2. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:
   a. Penetrations located outside wall cavities.
   b. Penetrations located outside fire-resistance-rated shaft enclosures.

C. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.

1. For floor penetrations with annular spaces exceeding 4 inches in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved, either by installing floor plates or by other means.

D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

1.3 SUBMITTALS

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

B. Shop Drawings: For each through-penetration firestop system, submit documentation, including illustrations, from a qualified testing and inspecting agency, showing each type of construction condition penetrated, relationships to adjoining construction, and type of penetrating item.

1. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular through-penetration firestop condition, submit illustration, with modifications marked, approved by through-penetration firestop system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

C. Qualification Data: For Installer.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:

1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.

2. Through-penetration firestop systems are identical to those tested per testing standard referenced in "Part 1 Performance Requirements" Article. Provide rated systems bearing classification marking of qualified testing and inspecting agency.

B. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.

C. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until each installation has been examined by Owner's inspecting agency and building inspector, if required by authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the through-penetration firestop systems indicated for each application on Drawings or that are produced by one of the following manufacturers:

1. Grace, W. R. & Co. - Conn.
2. Hilti, Inc.
3. Johns Manville.
4. Nelson Firestop Products.
5. 3M; Fire Protection Products Division.
6. Tremco; Sealant/Weatherproofing Division.
7. USG Corporation.

2.2 FIRESTOPPING

A. Compatibility: Provide through-penetration firestop systems that are compatible with one another; with the substrates forming openings; and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.

B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by qualified testing and inspecting agency for firestop systems indicated.

PART 3 - EXECUTION

3.1 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

A. General: Install through-penetration firestop systems to comply with Part 1 "Performance Requirements" Article and with firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

C. Install fill materials for firestop systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.2 FIELD QUALITY CONTROL

A. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.

B. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued and firestop installations comply with requirements.

END OF SECTION 260100

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Building wires and cables rated 600 V and less.
   2. Connectors, splices, and terminations rated 600 V and less.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.
B. Field quality-control test reports.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Copper Conductors: Comply with NEMA WC 70.
B. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN.
C. Multiconductor Cable: Comply with NEMA WC 70 for metal-clad cable, Type MC with ground wire.

2.2 CONNECTORS AND SPLICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. AFC Cable Systems, Inc.
   2. Hubbell Power Systems, Inc.
   3. O-Z/Gedney; EGS Electrical Group LLC.
   4. 3M; Electrical Products Division.
   5. Tyco Electronics Corp.
B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN-THWN, single conductors in raceway.
B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.
C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-THWN, single conductors in raceway.
D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
E. Exposed Branch Circuits, Including in Crawlspaces: Type THHN-THWN, single conductors in raceway.
F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.
G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
I. Class 1 Control Circuits: Type THHN-THWN, in raceway.

J. Class 2 Control Circuits: Type THHN-THWN, in raceway Power-limited cable, concealed in building finishes, or Power-limited tray cable, in cable tray.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Division 26 Sections "Hangers and Supports for Electrical Systems."

F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

G. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

H. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.

I. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.
   a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
   b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
   c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

C. Test Reports: Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

D. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes methods and materials for grounding systems and equipment.

1.2 SUBMITTALS

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

B. Field quality-control test reports.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
4. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
5. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

2.2 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

A. Ground Rods: [**Copper-clad**] steel; [**3/4 inch by10 feet**] in diameter.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.

B. Underground Grounding Conductors: Install barecopper conductor, No. 2/0 AWG minimum. Bury at least 24 inches below grade.

C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

D. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors, except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
   1. Feeders and branch circuits.
   2. Lighting circuits.
   3. Receptacle circuits.
   4. Single-phase motor and appliance branch circuits.
   5. Three-phase motor and appliance branch circuits.
   6. Flexible raceway runs.
   7. Armored and metal-clad cable runs.
   8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
   9. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.
   10. X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.

B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

D. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.

E. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.

F. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
   1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch grounding bus.
   2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

G. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.3 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

C. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Division 26 Section "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches deep, with cover.
1. Test Wells: Install at least one test well for each service, unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.

D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

E. Grounding and Bonding for Piping:
1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

F. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Installbonding jumper to bond across flexible duct connections to achieve continuity.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:
1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells.
   a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
   b. Perform tests by fall-of-potential method according to IEEE 81.

B. Report measured ground resistances that exceed the following values:
1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: [**10**] ohms.
2. Power and Lighting Equipment or System with Capacity 500 to 1000 kVA: [**5**] ohms.

3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: [**3**] ohms.
4. Power Distribution Units or Panelboards Serving Electronic Equipment: [**3**] ohm(s).

C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Designer promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. Hangers and supports for electrical equipment and systems.
   2. Construction requirements for concrete bases.

1.2 PERFORMANCE REQUIREMENTS

A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.3 SUBMITTALS

A. Product Data: For steel slotted support systems.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
   1. Trapeze hangers. Include Product Data for components.
   2. Steel slotted channel systems. Include Product Data for components.
   3. Equipment supports.

C. Welding certificates.

1.4 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Allied Tube & Conduit.
      b. Cooper B-Line, Inc.; a division of Cooper Industries.
      c. ERICO International Corporation.
      d. GS Metals Corp.
      e. Thomas & Betts Corporation.
      f. Unistrut; Tyco International, Ltd.
      g. Wesanco, Inc.
   2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
   3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
   4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
   5. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor

gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Hilti Inc.
      2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      3) MKT Fastening, LLC.
      4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
2. Mechanical-Expansion Anchors: Insert-wedge-type, [**zinc-coated**] steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Cooper B-Line, Inc.; a division of Cooper Industries.
      2) Empire Tool and Manufacturing Co., Inc.
      3) Hilti Inc.
      4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      5) MKT Fastening, LLC.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
   1. Secure raceways and cables to these supports with [**two-bolt conduit clamps**].

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
6. To Steel: [**Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69**].
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Miscellaneous Cast-in-Place Concrete."

C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touchup: Comply with requirements in Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SCOPE

A. The work under this section includes conduits, surface raceways, multi-outlet assemblies, auxiliary gutters, wall duct, and boxes for electrical systems including wall and ceiling outlet boxes, floor boxes, and junction boxes.

1.2 SUBMITTALS

A. Surface Raceway System - submit product data and catalog sheets for all components.

B. Boxes - provide product data showing configurations, finishes, dimensions, and manufacturer's instructions.

PART 2 - PRODUCTS

2.1 RIGID METAL CONDUIT AND FITTINGS

A. Conduit: Heavy wall, galvanized steel, schedule 40, threaded.

B. Fittings and Conduit Bodies: Use all steel threaded fittings and conduit bodies.

2.2 PVC COATED RIGID METAL CONDUIT

A. PVC Externally Coated Conduit: Rigid heavy wall, schedule 40, steel conduit with external 40 mil (0.1 mm) PVC coating. Conduit must be hot dipped galvanized inside and out including threads. The PVC coating bond to the galvanized steel conduit shall be stronger than the tensile strength of the coating itself.

B. Fittings and Conduit Bodies: Threaded type, material to match conduit. PVC coated fittings and couplings shall have specially formed sleeves to tightly seal to conduit PVC coating. The sleeves shall extend beyond the fitting or coupling a distance equal to the pipe outside steel diameter or two inches (50 mm) whichever is greater.

2.3 INTERMEDIATE METAL CONDUIT (IMC) AND FITTINGS

A. Conduit: Galvanized steel, threaded.

B. Fittings and Conduit Bodies: Use all steel threaded fittings and conduit bodies.

2.4 ELECTRICAL METALLIC TUBING (EMT) AND FITTINGS

A. Conduit: Steel, galvanized tubing.

B. Fittings: All steel, set screw, water tight, concrete tight. No push-on or indenter types permitted.

C. Conduit Bodies: All steel threaded conduit bodies.

2.5 FLEXIBLE METAL CONDUIT AND FITTINGS

A. Conduit: steel, galvanized, spiral strip.

B. Fittings and Conduit Bodies: All steel, galvanized, or malleable iron.

2.6 LIQUIDTIGHT FLEXIBLE METAL CONDUIT AND FITTINGS

A. Conduit: flexible, steel, galvanized, spiral strip with an outer Liquidtight, nonmetallic, sunlight-resistant jacket.

B. Fittings and Conduit Bodies: ANSI/NEMA FB 1, compression type. There shall be a metallic cover/insert on the end of the conduit inside the connector housing to seal the cut conduit end.

2.7 RIGID NONMETALLIC CONDUIT AND FITTINGS

A. Conduit: Schedule 40 PVC minimum, Listed, sunlight resistant, rated for 90^0 C conductors.

B. Fittings and Conduit Bodies: NEMA TC 2, Listed.

2.8 SURFACE METAL RACEWAY

A. Description: Sheet metal channel with fitted cover, suitable for use as surface metal raceway.

B. Size: As shown on Drawings.

C. Finish: Color selection by Architect.

D. Fittings: Couplings, elbows, and connectors designed for use with raceway system.

E. Boxes and Extension Rings: Designed for use with raceway systems.

2.9 SURFACE NONMETAL RACEWAY

A. Description: Nonmetallic channel with fitted cover, suitable for use as surface raceway.
B. Size: As shown on Drawings.
C. Finish: Color selection by Architect.
D. Fittings: Couplings, elbows, and connectors designed for use with raceway system.
E. Boxes and Extension Rings: Designed for use with raceway systems.

2.10 AUXILIARY GUTTERS (Wireways)

A. Description: General purpose, Oil-tight and dust- tight, or Rain-tight type wireway without knockouts.
B. Size: Cross-section and length as indicated on drawings.
C. Cover: Hinged cover with full gasketing, where required by application.
D. Connector: [hinged cover.]
E. Fittings: Lay-in type with [removable top, bottom, and side; captive screws.]
F. Finish: Rust inhibiting primer coat with gray enamel finish.

2.11 OUTLET BOXES

A. Sheet Metal Outlet Boxes: galvanized steel, with stamped knockouts.
B. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 3/8 inch male fixture studs where required.
C. Concrete Ceiling Boxes: Concrete type.
D. Cast Boxes: Cast ferroalloy, or aluminum type deep type, gasketed cover, threaded hubs.

2.12 FLOOR BOXES

A. Floor Boxes for Installation in Cast-In-Place Concrete Floors: As shown and detailed on Drawings.

2.13 PULL AND JUNCTION BOXES

A. Pull boxes and junction boxes shall be minimum 4 inch square (100 mm) by 2 1/8th inches (54 mm) deep for use with 1 inch (25 mm) conduit and smaller. On conduit systems using 1 1/4 inch (31.75 mm) conduit or larger, pull and junction boxes shall be sized per NEC but not less than 4 11/16 inch square (117 mm).
B. For telecommunication, fiber optic, security, and other low voltage cable installations the NEC box size requirements shall apply. All boxes, used on telecommunication, security, other low voltage and fiber optic systems with conduits of 1 1/4” and larger, shall be sized per the NEC conduit requirements. For determining box size, the conduit is the determining factor not the wire size.
C. Sheet Metal Boxes: code gauge galvanized steel, screw covers, flanged and spot welded joints and corners.
D. Sheet Metal Boxes Larger Than 12 Inches (300 mm) in any dimension shall have a hinged cover or a chain installed between box and cover.
E. Cast Metal Boxes for Outdoor and Wet Location Installations: Type 4 and Type 6, flat-flanged, surface-mounted junction box, UL listed as raintight. Galvanized cast iron or aluminum box and cover with ground flange, neoprene gasket, and stainless steel cover screws.
F. Fiberglass or Concrete Handholes with weatherproof cover of non-skid finish shall be used for underground installations.
G. Box extensions and adjacent boxes within 48” of each other are not allowed for the purpose of creating more wire capacity.
H. Junction boxes 6" x 6" or larger size shall be without stamped knock-outs.
I. Wireways shall not be used in lieu of junction boxes.

2.14 GENERAL

A. All steel fittings and conduit bodies shall be galvanized.

B. No cast metal, split or gland type fittings permitted.
C. Condulets larger than 2 inch are (50 mm) not permitted except as approved or detailed.
D. All condulet covers must be fastened to the condulet body with screws and be of the same manufacture.
E. Wireways and gutters shall not be used in lieu of pull boxes and condulets.
F. All boxes shall be of sufficient size to provide free space for all conductors enclosed in the box and shall comply with NEC requirements.

PART 3 - EXECUTION

3.1 CONDUIT SIZING, ARRANGEMENT, AND SUPPORT

A. EMT is permitted to be used in sizes 4" and smaller for power and telecommunication systems. See CONDUIT INSTALLATION SCHEDULE below for other limitations for EMT and other types of conduit.
B. Size power conductor raceways for conductor type installed. Conduit size shall be 3/4 inch minimum except as specified elsewhere. **Caution: Per the NEC, the allowable conductor ampacity is reduced when more than three current-carrying conductors are installed in a raceway. Contractor must take the NEC ampacity adjustment factors into account when sizing the raceway and wiring system.**
C. Size conduit for all other wiring, including but not limited to data, control, security, fire alarm, telecommunications, signal, video, etc. shall be sized per number of conductors pulled and their cross-section. 40% fill shall be maximum for all new conduit fills.
D. Arrange conduit to maintain headroom and present a neat appearance.
E. Route exposed conduit and conduit above accessible ceilings parallel and perpendicular to walls and adjacent piping.
F. Arrange conduit supports to prevent distortion of alignment by wire pulling operations. Fasten conduit using galvanized pipe straps, conduit racks (lay-in adjustable hangers), clevis hangers, or bolted split stamped galvanized hangers.
G. Group conduit in parallel runs where practical and use conduit rack (lay-in adjustable hangers) constructed of steel channel with conduit straps or clamps. Provide space for 25 percent additional conduit.
H. Do not fasten conduit with wire or perforated pipe straps. Before conductors are pulled, remove all wire used for temporary conduit support during construction.
I. Support and fasten metal conduit at a maximum of 8 feet on center, and as required by NEC.
J. Supports shall be independent of the installations of other trades, e.g. ceiling support wires, HVAC pipes, etc., unless so approved or detailed.
K. In general, all conduits shall be concealed except where noted on the drawings or approved by the Architect/Engineer. Contractor shall verify with Architect/Engineer all surface conduit installations except in mechanical rooms.
L. Changes in direction shall be made with symmetrical bends, cast steel boxes, stamped metal boxes or cast steel conduit bodies.
M. No continuous conduit run shall exceed 100 feet without a junction box.

3.2 CONDUIT INSTALLATION

A. Cut conduit square using a saw or pipecutter; de-burr cut ends.
B. Conduit shall not be fastened to the corrugated metal roof deck.
C. Bring conduit to the shoulder of fittings and couplings and fasten securely.
D. Use conduit hubs for fastening conduit to cast boxes. Use sealing locknuts or conduit hubs for fastening conduit to sheet metal boxes in damp or wet locations (sheet metal boxes 4 & 11/16th” square and larger, shall contain NO pre-punched or concentric knockouts).

E. All conduit terminations (except for terminations into conduit bodies) shall use connectors or conduit hubs with one locknut or shall use double locknuts (one each side of box wall) and insulating bushing. Provide bushings for the ends of all conduits not terminated in box walls. Refer to Division 26 Sections for grounding bushing requirements.
F. Install no more than the equivalent of three 90 degree bends between boxes.
G. Use hydraulic one-shot conduit bender or factory elbows for bends in conduit larger than 2 inch size unless sweep elbows are required.
H. Conduit shall be bent according to manufacturers' recommendations. Torches or open flame shall not be used to aid in bend of PVC conduit.
I. Use suitable conduit caps or other approved seals to protect installed conduit against entrance of dirt and moisture.
J. Provide 1/8 inch (3 mm) nylon pull string in empty conduit, except sleeves and nipples.
K. Install expansion-deflection joints where conduit crosses building expansion joints. Note: expansion-deflection joints are not required where conduit crosses building control joints if the control joint does not act as an expansion joint. Install expansion fitting in PVC conduit runs as recommended by the manufacturer.
L. Avoid moisture traps where possible. Where moisture traps are unavoidable, provide junction boxes with drain fittings at conduit low points.
M. Where conduit passes between areas of differing temperatures such as into or out of cool rooms, freezers, unheated and heated spaces, buildings, etc., provide Listed conduit seals to prevent the passage of moisture and water vapor through the conduit.
N. Route conduit through roof openings for piping and ductwork where possible.
O. Ground and bond conduit per other Division 26 Sections.
P. PVC conduit shall transition to galvanized rigid metal conduit before it enters a concrete pole base, foundation, wall (where exposed) or up through a concrete floor. Transition shall be under the slab or under grade, with a rigid 90-degree bend or elbow.
Q. Use PVC-coated rigid steel factory elbows for bends in plastic conduit larger than 2". PVC elbows are allowed in PVC conduit runs 2" and smaller.
R. All conduit installed underground (exterior to building) shall be buried a minimum of 24" below finished grade, whether or not the conduit is concrete encased.
S. PVC conduit shall be cleaned with solvent, and dried before application of glue. The temperature rating of glue/cement shall match weather condition. Apply full even coat of cement/glue to entire area that will be inserted into fitting. The entire installation shall meet manufacturers' recommendations.
T. Medium voltage conduit may be installed in interior locations other than electrical vaults only with special permission from Architect/Engineer.

3.3 CONDUIT INSTALLATION SCHEDULE

A. Conduit other than that specified below for specific applications shall not be used.
B. Underground Installations within five feet of foundation fall: Rigid steel conduit.
C. Underground Installations more than five feet from foundation fall: Rigid steel conduit. Plastic-coated rigid steel conduit. Schedule 40 PVC conduit. Install in concrete duct bank as detailed on Drawings.
D. Under Slab on Grade Installations: Schedule 40 PVC conduit. Where conduit turns up through slab and is exposed, elbow shall be rigid steel conduit.
E. Exposed Outdoor Locations: Rigid steel conduit.
F. Concealed in Concrete and Block Walls: Rigid steel conduit. Schedule 40 PVC conduit. Electrical Metallic Tubing (EMT).
G. Wet Interior Locations: Rigid steel conduit.

H. Concealed Dry Interior Locations: Rigid steel conduit. Intermediate metal conduit. Electrical metallic tubing.
I. Exposed Dry Interior Locations: Rigid steel conduit.
J. Motor and equipment connections: Flexible PVC coated metal conduit (wet, damp, or dry locations). Flexible metal conduit (dry locations only). Minimum length shall be one foot; maximum length shall be three feet. Conduit must be installed perpendicular to direction of equipment vibration to allow conduit to freely flex.
K. Light fixtures: Direct box or conduit connection for surface mounted and recessed fixtures. Flexible metal conduit (fixture whip) from a J-box for recessed lay-in light fixtures. Conduit size shall be 3/8" minimum diameter and six foot maximum length. Conduit length shall allow movement of fixture for maintenance purposes. Contractor may use Type MC metal-clad cable in lieu of conduit/wire for fixture whips, size and wire size as specified above.
L. Medium Voltage Applications (Interior Locations): Rigid steel conduit.

3.4 SURFACE METAL RACEWAY AND MULTI-OUTLET ASSEMBLY INSTALLATION

A. Use flat-head screws to fasten channel to surfaces every twenty-four (24) inches. Mount plumb and level.
B. Use suitable insulating bushings and inserts at connections to outlets and corner fittings.
C. Maintain grounding continuity between raceway components to provide a continuous grounding path per Division 26 Sections.
D. Fastener Option: Use clips and straps suitable for the purpose.

3.5 NONMETALLIC SURFACE RACEWAY INSTALLATION

A. Use flat headed screws with appropriate anchors to fasten channel to surfaces secured every twenty-four (24) inches. Mount plumb and level. All surface mounted devices shall be fastened to the wall utilizing flat head screws along with appropriate anchors. No device shall be adhered to the wall surface using two-faced tape or any means other than as described above.
B. Use suitable insulating bushings and inserts at connections to outlets and corner fittings.
C. In areas where the walls cannot be fished, the station cable serving these outlets shall be covered with raceways. No exposed wire shall be permitted within offices, laboratories, and conference rooms or like facilities.
D. The non-metallic raceway shall have a screw applied base. Both the base and cover shall be manufactured of rigid PVC materials.
E. The raceway shall originate from a surface mounted box mounted adjacent to and at the same height as existing electrical boxes in the room, be attached to the wall and terminate above the ceiling.
F. All fittings including, but not limited to, extension boxes, elbows, tees, fixture bodies shall match the color of the raceway.
G. The raceway and all systems devices shall be UL listed and exhibit nonflammable self extinguishing characteristics, tested to specifications of UL94V-0.
H. The raceway and all systems devices shall adhere to the EIA/TIA Category 5e bend radius standard.

3.6 AUXILIARY GUTTERS (Wireways) INSTALLATION

A. Bolt auxiliary gutter to wall using two-piece hangers or steel channels fastened to the wall or in self-supporting structure.
B. Gasket each joint in oil-tight gutter.
C. Mount rain-tight gutter in horizontal position only.
D. Maintain grounding continuity between raceway components to provide a continuous grounding path under Division 26 Sections.

E. Provide terminal blocks for wiring terminations in auxiliary gutters and wireways.

3.7 COORDINATION OF BOX LOCATIONS

A. Provide electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance.

B. Electrical box locations shown on Contract Drawings are approximate unless dimensioned. Verify location of floor boxes and outlets in offices and work areas prior to rough-in.

C. No outlet shall be located where it will be obstructed by other equipment, piping, lockers, benches, casework, etc.

D. Boxes shall not be fastened to the metal roof deck.

E. Contractor shall study drawings pertaining to other trades, discuss location of outlets with workmen installing other piping, equipment, casework, furnishing, etc., and fit all electrical outlets to job conditions. In case of conflicts, notify Designer prior to installation.

F. The proper location of each outlet is considered a part of this contract and no additional compensation will be paid to the Contractor for moving outlets which were improperly located.

G. Locate and install boxes to allow access to them. Where installation is inaccessible, coordinate locations and provide 18 inch by 24 inch access doors.

H. Locate and install to maintain headroom and to present a neat appearance.

I. Install boxes to preserve fire resistance rating of partitions and other elements, using approved materials and methods.

3.8 OUTLET BOX INSTALLATION

A. Do not install boxes back-to-back in walls. Provide minimum 6 inch separation, except provide minimum 24 inch separation in acoustic-rated walls.

B. Power: Recessed (1/4” maximum) outlet boxes in masonry, concrete or tile construction shall be masonry type, minimum 4 inch square. Device covers shall be square-cut except rounded corner plaster rings are allowed in drywall applications. Angle cut plaster rings are not permitted. Coordinate masonry cutting to achieve neat openings for boxes.

C. Low Voltage: Recessed (1/4” maximum) outlet boxes in masonry, concrete or tile construction shall be masonry type, minimum 4 11/16 inch square. Device covers shall be square-cut except rounded corner plaster rings are allowed in drywall applications. Angle cut plaster rings are not permitted. Coordinate masonry cutting to achieve neat openings for boxes.

D. Provide knockout closures for unused openings.

E. Support boxes independently of conduit except for cast boxes that are connected to two rigid metal conduits, both supported within 12 inches of box.

F. Use multiple-gang boxes where more than one device are mounted together; do not use sectional boxes. Provide non-metallic barriers to separate wiring of different voltage systems.

G. Install boxes in walls without damaging wall insulation.

H. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.

I. Ceiling outlets shall be 4 inch octagon or 4 inch square, minimum 2-1/8 inch deep except that concrete boxes and plates will be approved where applicable. Position outlet boxes to locate luminaires as shown on reflected ceiling plans. All ceiling outlets shall be equipped with 3/8 inch fixture studs.

J. In inaccessible ceiling areas, position outlets and junction boxes within 6 inches of recessed luminaire, to be accessible through luminaire ceiling opening.

K. Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately positioning to allow for surface finish thickness. Use

stamped steel stud bridges for flush outlets in hollow stud wall, and adjustable steel channel fasteners for flush ceiling outlet boxes.

L. Align wall-mounted outlet boxes for switches, thermostats, and similar devices.

M. Provide cast ferroalloy or aluminum outlet boxes in exterior and wet locations.

N. Surface wall outlets shall be 4 inch square with raised covers for one and two gang requirements. For three gang or larger requirements, use gang boxes with non-overlapping covers.

3.9 FLOOR BOX INSTALLATION

A. Set boxes level and flush with finish flooring material.

3.10 PULL AND JUNCTION BOX INSTALLATION

A. Locate pull boxes and junction boxes above accessible ceilings, in unfinished areas or furnish and install approved access panels in non-accessible ceilings where boxes are installed.

B. Support pull and junction boxes independent of conduit.

3.11 SYSTEM IDENTIFICATION CONDUIT COLORS – BY BRANCH:

1.	Emergency – Life Safety Branch	Yellow
2.	Emergency – Critical Branch	Blue
3.	Emergency – Equipment Branch	Orange
4.	Fire Alarm	Red
5.	Normal Power and Lighting	Silver (or unpainted galvanized)
6.	Nurse Call	White
7.	IT/Data	Purple
8.	Low Voltage Data, Thermostat	Green
9.	UPS	Black

END OF SECTION 260533

SECTION 260548 - VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes performance requirements for delegated design of vibration and seismic controls.

1.2 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading: Refer to Structural Drawings for Seismic Design Category, Building Use Group, and Seismic design parameters.

1.3 SUBMITTALS

A. Product Data: For all products provided.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint calculations and details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Welding certificates.

D. Qualification Data: For professional engineer.

E. Field quality-control test reports.

1.4 QUALITY ASSURANCE

A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproved by ICC-ES, or preapproved by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

A. Products shall be selected by engineer providing delegated design services.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Delegated Design Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.2 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment Restraints:

1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inches.
2. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

B. Piping Restraints:

1. Comply with requirements in MSS SP-127.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
F. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
G. Drilled-in Anchors:
    1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
    2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
    3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
    4. Set anchors to manufacturer's recommended torque, using a torque wrench.
    5. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

3.3 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Division 22 Section "Domestic Water Piping" for piping flexible connections.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.
B. Tests and Inspections:
    1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
    2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
    3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
    4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
    5. Test to 90 percent of rated proof load of device.
    6. Measure isolator restraint clearance.
    7. Measure isolator deflection.
    8. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
C. Remove and replace malfunctioning units and retest as specified above.
D. Prepare test and inspection reports, certified by Professional Engineer who provided Delegated Design.

3.5 ADJUSTING

A. Adjust isolators after piping system is at operating weight.
B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
C. Adjust active height of spring isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 260548

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Identification for conductors and communication and control cable.
   2. Warning labels and signs.
   3. Equipment identification labels.
   4. Ceiling identification labels.

1.2 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

1.3 QUALITY ASSURANCE

A. Comply with ANSI A13.1.

1.4 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

PART 2 - PRODUCTS

2.1 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS

A. Marker Tape: Vinyl or vinyl -cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.2 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.

C. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 7 by 10 inches.

D. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 10 by 14 inches.

E. Fasteners for Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

F. Warning label and sign shall include, but are not limited to, the following legends:
   1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
   2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 mm)."

2.3 EQUIPMENT IDENTIFICATION LABELS

A. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with color code as described below. Minimum letter height shall be 3/8 inch.

2.4 CEILING IDENTIFICATION LABELS

A. Permanent, self-adhesive ¾” diameter colored labels

PART 3 - EXECUTION

3.1 APPLICATION

A. Auxiliary Electrical Systems Conductor and Cable Identification: Use marker tape to identify field-installed alarm, control, signal, sound, intercommunications, voice, and data wiring connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and cable pull points. Identify by system and circuit designation.
2. Use system of designations that is uniform and consistent with system used by manufacturer for factory-installed connections.

B. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply baked-enamel warning signs or metal-backed, butyrate warning signs. Identify system voltage using color code as described below. Apply to exterior of door, cover, or other access.
1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:
   a. Power transfer switches.
   b. Controls with external control power connections.
2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.

C. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
1. Labeling Instructions:
   a. Indoor Equipment: Engraved, laminated acrylic or melamine label, drilled for screw attachment. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where 2 lines of text are required, use labels 2 inches high.
   b. Outdoor Equipment: Engraved, laminated acrylic or melamine label, drilled for screw attachment.
   c. Elevated Components: Increase sizes of labels and legend to those appropriate for viewing from the floor.
2. Equipment to Be Labeled:
   a. Panelboards, electrical cabinets, and enclosures.
   b. Electrical switchgear and switchboards.
   c. Transformers.
   d. Motor-control centers.
   e. Disconnect switches.
   f. Enclosed circuit breakers.
   g. Motor starters.
   h. Push-button stations.
   i. Power transfer equipment.
   j. Contactors.

D. Ceiling identification labels
1. Install ceiling identification labels on ceiling grid below junction boxes, switches, and other items that require adjustment.
2. Install prior to installation of ceiling tile.

3.2 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Attach nonadhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.

E. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.
   1. Color shall be factory applied.
   2. Colors for 208/120-V Circuits:
      a. Phase A: Black.
      b. Phase B: Red.
      c. Phase C: Blue.
      d. Neutral: White
   3. Colors for 480/277-V Circuits:
      a. Phase A: Brown.
      b. Phase B: Orange.
      c. Phase C: Yellow.
      d. Neutral: Gray
   4. Isolated Circuits:
      a. Hot: Orange
      b. Neutra: Brown

F. Color-Coding for Equipment Identification: MATCH FACILITY STANDARD. When no facility standard exists, use the colors listed below for equipment.
   1. Normal Branch Power: Green label with white lettering
   2. Life Safety Branch Power: Yellow label with white lettering
   3. Critical Branch Power: Blue label with white lettering
   4. Equipment Branch Power: Red label with white lettering.

G. All outlet boxes, junction boxes and pull boxes shall have their covers and exterior visible surfaces painted with colors to match the surface color scheme outlined above. This includes covers above lift-out and other type accessible ceilings.

H. All J-box covers to be identified with circuit number.

END OF SECTION 260553

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following lighting control devices:
   1. Outdoor photoelectric switches.
   2. Indoor occupancy sensors.
   3. Outdoor motion sensors.

B. See Division 26 Section "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

1.2 SUBMITTALS

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

B. Field quality-control test reports.

C. Operation and maintenance data.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 OUTDOOR PHOTOELECTRIC SWITCHES

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
   1. Area Lighting Research, Inc.; Tyco Electronics.
   2. Cooper Controls
   3. Lithonia Lighting; Acuity Lighting Group, Inc.
   4. Square D; Schneider Electric.
   5. Watt Stopper (The).

B. Description: Solid state, with [**SPST**] dry contacts rated for [**1800-VA tungsten or 1000-VA inductive**], to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.
   1. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of photocell to prevent fixed light sources from causing turn-off.
   2. Time Delay: 15-second minimum, to prevent false operation.
   3. Surge Protection: Metal-oxide varistor, complying with IEEE C62.41.1, IEEE C62.41.2, and IEEE 62.45 for Category A1 locations.
   4. Mounting: Twist lock complying with IEEE C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.

C. Description: Solid state, with [**SPST**] dry contacts rated for 1800 VA to operate connected load, relay, or contactor coils; complying with UL 773.
   1. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range.
   2. Time Delay: 30-second minimum, to prevent false operation.
   3. Lightning Arrester: Air-gap type.
   4. Mounting: Twist lock complying with IEEE C136.10, with base.

2.2 INDOOR OCCUPANCY SENSORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
   1. Hubbell Lighting.
   2. Leviton Mfg. Company Inc.
   3. Lithonia Lighting; Acuity Lighting Group, Inc.
   4. Sensor Switch, Inc.

B. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.

1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
4. Mounting:
   a. Sensor: Suitable for mounting in any position on a standard outlet box.
   b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
   c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
6. Bypass Switch: Override the on function in case of sensor failure.
7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; keep lighting off when selected lighting level is present.

C. PIR Type: Ceiling mounting; detect occupancy by sensing a combination of heat and movement in area of coverage.
1. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in..
2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.
3. Detection Coverage (Corridor): Detect occupancy within 90 feet when mounted on a 10-foot- high ceiling.

2.3 OUTDOOR MOTION SENSORS (PIR)

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
1. Bryant Electric; a Hubbell Company.
2. Hubbell Lighting.
3. Lithonia Lighting; Acuity Lighting Group, Inc.
4. Paragon Electric Co.; Invensys Climate Controls.
5. RAB Lighting, Inc.
6. TORK.
7. Watt Stopper (The).

B. Performance Requirements: Suitable for operation in ambient temperatures ranging from minus 40 to plus 130 deg F, rated as raintight according to UL 773A.
1. Operation: Turn lights on when sensing infrared energy changes between background and moving body in area of coverage; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
2. Mounting:
   a. Sensor: Suitable for mounting in any position on a standard outdoor junction box.
   b. Relay: Internally mounted in a standard weatherproof electrical enclosure.
   c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
3. Bypass Switch: Override the on function in case of sensor failure.
4. Automatic Light-Level Sensor: Adjustable from 1 to 20 fc; keep lighting off during daylight hours.

C. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in..

D. Detection Coverage: [**Up to 35 feet, with a field of view of 180 degrees**].
E. Lighting Fixture Mounted Sensor: Suitable for switching 300 W of tungsten load at 120- or 277-V ac.
F. Individually Mounted Sensor: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
1. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
2. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.

2.4 CONDUCTORS AND CABLES
A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. [**18**] AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. [**14**] AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION
3.1 SENSOR INSTALLATION
A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.
B. When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

3.2 CONTACTOR INSTALLATION
A. Mount electrically held lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.3 WIRING INSTALLATION
A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 1/2 inch.
B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION
A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."
1. Identify controlled circuits in lighting contactors.
2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.
B. Label time switches and contactors with a unique designation.

3.5 FIELD QUALITY CONTROL
A. Perform the following field tests and inspections and prepare test reports:
1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
2. Operational Test: Verify operation of each lighting control device, and adjust time delays.

B. Lighting control devices that fail tests and inspections are defective work.

END OF SECTION 260923

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes distribution panelboards and lighting and appliance branch-circuit panelboards.

1.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
   1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.3 SUBMITTALS

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

B. Shop Drawings: For each panelboard and related equipment.
   1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
   2. Detail enclosure types and details for types other than NEMA 250, Type 1.
   3. Detail bus configuration, current, and voltage ratings.
   4. Short-circuit current rating of panelboards and overcurrent protective devices.
   5. Include evidence of NRTL listing for series rating of installed devices.
   6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
   7. Include wiring diagrams for power, signal, and control wiring.
   8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.

C. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

D. Field quality-control reports.

E. Panelboard schedules for installation in panelboards.

F. Operation and maintenance data.

1.4 QUALITY ASSURANCE

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

B. Comply with NEMA PB 1.

C. Comply with NFPA 70.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

B. Enclosures: Flush- and surface-mounted cabinets.
   1. Rated for environmental conditions at installed location.
      a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
      b. Outdoor Locations: NEMA 250, Type 3R.
      c. Kitchen Areas: NEMA 250, Type 4X,.
      d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
   2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.

3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
4. Directory Card: Inside panelboard door, mounted in transparent card holder.

C. Incoming Mains Location: Top and bottom, as shown on Drawings.
D. Phase, Neutral, and Ground Buses: Hard-drawn copper, 98 percent conductivity.
E. Conductor Connectors: Suitable for use with conductor material and sizes.
1. Material: [**Hard-drawn copper, 98 percent conductivity**].
2. Main and Neutral Lugs: [**Mechanical**] type.
3. Ground Lugs and Bus Configured Terminators: [**Mechanical**] type.
4. Feed-Through Lugs: [**Mechanical**] type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
5. Subfeed (Double) Lugs: [**Mechanical**] type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

F. Service Equipment Label: NRTL labeled for use as service equipment for all panelboards.
G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
H. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include size and type of allowable upstream and branch devices, and listed and labeled for series-connected short-circuit rating by an NRTL.
I. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.
J. Provide surge protection devices on all emergency panelboards per NEC 700.8. Refer to electrical specification section: 264313 Transient-Voltage Surge Suppression for details.

2.2 DISTRIBUTION PANELBOARDS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Square D; a brand of Schneider Electric.
B. Panelboards: NEMA PB 1, power and feeder distribution type.
C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
D. Mains: Circuit breaker, Fused switch, or Lugs only, as indicated on drawings.
E. Branch Overcurrent Protective Devices: For Circuit-Breaker Frame Sizes 125 A and Smaller: [**Bolt-on**] circuit breakers.
F. Branch Overcurrent Protective Devices: For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
G. Branch Overcurrent Protective Devices: Fused switches.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Square D; a brand of Schneider Electric.
B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
C. Mains: Circuit breaker or lugs only.
D. Branch Overcurrent Protective Devices: [**Bolt-on**] circuit breakers, replaceable without disturbing adjacent units.
E. Contactors in Main Bus: NEMA ICS 2, Class A, [**electrically**] held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
1. External Control-Power Source: [**120-V branch circuit**].
F. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
G. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

2.1 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES. (SERVICE ENTRANCE MAIN BREAKER TO BE GFI PROTECTED PER NEC 230.95)

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. Square D; a brand of Schneider Electric.

B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with [**interrupting capacity**] to meet available fault currents.
   1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
   2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
   3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
      a. Instantaneous trip.
      b. Long- and short-time pickup levels.
      c. Long- and short-time time adjustments.
      d. Ground-fault pickup level, time delay, and I^2t response.
   4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
   5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
   6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
   7. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
   8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
      a. Standard frame sizes, trip ratings, and number of poles.
      b. Lugs: [**Mechanical**] style, suitable for number, size, trip ratings, and conductor materials.
      c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
      d. Ground-Fault Protection: [**Integrally mounted**] relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
      e. Communication Capability: [**Circuit-breaker-mounted**] communication module with functions and features compatible with power monitoring and control system specified in Division 26 Section "Electrical Power Monitoring and Control."
      f. Shunt Trip: [**120**] -V trip coil energized from separate circuit, set to trip at [**55**] percent of rated voltage.
      g. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in [**on or off**] position.
      h. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
   1. Fuses, and Spare-Fuse Cabinet: Comply with requirements specified in Division 26 Section "Fuses."

2.2 ACCESSORY COMPONENTS AND FEATURES

A. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Receive, inspect, handle, store and install panelboards and accessories according to [**NECA 407**] [**NEMA PB 1.1**].

B. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

C. Mount top of trim 90 inches above finished floor unless otherwise indicated.

D. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

E. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

F. Install filler plates in unused spaces.

G. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.

H. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

I. Comply with NECA 1.

3.2 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads and incorporating Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.4 STUDIES

A. Electrical Contractor to provide a complete short circuit and selective coordination study from the service entrance to all end devices. The study shall be provided by the switchgear manufacturer and utilize time current curves provided by manufacturer for the specific project. The study shall be made available for engineer's review and included with shop drawings. **Study must be reviewed and approved prior to submitting panelboards.**

B. The selective coordination study shall meet the requirements described by NEC Articles 700.32, 701.27, 708.54, and 620.62.

C. The minimum NEC requirement for the selective coordination study is applicable to the systems described in NEC Articles 700.32, 701.27, 708.54, and 620.62, and as indirectly referenced for essential electrical systems in Article 517.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Receptacles, receptacles with integral GFCI, and associated device plates.
   2. Wall-box motion sensors.
   3. Snap switches and wall-box dimmers.
   4. Solid-state fan speed controls.
   5. Wall-switch and exterior occupancy sensors.
   6. Communications outlets.

B. See Division 27 Section "Communications Horizontal Cabling" for workstation outlets.

1.2 SUBMITTALS

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

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Samples: One for each type of device and wall plate specified, in each color specified.

D. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Basis of Design Product: As shown on Drawings.

B. Comparable Products by, Hubbell,

2.2 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

2.3 GFCI RECEPTACLES

A. General Description: Straight blade, feed or non-feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A.

2.4 SNAP SWITCHES

A. Comply with NEMA WD 1 and UL 20.

B. Switches, 120/277 V, 20 A.

C. Pilot Light Switches, 20 A.
   1. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."

D. Key-Operated Switches, 120/277 V, 20 A.
   1. Description: Single pole, with factory-supplied key in lieu of switch handle.

E. Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors and where otherwise indicated.

F. Key-Operated, Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors and where otherwise indicated, with factory-supplied key in lieu of switch handle.

2.5 WALL-BOX DIMMERS

A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.

B. Control: Continuously adjustable slider, toggle switch, or rotary knob; with single-pole or three-way switching. Comply with UL 1472.

C. Incandescent Lamp Dimmers: 120 V; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module.
   1. Wattage as shown on Drawings; dimmers shall require no derating when ganged with other devices.

2.6 FAN SPEED CONTROLS

A. Modular, 120-V, full-wave, solid-state units with integral, quiet on-off switches and audible frequency and EMI/RFI filters. Comply with UL 1917.
   1. Continuously adjustable slider, toggle switch, or rotary knob, 5 A.
   2. Three-speed adjustable slider or rotary knob, 1.5 A.

2.7 OCCUPANCY SENSORS

A. Wall-Switch Sensors:
   1. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft..

B. Wall-Switch Sensors:
   1. Description: Adaptive-technology type, 120/277 V, adjustable time delay up to 20 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft..

C. Long-Range Wall-Switch Sensors:
   1. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 110-degree field of view, with a minimum coverage area of 1200 sq. ft..

D. Long-Range Wall-Switch Sensors:
   1. Description: Dual technology, with both passive-infrared- and ultrasonic-type sensing, 120/277 V, adjustable time delay up to 30 minutes, 110-degree field of view, and a minimum coverage area of 1200 sq. ft..

E. Wide-Range Wall-Switch Sensors:
   1. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 150-degree field of view, with a minimum coverage area of 1200 sq. ft..

F. Exterior Occupancy Sensors:
   1. Description: Passive-infrared type, 120/277 V, weatherproof, adjustable time delay up to 15 minutes, 180-degree field of view, and 110-foot detection range. Minimum switch rating: 1000-W incandescent, 500-VA fluorescent.

2.8 COMMUNICATIONS OUTLETS

A. Telephone Outlet:
   1. Description: Single RJ-45 jack for terminating 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1 complying with Category 5e. Comply with UL 1863.

B. Combination TV and Telephone Outlet:
   1. Description: Single RJ-45 jack for 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 5e; and one Type F coaxial cable connector.

2.9 WALL PLATES

A. Single and combination types to match corresponding wiring devices.
   1. Plate-Securing Screws: Metal with head color to match plate finish.
   2. Material for Finished Spaces: 0.035-inch- thick, satin-finished stainless steel.
   3. Material for Unfinished Spaces: Galvanized steel.
   4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover.

2.10 FLOOR SERVICE FITTINGS

A. Type: Modular, [**flush-type**], dual-service units suitable for wiring method used.

B. Compartments: Barrier separates power from voice and data communication cabling.

C. Service Plate: [**Round**], [**die-cast aluminum**] with satin finish.

D. Power Receptacle: NEMA WD 6 configuration 5-20R, gray finish, unless otherwise indicated.

E. Voice and Data Communication Outlet: [**Blank cover with bushed cable opening**].

2.11 FINISHES

A. Color: Wiring device catalog numbers in Section Text do not designate device color.
   1. Wiring Devices Connected to Normal Power System: Gray, unless otherwise indicated or required by NFPA 70 or device listing.
   2. Wiring Devices Connected to Emergency Power System: Red.
   3. TVSS Devices: Blue.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:
   1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
   2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
   3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
   4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:
   1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
   2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
   3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
   4. Existing Conductors:
      a. Cut back and pigtail, or replace all damaged conductors.
      b. Straighten conductors that remain and remove corrosion and foreign matter.
      c. Pigtailing existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:
   1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
   2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
   3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
   4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
   5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
   6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
   7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
   8. Tighten unused terminal screws on the device.
   9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles [**down**], and on horizontally mounted receptacles to the [**right**].

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:
1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

3.2 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."
1. Receptacles: Identify panelboard and circuit number from which served. Use durable wire markers or tags inside outlet boxes.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.
1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:
1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new, and retest as specified above.

END OF SECTION 262726

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following individually mounted, enclosed switches and circuit breakers:
   1. Fusible switches.
   2. Nonfusible switches.
   3. Molded-case circuit breakers.
   4. Enclosures.

1.2 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and maintenance data.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 FUSIBLE AND NONFUSIBLE SWITCHES

A. Manufacturers:
   1. Square D/Group Schneider.

B. Fusible Switch, [**600**] A and Smaller: NEMA KS 1, Type [**GD**], with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Nonfusible Switch, [**600**] A and Smaller: NEMA KS 1, Type [**GD**], lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

D. Accessories:
   1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
   2. Neutral Kit: Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper and aluminum neutral conductors.
   3. Auxiliary Contact Kit: Auxiliary set of contacts arranged to open before switch blades open.

2.3 MOLDED-CASE CIRCUIT BREAKERS AND SWITCHES

A. Manufacturers:
   1. Square D/Group Schneider.

B. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.
   1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
   2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
   3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller and let-through ratings less than NEMA FU 1, RK-5.
   4. GFCI Circuit Breakers: Single- and two-pole configurations with [**30**]-mA trip sensitivity.

C. Molded-Case Circuit-Breaker Features and Accessories:
   1. Standard frame sizes, trip ratings, and number of poles.
   2. Lugs: Mechanical style suitable for number, size, trip ratings, and conductor material.
   3. Application Listing: Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
   4. Ground-Fault Protection: [**Integrally mounted**] relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
   5. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at [**55**] percent of rated voltage.

2.4 ENCLOSURES

A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.
   1. Outdoor Locations: NEMA 250, Type 3R.
   2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
   3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.

B. Concrete base is specified in Division 26 Section "Hangers and Supports for Electrical Systems," and concrete materials and installation requirements are specified in Division 03.

C. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.

D. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.

E. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

F. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

G. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."

3.2 FIELD QUALITY CONTROL

A. Prepare for acceptance testing as follows:
   1. Inspect mechanical and electrical connections.
   2. Verify switch and relay type and labeling verification.
   3. Verify rating of installed fuses.

B. Perform the following field tests and inspections and prepare test reports:
   1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
   2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

END OF SECTION 262816

SECTION 263213 - ENGINE GENERATORS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes packaged engine-generator sets for [**standby**] power supply with the following features:
   1. [**Diesel**] engine.
   2. [**Unit-mounted**] cooling system.
   3. [**Remote-mounting**] control and monitoring.
   4. Outdoor enclosure.

B. See Division 26 Section "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.

1.2 SUBMITTALS

A. Product Data: For each type of packaged engine generator and accessory indicated.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

C. Manufacturer Seismic Qualification Certification: Submit certification that engine-generator set, batteries, battery racks, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
      a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
      b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Source quality-control test reports.

E. Field quality-control test reports.

F. Operation and maintenance data.

G. Coordination Study verifying compliance with NEC 700.27. Provide prior to ordering equipment. Refer to section: 260573 Overcurrent Protective Coordination

H. Warranty: Special warranty specified in this Section.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within [**200 miles**] of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with ASME B15.1.

E. Comply with NFPA 37.

F. Comply with NFPA 70.

G. Comply with NFPA 99.

H. Comply with NFPA 110 requirements for Level [**1**] emergency power supply system.

I. Comply with UL 2200.

J. Engine Exhaust Emissions: Comply with applicable state and local government requirements.

K. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

1.4 PROJECT CONDITIONS

A. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
1. Ambient Temperature: [**Minus 15 to plus 40 deg C**].
2. Relative Humidity: 0 to 95 percent.
3. Altitude: Sea level to [**1000 feet**] .

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.
1. Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
1. Owner provided generator

B. Comply with NFPA 30.

C. Onsite fuel storage tank: Factory installed and piped, complying with UL 142 fuel oil tank. Features include the following:
1. Tank level indicator.
2. Capacity: 133% of required run capacity.
3. Run capacity: [**36 hours**] continuous operation at 100 percent rated power output.

4. Vandal-resistant fill cap.
5. Containment Provisions: Comply with requirements of authorities having jurisdiction.

2.2 CONTROL AND MONITORING

A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms.

B. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts generator set. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms.

C. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration.

D. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level [**1**] system, and the following:
   1. AC voltmeter.
   2. AC ammeter.
   3. AC frequency meter.
   4. DC voltmeter (alternator battery charging).
   5. Engine-coolant temperature gage.
   6. Engine lubricating-oil pressure gage.
   7. Running-time meter.
   8. Ammeter-voltmeter, phase-selector switch(es).
   9. Generator-voltage adjusting rheostat.
   10. Fuel tank derangement alarm.
   11. Fuel tank high-level shutdown of fuel supply alarm.
   12. Generator overload.

E. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

F. Common Remote Audible Alarm: Comply with NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel.
   1. Overcrank shutdown.
   2. Coolant low-temperature alarm.
   3. Control switch not in auto position.
   4. Battery-charger malfunction alarm.
   5. Battery low-voltage alarm.

G. Remote Alarm Annunciator: Comply with NFPA 99. An LED labeled with proper alarm conditions shall identify each alarm event and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.

2.3 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Generator Circuit Breaker: Molded-case, thermal-magnetic type; 100 percent rated; complying with NEMA AB 1 and UL 489.

1. Tripping Characteristic: Designed specifically for generator protection.
2. Trip Rating: Matched to generator rating.
3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
4. Mounting: Adjacent to or integrated with control and monitoring panel.

B. Ground-Fault Indication: Comply with NFPA 70, "Emergency System" signals for ground-fault. Integrate ground-fault alarm indication with other generator-set alarm indications.

2.4 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with NEMA MG 1.

B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: Class H or Class F.

D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.

E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

F. Enclosure: Dripproof.

G. Instrument Transformers: Mounted within generator enclosure.

H. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.
1. Adjusting rheostat on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band.

I. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.

J. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

K. Subtransient Reactance: [**12**] percent, maximum.

L.

2.5 VIBRATION ISOLATION DEVICES

A. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized-steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.
1. Material: [Standard neoprene] .
2. Durometer Rating: [**45**] .
3. Number of Layers: [**Two**] .

B. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.
1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch- thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
2. Outside Spring Diameter: Not less than 80 percent of compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.6 FINISHES

A. Indoor Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.7 SOURCE QUALITY CONTROL

A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
   1. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.
   2. Report factory test results within 10 days of completion of test.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.

B. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.

C. Install packaged engine generator with [**restrained spring isolators**] having a minimum deflection of [**1 inch**] on 4-inch- high concrete base. Secure sets to anchor bolts installed in concrete bases. Concrete base construction is specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

D. Install Schedule 40, black steel piping with welded joints and connect to engine muffler. Install thimble at wall. Piping shall be same diameter as muffler outlet. Flexible connectors and steel piping materials and installation requirements are specified in Division 23 Section "Hydronic Piping."
   1. Install condensate drain piping to muffler drain outlet full size of drain connection with a shutoff valve, stainless-steel flexible connector, and Schedule 40, black steel pipe with welded joints. Flexible connectors and piping materials and installation requirements are specified in Division 23 Section "Hydronic Piping."

E. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

F. Piping installation requirements are specified in Division 23 Sections. Drawings indicate general arrangement of piping and specialties.

G. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow service and maintenance.

H. Connect engine exhaust pipe to engine with flexible connector.

I. Connect fuel piping to engines with a gate valve and union and flexible connector.

J. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

K. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

L. Identify system components according to Division 23 Section "Identification for HVAC Piping and Equipment" and Division 26 Section "Identification for Electrical Systems."

M. Provide a minimum of TWO emergency stops. One mounted on the generator enclosure and one remote mounted away from the enclosure, but within site of the generator. Coordinate exact location on site.

N. WHERE BASE MOUNTED TANK RAISES THE OUTPUT CIRCUIT BREAKER ON THE EXTERIOR OF THE GENSET TO ABOVE 6'-0", OR IF HEIGHT OF TANK IS 42" OR ABOVE, E.C. SHALL PROVIDE AND INSTALL A CATWALK AROUND 3 SIDES OF THE GENSET REQUIREING ACCESS OR MAINTAINCE, COMPLETE WITH ACCESS STEPS AND HANDRAIL.

O. Electrical contractor to coordinate with utility company and provide reverse power relay, as required. Manufacturers to be ABB, SELCO, or approved equal.

3.2 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.
1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:
1. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection for "AC Generators and for Emergency Systems" specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.
3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
   a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
   b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
   c. Verify acceptance of charge for each element of the battery after discharge.
   d. Verify that measurements are within manufacturer's specifications.
4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
6. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg. Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.
7. Exhaust Emissions Test: Comply with applicable government test criteria.
8. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
9. Harmonic-Content Tests: Measure harmonic content of output voltage under 25 percent and at 100 percent of rated linear load. Verify that harmonic content is within specified limits.
10. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at [**four**] locations [**on the property line**] , and compare measured levels with required values.
11. Load Test: Minimum four hours at 85% rated load.

C. Coordinate tests with tests for transfer switches and run them concurrently.

D. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

E. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

F. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

G. Remove and replace malfunctioning units and [**retest**] as specified above.

H. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

I. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

3.3 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators. Refer to Division 26 Section "Demonstration and Training."

END OF SECTION 263213

SECTION 263600 - TRANSFER SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes automatic transfer switches rated 600 V and less.

B. See Division 21 Section "Electric-Drive, Centrifugal Fire Pumps" for automatic transfer switches for fire pumps.

C. See Division 21 Section "Electric-Drive, Vertical-Turbine Fire Pumps" for automatic transfer switches for fire pumps.

1.2 SUBMITTALS

A. Product Data: Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.

C. Manufacturer Seismic Qualification Certification: Submit certification that transfer switches accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
    a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
2. Dimensioned Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based.

D. Field quality-control test reports.

E. Operation and maintenance data.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NEMA ICS 1.

C. Comply with NFPA 70.

D. Comply with NFPA 99.

E. Comply with NFPA 110.

F. Comply with UL 1008 unless requirements of these Specifications are stricter.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following

1. Contactor Transfer Switches:
    a. Caterpillar; Engine Div.
    b. Generac
    c. Kohler

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.

B. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.
   1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.
C. Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.
D. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
E. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.
F. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
   1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.
   2. Switch Action: Double throw; mechanically held in both directions.
   3. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.
   4. Closed transition
   5. Isolation By-pass
G. Neutral Switching. Where four-pole switches are indicated, provide [**neutral pole switched simultaneously with phase poles**].
H. Neutral Terminal: Solid and fully rated, unless otherwise indicated.
I. Oversize Neutral: Ampacity and switch rating of neutral path through units indicated for oversize neutral shall be double the nominal rating of circuit in which switch is installed.
J. Battery Charger: For generator starting batteries.
   1. Float type rated [**10**] A.
   2. Ammeter to display charging current.
   3. Fused ac inputs and dc outputs.
K. Enclosures: General-purpose NEMA 250, Type [**1**], complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.3 AUTOMATIC TRANSFER SWITCHES

A. Comply with Level 1 equipment according to NFPA 110.
B. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.
C. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.
D. Transfer Switches Based on Molded-Case-Switch Components: Comply with NEMA AB 1, UL 489, and UL 869A.
E. In-Phase Monitor: Factory-wired, internal relay controls transfer so it occurs only when the two sources are synchronized in phase.
F. Motor Disconnect and Timing Relay: Controls designate starters so they disconnect motors before transfer and reconnect them selectively at an adjustable time interval after

transfer. Time delay for reconnecting individual motor loads is adjustable between 1 and 60 seconds, and settings are as indicated.

G. Programmed Neutral Switch Position: Switch operator has a programmed neutral position arranged to provide a midpoint between the two working switch positions, with an intentional, time-controlled pause at midpoint during transfer.

H. Automatic Transfer-Switch Features:
   1. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
   2. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
   3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
   4. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
   5. Test Switch: Simulate normal-source failure.
   6. Switch-Position Pilot Lights: Indicate source to which load is connected.
   7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.
      a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
      b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
   8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
   9. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
   10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
   11. Engine Shutdown Contacts: Instantaneous; shall initiate shutdown sequence at remote engine-generator controls after retransfer of load to normal source.
   12. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
   13. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:

a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
b. Push-button programming control with digital display of settings.
c. Integral battery operation of time switch when normal control power is not available.

2.4 SOURCE QUALITY CONTROL

A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Design each fastener and support to carry load indicated by seismic requirements and according to seismic-restraint details. See Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
B. Floor-Mounting Switch: Anchor to floor by bolting.
1. Concrete Bases: 4 inches high, reinforced, with chamfered edges. Extend base no more than 4 inches in all directions beyond the maximum dimensions of switch, unless otherwise indicated or unless required for seismic support. Construct concrete bases according to Division 26 Section "Hangers and Supports for Electrical Systems."
C. Identify components according to Division 26 Section "Identification for Electrical Systems."
D. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.2 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
B. Perform tests and inspections and prepare test reports.
1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installation, including connections, and to assist in testing.
2. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
a. Check for electrical continuity of circuits and for short circuits.
b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
c. Verify that manual transfer warnings are properly placed.

d. Perform manual transfer operation.

5. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.
   a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
   b. Simulate loss of phase-to-ground voltage for each phase of normal source.
   c. Verify time-delay settings.
   d. Verify pickup and dropout voltages by data readout or inspection of control settings.
   e. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.
   f. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
6. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
   a. Verify grounding connections and locations and ratings of sensors.

C. Coordinate tests with tests of generator and run them concurrently.

D. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

E. Remove and replace malfunctioning units and retest as specified above.

F. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.
   1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
   2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
   3. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below. Refer to Division 26 Section "Demonstration and Training."

B. Coordinate this training with that for generator equipment.

END OF SECTION 263600

SECTION 264313 - TRANSIENT-VOLTAGE SUPPRESSION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes TVSSs for low-voltage power equipment.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating weights, operating characteristics, furnished specialties, and accessories.

B. Field quality-control test reports.

C. Operation and Maintenance Data.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain suppression devices and accessories through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with IEEE C62.41, "IEEE Guide for Surge Voltages in Low Voltage AC Power Circuits," and test devices according to IEEE C62.45, "IEEE Guide on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits."

D. Comply with NEMA LS 1, "Low Voltage Surge Protection Devices."

E. Comply with UL 1283, "Electromagnetic Interference Filters," and UL 1449 (3rd edition), "Transient Voltage Surge Suppressors."

1.4 PROJECT CONDITIONS

A. Service Conditions: Rate surge protection devices for continuous operation under the following conditions, unless otherwise indicated:
   1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage.
   2. Operating Temperature: 30 to 120 deg F.
   3. Humidity: 0 to 85 percent, noncondensing.
   4. Altitude: Less than 20,000 feet above sea level.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Advanced Protection Technologies, Inc.
   2. Cutler-Hammer, Inc.; Eaton Corporation.
   3. Intermatic, Inc.
   4. Leviton Mfg. Company Inc.
   5. Liebert Corporation; a division of Emerson.
   6. Siemens Energy & Automation, Inc.
   7. Square D; Schneider Electric.
   8. Tycor; Cutler-Hammer, Inc.

2.2 SERVICE ENTRANCE SUPPRESSORS

A. Surge Protection Device Description: Non-modular, sine-wave-tracking type with the following features and accessories:
   1. LED indicator lights for power and protection status.
   2. Audible alarm, with silencing switch, to indicate when protection has failed.
   3. Fuses, rated at 200-kA interrupting capacity.
   4. Integral disconnect switch.
   5. Redundant suppression circuits.
   6. Surge-event operations counter.

B. Peak Single-Impulse Surge Current Rating: [**240**] kA per phase.

C. Connection Means: Permanently wired.

D. Protection modes and UL 1449 suppressed voltage rating for grounded wye circuits with voltages of [**208Y/120**], 3-phase, 4-wire circuits shall be as follows:
   1. Line to Neutral: [400 V for 208Y/120].
   2. Line to Ground: [400 V for 208Y/120].
   3. Neutral to Ground: [400 V for 208Y/120].

E. Protection modes and UL 1449 suppressed voltage rating for 240/120-V, single-phase, 3-wire circuits shall be as follows:
   1. Line to Neutral: 400 V.
   2. Line to Ground: 400 V.
   3. Neutral to Ground: 400 V.

F. Protection modes and UL 1449 suppressed voltage rating for 240/120-V, 3-phase, 4-wire circuits with high leg shall be as follows:
   1. Line to Neutral: 400 V, 800 V from high leg.
   2. Line to Ground: 400 V.
   3. Neutral to Ground: 400 V.

G. Protection modes and UL 1449 suppressed voltage rating for voltages of 240 or 480, 3-phase, 3-wire, delta circuits shall be as follows:
   1. Line to Line: [2000 V for 480 V] [1000 V for 240 V].
   2. Line to Ground: [2000 V for 480 V] [1000 V for 240 V].

2.3 PANELBOARD SUPPRESSORS

A. Surge Protection Device Description: Non-modular, sine-wave-tracking type with the following features and accessories:
   1. LED indicator lights for power and protection status.
   2. Audible alarm, with silencing switch, to indicate when protection has failed.
   3. Fuses, rated at 200-kA interrupting capacity.
   4. Integral disconnect switch.
   5. Redundant suppression circuits.
   6. Surge-event operations counter.

B. Peak Single-Impulse Surge Current Rating: [**120**] kA per phase.

C. Protection modes and UL 1449 suppressed voltage rating for grounded wye circuits with voltages of [**208Y/120**], 3-phase, 4-wire circuits shall be as follows:
   1. Line to Neutral: [400 V for 208Y/120].
   2. Line to Ground: [400 V for 208Y/120].
   3. Neutral to Ground: [400 V for 208Y/120].

D. Protection modes and UL 1449 suppressed voltage rating for 240/120-V, single-phase, 3-wire circuits shall be as follows:
   1. Line to Neutral: 400 V.
   2. Line to Ground: 400 V.
   3. Neutral to Ground: 400 V.

E. Protection modes and UL 1449 suppressed voltage rating for 240/120-V, 3-phase, 4-wire circuits with high leg shall be as follows:
   1. Line to Neutral: 400 V, 800 V from high leg.
   2. Line to Ground: 400 V.
   3. Neutral to Ground: 400 V.

F. Protection modes and UL 1449 suppressed voltage rating for voltages of 240 or 480, 3-phase, 3-wire, delta circuits shall be as follows:
   1. Line to Line: [1000 V for 240 V].
   2. Line to Ground: [800 V for 240 V].

2.4 SUPPRESSORS FOR ELECTRONIC-GRADE PANELBOARDS

A. Surge Protection Device Description: Sine-wave-tracking type, panel-mounted design with the following features and accessories:
   1. LED indicator lights for power and protection status.
   2. Audible alarm, with silencing switch, to indicate when protection has failed.
   3. Arrangement with wire connections to phase buses, neutral bus, and ground bus.

B. Peak Single-Impulse Surge Current Rating: [**120**] kA per phase.

C. Protection modes and UL 1449 suppressed voltage rating for grounded wye circuits with voltages of [**208Y/120**], 3-phase, 4-wire circuits shall be as follows:
   1. Line to Neutral: [400 V for 208Y/120].
   2. Line to Ground: [400 V for 208Y/120].
   3. Neutral to Ground: [400 V for 208Y/120].

D. Protection modes and UL 1449 suppressed voltage rating for 240/120-V, single-phase, 3-wire circuits shall be as follows:
   1. Line to Neutral: 400 V.
   2. Line to Ground: 400 V.
   3. Neutral to Ground: 400 V.

E. Protection modes and UL 1449 suppressed voltage rating for 240/120-V, 3-phase, 4-wire circuits with high leg shall be as follows:
   1. Line to Neutral: 400 V, 800 V from high leg.
   2. Line to Ground: 400 V.
   3. Neutral to Ground: 400 V.

F. Protection modes and UL 1449 suppressed voltage rating for voltages of 240, 480, or 600, 3-phase, 3-wire, delta circuits shall be as follows:
   1. Line to Line: [1000 V for 240 V].
   2. Line to Ground: [800 V for 240 V].

2.5 ENCLOSURES

A. NEMA 250, with type matching the enclosure of panel or device being protected.

PART 3 - EXECUTION

3.1 INSTALLATION OF SURGE PROTECTION DEVICES

A. Install devices at service entrance on load side, with ground lead bonded to service entrance ground. Install devices on all emergency panels per NEC 700.8. Install on all normal power panels.

B. Install devices for panelboard and auxiliary panels with conductors or buses between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
   1. Provide multipole, [**60**] -A circuit breaker as a dedicated disconnect for suppressor, unless otherwise indicated.

3.2 PLACING SYSTEM INTO SERVICE

A. Do not energize or connect [**service entrance equipment**] [**panelboards**] [**control terminals**] [**data terminals**] to their sources until surge protection devices are installed and connected.

3.3 FIELD QUALITY CONTROL

A. Testing: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports:

B. Testing: Perform the following field tests and inspections and prepare test reports:
   1. Complete startup checks according to manufacturer's written instructions.

2. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, "Surge Arresters, Low-Voltage Surge Protection Devices" Section. Certify compliance with test parameters.

END OF SECTION 264313

SECTION 265100 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Interior lighting fixtures, lamps, and ballasts.
   2. Emergency lighting units.
   3. Exit signs.
   4. Lighting fixture supports.
   5. Retrofit kits for fluorescent lighting fixtures.

B. See Division 26 Section "Wiring Devices" for manual wall-box dimmers for incandescent lamps.

C. See Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

1.2 SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes.

B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.

C. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, signed by product manufacturer.

D. Field quality-control test reports.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In Interior Lighting Fixture Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:
   1. Basis-of-Design Product: The design for each lighting fixture is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.
   2. Pre-approved manufacturers: Cooper Industries, Lithonia, Philips, Lite Source and Hubbell.

2.2 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Metal Parts: Free of burrs and sharp corners and edges.

C. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

D. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

E. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
   1. White Surfaces: 85 percent.
   2. Specular Surfaces: 83 percent.
   3. Diffusing Specular Surfaces: 75 percent.
   4. Laminated Silver Metallized Film: 90 percent.

F. Plastic Diffusers, Covers, and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
   a. Lens Thickness: At least 0.125 inch minimum unless different thickness is indicated.
   b. UV stabilized.
2. Glass: Annealed crystal glass, unless otherwise indicated.

2.3 EXIT SIGNS

A. Internally Lighted Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
   1. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.

2.4 EMERGENCY LIGHTING UNITS

A. Description: Self-contained units complying with UL 924.
   1. Battery: Sealed, maintenance-free, lead-acid type.
   2. Charger: Fully automatic, solid-state type with sealed transfer relay.
   3. Operation: Relay automatically turns lamp on when power supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
   4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
   5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

2.5 LAMPS

A. LED: color temperature [**4000**] K,

2.6 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.
B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, [**12 gage**].
E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, [**12 gage**].
F. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
B. Comply with NFPA 70 for minimum fixture supports.
C. Suspended Lighting Fixture Support:
   1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
   2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
   3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
D. Air-Handling Lighting Fixtures: Install with dampers closed and ready for adjustment.
E. Adjust aimable lighting fixtures to provide required light intensities.
F. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

G. For 2x4 fixtures in suspended ceilings, install support wires (ceiling hanger wires) from 2 diagonal corners directly to structure, independent of ceiling grid.

3.2 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION 265100

SECTION 270500 - COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves for pathways and cables.
2. Sleeve seals.
3. Grout.
4. Common communications installation requirements.

1.2 SUBMITTALS

A. Product Data: For sleeve seals.

PART 2 - PRODUCTS

2.1 SLEEVES FOR PATHWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel.

1. Minimum Metal Thickness:
   a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
   b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Metraflex Co.
   d. Pipeline Seal and Insulator, Inc.
2. Sealing Elements: [**EPDM**] [**NBR**] interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of pathway or cable.
3. Pressure Plates: [**Carbon steel**]. Include two for each sealing element.
4. Connecting Bolts and Nuts: [**Carbon steel with corrosion-resistant coating**] of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR COMMUNICATIONS INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both communications equipment and other nearby installations.

Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR COMMUNICATIONS PENETRATIONS

A. Communications penetrations occur when pathways, cables, wireways, or cable trays penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Extend sleeves installed in floors 2 inches above finished floor level.

G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and pathway or cable, unless indicated otherwise.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry

1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants.".

J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pathway and cable penetrations. Install sleeves and seal pathway and cable penetration sleeves with firestop materials. Comply with requirements in Division 26 Section "Penetration Firestopping."

K. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.

L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using [**steel**] pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between pathway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for communications installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 26 Section "Penetration Firestopping."

END OF SECTION 270500

SECTION 271100 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Telecommunications mounting elements.
   2. Backboards.
   3. Telecommunications service entrance pathways.
   4. Grounding.

1.2 SUBMITTALS

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

B. Shop Drawings: For communications equipment room fittings. Include plans, elevations, sections, details, and attachments to other work.
   1. Detail equipment assemblies, and location and size of each field connection.
   2. Equipment racks and cabinets: Include workspace requirements and access for cable connections.
   3. Grounding: Indicate location of grounding bus bar and its mounting detail.

C. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
   1. Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of RCDD.
   2. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
   3. Field Inspector: Currently registered by BICSI as RCDD to perform the on-site inspection.

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

C. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.

D. Grounding: Comply with ANSI-J-STD-607-A.

1.4 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install equipment frames and cable trays until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and work above ceilings is complete.

1.5 COORDINATION

A. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.
   1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
   2. Record agreements reached in meetings and distribute them to other participants.
   3. Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.

PART 2 - PRODUCTS

2.1 PATHWAYS

A. Cable Support: NRTL labeled. Cable support brackets shall be designed to prevent degradation of cable performance and pinch points that could damage cable. Cable tie slots fasten cable ties to brackets.
   1. Comply with NFPA 70 and UL 2043 for fire-resistant and low-smoke-producing characteristics.
   2. Support brackets with cable tie slots for fastening cable ties to brackets.
   3. Lacing bars, spools, J-hooks, and D-rings.
   4. Straps and other devices.

B. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." Flexible metal conduit shall not be used.
   1. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.

2.2 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches. Comply with requirements for plywood backing panels specified in Division 06 Section "Rough Carpentry."

2.3 GROUNDING

A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.

B. Telecommunications Main Bus Bar:
   1. Connectors: Mechanical type, cast silicon bronze, solderless compression or exothermic-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
   2. Ground Bus Bar: Copper, minimum 1/4 inch thick by 4 inches wide with 9/32-inch holes spaced 1-1/8 inches apart.
   3. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

C. Comply with ANSI-J-STD-607-A.

2.4 LABELING

A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Contact telecommunications service provider and arrange for installation of demarcation point, protected entrance terminals, and a housing when so directed by service provider.

B. Install underground pathways complying with recommendations in TIA/EIA-569-A, "Entrance Facilities" Article.

3.2 Install underground entrance pathway complying with Division 26 Section "Raceway and Boxes for Electrical Systems."

3.3 INSTALLATION

A. Comply with NECA 1.

B. Comply with BICSI TDMM for layout and installation of communications equipment rooms.

C. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A-7.

D. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.4 FIRESTOPPING

A. Comply with requirements in Division 07 Section "Penetration Firestopping."Comply with TIA/EIA-569-A, Annex A, "Firestopping."

B. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.5 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with ANSI-J-STD-607-A.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.6 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements in Division 26 Section "Identification for Electrical Systems." Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

B. See Division 27 Section "Communications Horizontal Cabling" for additional identification requirements. See Evaluations for discussion of TIA/EIA standard as it applies to this Section. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration.

C. Labels shall be preprinted or computer-printed type.

END OF SECTION 271100

SECTION 283111 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Manual fire-alarm boxes.
   2. System smoke detectors.
   3. Heat detectors.
   4. Notification appliances.
   5. Magnetic door holders.
   6. Addressable interface device.

1.2 SYSTEM DESCRIPTION

A. Integrate with Existing, addressable system, with multiplexed signal transmission, dedicated to fire-alarm service only.

1.3 PERFORMANCE REQUIREMENTS

A. Comply with NFPA-72 and South Carolina Office of State Fire Marshall Guidelines for Fire Alarms in State Owned Buildings.

1.4 SUBMITTALS

A. General Submittal Requirements:
   1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
   2. Shop Drawings shall be prepared by persons with the following qualifications:
      a. Trained and certified by manufacturer in fire-alarm system design.
      b. NICET-certified fire-alarm technician, Level III minimum.

B. Product Data: For each type of product indicated.

C. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.
   1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
   2. Include voltage drop calculations for notification appliance circuits.
   3. Include battery-size calculations.
   4. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
   5. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
   6. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.

D. Qualification Data: For qualified Installer.

E. Seismic Qualification Certificates: For fire-alarm control unit, accessories, and components, from manufacturer.

F. Field quality-control reports.

G. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
   1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
   2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.

3. Record copy of site-specific software.
4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
   a. Frequency of testing of installed components.
   b. Frequency of inspection of installed components.
   c. Requirements and recommendations related to results of maintenance.
   d. Manufacturer's user training manuals.
5. Manufacturer's required maintenance related to system warranty requirements.
6. Abbreviated operating instructions for mounting at fire-alarm control unit.
7. Copy of NFPA 25.

H. Software and Firmware Operational Documentation:
1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level II technician.
C. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer. Components shall be compatible with, and operate as, an extension of existing system.
D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.6 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.
B. Technical Support: Beginning with Substantial Completion, provide software support for two years.
C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] or comparable product by one of the following:
1. MATCH OWNER’S PREFERRED VENDOR

2.2 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:
1. Manual stations.
2. Heat detectors.
3. Smoke detectors.
4. Duct smoke detectors.
5. Automatic sprinkler system water flow.
6. Heat detectors in elevator shaft and pit.
7. Fire-extinguishing system operation.

8. Fire standpipe system.

B. Fire-alarm signal shall initiate the following actions:
   1. Continuously operate alarm-notification appliances.
   2. Identify alarm at the fire-alarm control unit and remote annunciators.
   3. Transmit an alarm signal to the remote alarm receiving station.
   4. Unlock electric door locks in designated egress paths.
   5. Release fire and smoke doors held open by magnetic door holders.
   6. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
   7. Recall elevators to primary or alternate recall floors.
   8. Activate emergency lighting control.
   9. Activate emergency shutoffs for gas and fuel supplies.
   10. Record events in the system memory.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:
   1. Valve supervisory switch.
   2. Low-air-pressure switch of a dry-pipe sprinkler system.
   3. Elevator shunt-trip supervision.

D. System trouble signal initiation shall be by one or more of the following devices and actions:
   1. Open circuits, shorts, and grounds in designated circuits.
   2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
   3. Loss of primary power at fire-alarm control unit.
   4. Ground or a single break in fire-alarm control unit internal circuits.
   5. Abnormal ac voltage at fire-alarm control unit.
   6. Break in standby battery circuitry.
   7. Failure of battery charging.
   8. Abnormal position of any switch at fire-alarm control unit or annunciator.

E. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators.

2.3 FIRE-ALARM CONTROL UNIT

A. General Requirements for Fire-Alarm Control Unit:
   1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864 and listed and labeled by an NRTL.
      a. System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.
      b. Include a real-time clock for time annotation of events on the event recorder and printer.
   2. Addressable control circuits for operation of mechanical equipment.

B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
   1. Annunciator and Display: Liquid-crystal type, 3 line(s) of 40 characters, minimum.
   2. Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.
   3. Keyed access for control.

C. Circuits:
   1. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class A.

a. Initiating Device Circuits: Style D.
b. Notification Appliance Circuits: Style Z.
c. Signaling Line Circuits: Style 6.
d. Install no more than 50 addressable devices on each signaling line circuit.

D. Elevator Recall:
1. Smoke detectors indicated on drawings shall initiate automatic elevator recall. Alarm-initiating devices, except those listed, shall not start elevator recall.
2. Elevator lobby detectors located on the designated recall floors shall be programmed to move the cars to the alternate recall floor.
3. Water-flow alarm connected to sprinkler in an elevator shaft and elevator machine room shall shut down elevators associated with the location without time delay.
a. Water-flow switch associated with the sprinkler in the elevator pit may have a delay to allow elevators to move to the designated floor.

E. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke barrier walls shall be connected to fire-alarm system.

F. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

G. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.
1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

H. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
1. Batteries: Sealed lead calcium.

I. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.4 MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
1. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
2. Station Reset: Key- or wrench-operated switch.
3. Indoor Protective Shield: Muckle type cover with scored plexiglass front, no hammer.
4. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.
5. General Public areas such as lobbys to have Alarm cover.

2.5 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:
1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be four-wire type.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.

5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.

B. Photoelectric Smoke Detectors:
1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
   a. Primary status.
   b. Device type.
   c. Present average value.
   d. Present sensitivity selected.
   e. Sensor range (normal, dirty, etc.).

C. Duct Smoke Detectors: Photoelectric type complying with UL 268A.
1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
   a. Primary status.
   b. Device type.
   c. Present average value.
   d. Present sensitivity selected.
   e. Sensor range (normal, dirty, etc.).
3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.
4. Each sensor shall have multiple levels of detection sensitivity.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
6. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.
7. Remote indicator/test switch as shown on drawings.

2.6 HEAT DETECTORS

A. General Requirements for Heat Detectors: Comply with UL 521.

B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or a rate of rise that exceeds 15 deg F per minute unless otherwise indicated.
1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F.
1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.7 NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.
1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.

B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure

level of 90 dBA, measured 10 feet from the horn, using the coded signal prescribed in UL 464 test protocol.

C. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- high letters on the lens.
   1. Rated Light Output:
      a. 15/30/75/110 cd, selectable in the field, set for 110 cd.
   2. Mounting: Wall mounted unless otherwise indicated.
   3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
   4. Flashing shall be in a temporal pattern, synchronized with other units.
   5. Strobe Leads: Factory connected to screw terminals.
   6. Mounting Faceplate: Factory finished, red.

2.8 MAGNETIC DOOR HOLDERS

A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.
   1. Electromagnet: Requires no more than 3 W to develop 25-lbf holding force.
   2. Wall-Mounted Units: Flush mounted unless otherwise indicated.
   3. Rating: 24-V ac or dc.

B. Material and Finish: Match door hardware.

2.9 REMOTE ANNUNCIATOR

A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.
   1. Mounting: Flush cabinet, NEMA 250, Type 1.

B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.10 ADDRESSABLE INTERFACE DEVICE

A. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.

B. Integral Relay: Capable of providing a direct signal to equipment as required.

2.11 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632 and be listed and labeled by an NRTL.

B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture two telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.

C. Local functions and display at the digital alarm communicator transmitter shall include the following:
   1. Verification that both telephone lines are available.
   2. Programming device.
   3. LED display.
   4. Manual test report function and manual transmission clear indication.
   5. Communications failure with the central station or fire-alarm control unit.

D. Digital data transmission shall include the following:
   1. Address of the alarm-initiating device.

2. Address of the supervisory signal.
3. Address of the trouble-initiating device.
4. Loss of ac supply or loss of power.
5. Low battery.
6. Abnormal test signal.
7. Communication bus failure.

E. Secondary Power: Integral rechargeable battery and automatic charger.

F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Comply with NFPA 72 for installation of fire-alarm equipment.

B. Equipment Mounting: Install fire-alarm control unit to wall with tops of cabinets not more than 72 inches above the finished floor.

C. Smoke- or Heat-Detector Spacing:

1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
3. Smooth ceiling spacing shall not exceed 30 feet.
4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix A or Appendix B in NFPA 72.
5. HVAC: Locate detectors not closer than 3 feet from air-supply diffuser or return-air opening.
6. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture.

D. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.

E. Heat Detectors in Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.

F. Remote Status and Alarm Indicators: Install near each duct smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.

G. Audible Alarm-Indicating Devices: Install as shown on drawings. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.

H. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling.

I. Device Location-Indicating Lights: Locate in public space near the device they monitor.

J. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than 72 inches above the finished floor.

K. Annunciator: Install with top of panel not more than 72 inches above the finished floor.

3.2 CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Division 08 Section "Door Hardware." Connect hardware and devices to fire-alarm system.

1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet from the device controlled.

Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

1. Alarm-initiating connection to smoke-control system (smoke management) at firefighter smoke-control system panel.
2. Alarm-initiating connection to elevator recall system and components.
3. Alarm-initiating connection to activate emergency lighting control.
4. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
5. Supervisory connections at valve supervisory switches.
6. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
7. Supervisory connections at elevator shunt trip breaker.
8. Supervisory connections at fire-pump power failure including a dead-phase or phase-reversal condition.
9. Supervisory connections at fire-pump engine control panel.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

B. Install framed instructions in a location visible from fire-alarm control unit.

3.4 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.5 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by Engineer, authorities having jurisdiction and Owner.

B. Tests and Inspections:

1. Visual Inspection: Conduct visual inspection prior to testing.
    a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
    b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

C. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

D. Fire-alarm system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

F. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

G. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

END OF SECTION 283111

SECTION 284800 - EMERGENCY RESPONSE SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Emergency responder communications enhancement systems.
2. Two-way emergency communications systems for rescue assistance.

B. Related Requirements:

1. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
2. Section 280010 "Supplemental Requirements for Electronic Safety and Security" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
3. Section 284621.11 "Addressable Fire-Alarm Systems" for interfacing emergency response systems with fire-alarm systems.
4. Section 284700 "Mass Notification" for interfacing emergency response systems with mass notification systems.

1.2 DEFINITIONS

A. BDA: Bi-directional amplifier.

B. ERCES: Emergency responder communications enhancement system.

C. PES: Public emergency service.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Coordination Meeting(s): For emergency communications systems. Conduct meeting(s) [**as videoconference**] [**or**] [**at Project site**] at pre-construction meeting.

B. Electrical contractor to coordinate with sub-consultant to evaluate the site upon building completion. Electrical contractor will carry the cost to evaluate the site in their construction budget.

C. Installation fee. The electrical contractor is to carry an installation allowance of $50,000 to be applied towards the design, purchase, installation, and testing of the system.

1.4 ACTION SUBMITTALS

A. Product Data:

1. ERCESs:

a. BDAs.
b. In-building service antennas.
c. Outdoor donor antenna.
d. Coaxial cabling.
e. Couplers and splitters.
f. Remote indicator panels.

2. Two-Way Emergency Communications Systems for Rescue Assistance:

a. Master control station.
b. Remote communications stations.

B. Shop Drawings:

1. Project general notes.
2. ERCESs:

a. Device layout.
b. Block diagrams and cable/conduit routing.
c. Pathway class and survivability identification.
d. System communications details.
e. System sequence of operations.
f. System mounting details.
g. Secondary power calculations.

3. Two-Way Emergency Communications Systems for Rescue Assistance:

a. Device layout.
b. Block diagrams and cable/conduit routing.
c. Pathway class and survivability identification.
d. System communications details.
e. System sequence of operations.
f. System mounting details.
g. Secondary power calculations.

C. Certificates:

1. Certification from each system [**manufacturer**] that equipment and components are compatible and represent a complete system in accordance with NFPA 72, NFPA 1221, and specified requirements.

D. Field Quality-Control Submittals:

1. Field quality-control reports.

1.5 INFORMATIONAL SUBMITTALS

A. Manufacturers' Published Instructions: Record copy of official installation[**and testing**] instructions issued to Installer by manufacturer for the following:

1. Installation instructions for ERCESs.
2. Installation instructions for two-way emergency communications systems for rescue assistance.
3. Recommended tests and inspections for ERCESs.
4. Recommended tests and inspections for two-way emergency communications systems for rescue assistance.

B. Baseline Radio Signal Strength Testing Report:

1. Detailed report indicating NFPA 72 or NFPA 1221 plotted interior radio signal strength or delivered audio quality score throughout building critical and general areas with construction of interior partitions and doors completed, but without ERCES installed.
2. Approval from authorities having jurisdiction to omit ERCES installation within building areas where baseline radio signal strength testing demonstrates that minimum required radio signal strength values are provided within these areas.

C. System Record of Inspection and Testing: Record copy of completed system acceptance testing.[**Format must be approved by authorities having jurisdiction.**]

D. Sample warranties.

1.6 CLOSEOUT SUBMITTALS

A. Warranty documentation.

1.7 REGULATORY AGENCY APPROVALS

A. Submittals for emergency communications systems requiring approval by authorities having jurisdiction must be signed and sealed by qualified electrical professional engineer or qualified fire protection professional engineer responsible for their preparation. [**Submit for action by Architect prior to submitting for approval by authorities having jurisdiction.**]

B. Submittals for emergency communications systems require action by Architect prior to submitting for approval by authorities having jurisdiction.

1.8 WARRANTY FOR EMERGENCY RESPONSE SYSTEMS

A. Special Installer Extended Warranty: Installer warrants that fabricated and installed ERCES performs in accordance with specified requirements and agrees to repair or replace components or products that fail to perform as specified within extended-warranty period.

1. Extended-Warranty Period: [**Two**] years from date of Substantial Completion; full coverage for labor, materials, and equipment.

B. Special Manufacturer Extended Warranty: Manufacturer warrants that ERCES performs in accordance with specified requirements and agrees to provide repair or replacement of components or products that fail to perform as specified within extended-warranty period.

1. [**Initial**]Extended-Warranty Period: [**Five**] years from date of Substantial Completion; [**prorated**] coverage for labor, materials, and equipment.
2. Follow-On Extended-Warranty Period: [**Eight**] years from date of Substantial Completion; [**prorated**] coverage for materials[**that failed because of transient voltage surges**] only, free on board [**destination**], freight prepaid.

1.9 WARRANTY FOR BATTERIES

A. Special Manufacturer Extended Warranty for Batteries: Manufacturer warrants that batteries perform in accordance with specified requirements and agrees to provide repair or replacement of batteries that fail to perform as specified within extended-warranty period.

1. Initial Extended-Warranty Period for Li-ion Batteries: [**Five**] years from date of Substantial Completion; full coverage for materials only, free on board [**destination**], freight prepaid.
2. Follow-On Extended-Warranty Period for Li-ion Batteries: [**Ten**] years from date of Substantial Completion; prorated coverage for materials only, free on board [**destination**], freight prepaid.
3. Extended-Warranty Period for Ni-MH Batteries: [**Three**] years from date of Substantial Completion; prorated coverage for materials only, free on board [**destination**], freight prepaid.
4. Extended-Warranty Period for Ni-Cd Batteries: [**Five**] years from date of Substantial Completion; prorated coverage for materials only, free on board [**destination**], freight prepaid.
5. Warranted Cycle Life for Valve Regulated (Sealed) [**Lead Calcium**] Batteries: Equal to or greater than that represented in manufacturer's published table, but not less than the following, based on annual average battery temperature of 77 deg F (25 deg C):

    a. For discharge rate not faster than eight hours, discharge duration not longer than eight hours, and voltage at end of discharge not less than 1.67 V, warranted life must be not fewer than six discharge cycles.
    b. For discharge rate not faster than 30 minutes, discharge duration not longer than 30 minutes, and voltage at end of discharge not less than 1.67 V, warranted life must be not fewer than 20 discharge cycles.
    c. For discharge rate not faster than 15 minutes, discharge duration not longer than 45 seconds, and voltage at end of discharge not less than 1.67 V, warranted life must be not fewer than 120 discharge cycles.

6. Warranted Cycle Life for Premium Valve Regulated (Sealed) [**Lead Calcium**] [**or**] Batteries: Equal to or greater than that represented in manufacturer's published table, but not less than the following, based on annual average battery temperature of 77 deg F (25 deg C):

    a. For discharge rate not faster than eight hours, discharge duration not longer than eight hours, and voltage at end of discharge not less than 1.67 V, warranted life must be not fewer than 40 discharge cycles.

b. For discharge rate not faster than 30 minutes, discharge duration not longer than 30 minutes, and voltage at end of discharge not less than 1.67 V, warranted life must be not fewer than 125 discharge cycles.
c. For discharge rate not faster than 15 minutes, discharge duration not longer than 90 seconds, and voltage at end of discharge not less than 1.67 V, warranted life must be not fewer than 750 discharge cycles.

PART 2 - PRODUCTS

2.1 EMERGENCY RESPONDER COMMUNICATIONS ENHANCEMENT SYSTEMS

A. Description: This category includes in-building ERCES equipment to improve wireless communication. This FCC-certified enhancement system is inclusive of BDA, transmission lines, cables, power supplies, antennas, and other ancillary equipment that allows radio signals to pass to and from interior of structure for facilitating radio communications using PES radio frequencies.

B. Performance Criteria:

1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
b. Unless otherwise indicated in Contract Documents, products must comply with NFPA 1, NFPA 70, NFPA 72, NFPA 1221, [**NFPA 101,**] [**ICC IBC,**] [**ICC IFC,**] and local regulations enforced by authorities having jurisdiction.

C. In-Building ERCES Bi-Directional Amplifiers
1. Manufacturers
a. Gamewell- FCI
b. Notifier
c. Silent Knight

2. Listing Criteria: UL CCN UTMH; including UL 2524 and NFPA 1221.
3. Options:

a. Primary Power Supply: [**120 V(ac)**].
b. Secondary Power Supply: [**24 V(dc)**] supply system including batteries, automatic float-charge battery charger, and automatic transfer switch.
c. Supervision: Auxiliary contacts for remote status supervision by [**protected premises fire-alarm system**].

1) Signal booster failure.
2) Antenna malfunction.
3) Loss of primary power.
4) Low battery voltage.
5) Battery charger failure.

d. Cabinet Enclosures: [**UL 50E, Type 4**] steel enclosure for amplifiers and power supplies.
e. Mounting: [**Surface**] mount.
f. Finish: [**Factory-finish red enamel**].

D. In-Building ERCES Distributed Antennas:

1. Manufacturers
   a. Fractal Antenna Systems
   b. Laird Connectivity

2. Options:

   a. Type: [**Wide-band omnidirectional**] [**and**] [**multi-band**] [**single-band**].
   b. Mounting: Low-profile [**ceiling**] mount.

E. In-Building ERCES Donor Antennas:

1. Manufacturers
   a. Fractal Antenna Systems
   b. Laird Connectivity

2. Options:

   a. Configuration: Factory assembled and tuned directional UHF Yagi antenna.
   b. Mounting: [**Stainless steel**] mounting hardware.
   c. Finish: [**Welded**] [**or**] [**seamless**] corrosion-resistant aluminum construction.
   d. Wind Velocity Rating: [**Comply with minimum ICC IBC requirements**].

F. RF Antenna Cable Couplers and Splitters:

1. Manufacturers
   a. CommScope
   b. Mini-Circuits

2. Options:

   a. Configuration: Nominal [**0.5 inch (13 mm)**], [**50 Ω**], N-Type, weatherproof, medium-size, RF couplers and splitters for coaxial cables.
   b. Bandwidth: [**As required by in-building emergency radio enhancement system performance requirements**].
   c. Gain (dB) Rating: [**As required by in-building emergency radio enhancement system performance requirements**].
   d. Environmental Rating: [**Type 4 and**][**IP65**].

G. Remote Indicator Panel:

1. Manufacturers
   a. Space Age Technologies

2. Options:

a. Primary Power Supply: [**120 V(ac)**].
b. Secondary Power Supply: [**24 V(dc)**] supply system including batteries, automatic float-charge battery charger, and automatic transfer switch.
c. Configuration: Zone indicator panel with LED indicators[**, piezoelectric sounder**] and switches for lamp test and alarm silence.
d. LED Indicators: Green indicator for primary power in normal state; red indicators for each individual fault status required to be indicated by authorities having jurisdiction.
e. Enclosure: [**16-gauge steel**] with factory-applied red enamel finish.

2.2 TWO-WAY EMERGENCY COMMUNICATIONS SYSTEMS FOR RESCUE ASSISTANCE

A. Description: This category includes equipment for providing two-way emergency voice communication for areas of refuge, stairway landings, elevator landings, and occupant evacuation elevator lobbies in accordance with NFPA 72.

B. Performance Criteria:

1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
b. Unless otherwise indicated in Contract Documents, products must comply with NFPA 1, NFPA 70, NFPA 72, [**NFPA 101,**] [**ICC IBC,**] [**ICC IFC,**] and local regulations enforced by authorities having jurisdiction.

2. Listing Criteria: UL 2525 and NFPA 72.

C. General Characteristics:

1. Master Control Station: Mount [**in fire command center (if provided)**] or [**in constantly attended location**] to provide power, supervision, and control for two-way emergency communications systems for rescue assistance.

a. Power Supply: [**24 V(dc)**] supply system including batteries, automatic float-charge battery charger, and automatic transfer switch.
b. Communicate between master control station handset and remote communications stations.
c. Annunciate visual and audible signal at master control station when remote telephone handset is lifted from cradle or when phone is plugged into designated remote jack.
d. Silence audible signal when master control station handset is removed and remote telephone handset is acknowledged.
e. Display identification for location of remote communications stations in building.

2. Remote Communications Stations: [**double-gang**], stainless steel-plate mounted station with hands-free, two-way communication.
3. Pathway Survivability:

a. Riser Cables: [**Level 2 or 3**].
b. Feeder Cables: [**Level 0**].

PART 3 - EXECUTION

3.1 COMMON INSTALLATION REQUIREMENTS FOR EMERGENCY RESPONSE SYSTEMS

A. Comply with manufacturer's published instructions.

B. Reference Standards:

1. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NFPA 1, NFPA 70, NFPA 72, NFPA 1221, [**NFPA 101,**] [**ICC IBC,**] [**ICC IFC,**] and local regulations enforced by authorities having jurisdiction for installation of emergency communications systems.
2. Comply with NECA 305 for installation of emergency communications systems devices and their connections to fire-alarm system.
3. Consult [**Architect**] [**Owner**] for resolution of conflicting requirements.

C. Installation for Survivability:

1. Where NFPA 72 or NFPA 1221 Survivability Level 2 or 3 pathways are indicated or required, install cables and pathways within 2-hour fire-resistance-rated enclosures or provide fire-resistive pathway installation in accordance with NFPA 72 or NFPA 1221.
2. Install control equipment, power supplies, junction boxes, terminal cabinets, or similar components within dedicated 2-hour fire-resistance-rated fire-alarm system equipment rooms if components originate from or comprise a portion of NFPA 72 or NFPA 1221 Survivability Level 2 or 3 pathway.

3.2 INSTALLATION OF ERCES

A. Special Techniques:

1. Antenna Wiring Methods:

a. Coaxial Cabling:

1) Riser Coaxial Cable: Type CATVR, nominal [**0.5 inch (13 mm)**], [**50 Ω**] coaxial jacketed cable with corrugated [**copper**] [**or**] [**aluminum**] outer conductor.
2) Plenum Coaxial Cable: Type CATVP, nominal [**0.5 inch (13 mm)**], [**50 Ω**] coaxial jacketed cable with corrugated [**copper**] [**or**] [**aluminum**] outer conductor.
3) Plenum Radiating Coaxial Cable: Type CATVP, nominal [**0.5 inch (13 mm)**], [**50 Ω**] radiating coaxial jacketed cable with corrugated [**copper**] [**or**] [**aluminum**] outer conductor.

4) Connectors: Nominal [**0.5 inch (13 mm)**], [**50 Ω**] N-Type, weatherproof, medium-size, RF connectors for coaxial cables.

b. Pathway Survivability:

1) Riser Coaxial Cables: [**Level 2 or 3**].
2) Feeder Coaxial Cables: [**Level 0**].

2. Determine in-building service antenna locations based on baseline radio signal strength testing.
3. Request approval from authorities having jurisdiction to omit emergency responder radio coverage system from areas of building where baseline radio signal strength testing demonstrates that minimum required radio signal strength values are achieved without radio coverage system.
4. Install outdoor donor antenna with clear view to donor site with minimum [**2 ft (0.6 m)**] vertical clearance above nearby obstacles.

B. Interfaces with Other Work:

1. Coordinate installation of new products for emergency responder radio coverage systems with existing conditions.

2. Coordinate with [**Section 284621.11 "Addressable Fire-Alarm Systems"**] [**Section 284621.13 "Conventional Fire-Alarm Systems"**] for interfaces with fire-alarm system.

3.3 INSTALLATION OF TWO-WAY EMERGENCY COMMUNICATIONS SYSTEMS FOR RESCUE ASSISTANCE

A. Interfaces with Other Work:

1. Coordinate installation of new products for two-way emergency communications systems for rescue assistance with existing conditions.

2. Coordinate with [**Section 284621.11 "Addressable Fire-Alarm Systems"**] [**Section 284621.13 "Conventional Fire-Alarm Systems"**] for interfaces with fire-alarm system.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."

3.5 FIELD QUALITY CONTROL OF EMERGENCY RESPONDER RADIO COVERAGE SYSTEMS

A. Field tests and inspections must be witnessed by [**authorities having jurisdiction**].

B. Tests and Inspections:

1. Perform manufacturer's recommended tests and inspections.
2. Perform field tests and inspections required by NFPA 72 and NFPA 1221.
3. Baseline radio signal strength testing.

C. Nonconforming Work:

1. Device will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

D. Collect, assemble, and submit test and inspection reports.

E. Manufacturer Services:

1. Engage factory-authorized service representative to [**support**] [**supervise**] field tests and inspections.

3.6 FIELD QUALITY CONTROL OF TWO-WAY EMERGENCY COMMUNICATIONS SYSTEMS FOR RESCUE ASSISTANCE

A. Field tests and inspections must be witnessed by [**authorities having jurisdiction**].

B. Tests and Inspections:

1. Perform manufacturer's recommended tests and inspections.
2. Perform field tests and inspections required by NFPA 72 and NFPA 1221.

C. Nonconforming Work:

1. Device will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

D. Collect, assemble, and submit test and inspection reports.

E. Manufacturer Services:

1. Engage factory-authorized service representative to [**support**] [**supervise**] field tests and inspections.

3.7 PROTECTION

A. After installation, protect emergency communications systems devices from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 284800

SECTION 310505

DEMOLITION

PART 1 GENERAL

1.1 SCOPE OF WORK

A. The work of this section consists of removal and disposal of structures, old pavements, abandoned pipelines, and other obstructions as designated, including salvaging of materials and backfilling of resulting trenches, holes and pits. Also included is all work, which relates to explosives including receiving, handling, transporting, storing, distributing, priming, loading, firing, and disposal.

1.2 RELATED DOCUMENTS

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

PART 2 NOT USED

PART 3 EXECUTION

3.1 DEMOLITION

A. BITUMINOUS PAVED AREAS

Scarify and completely remove. Resultant material may be utilized in bottom portion of areas to receive fill. No pieces shall be left exposed in the fill slopes. If material is used in any portion of the new construction, layers shall be a maximum of 8" and separated by minimum 6" layers of earth. Water and compaction requirements are specified under other sections. No compaction is required for materials used for obliteration work outside the limits of new construction.

B. REMOVAL OF CONCRETE SURFACES AND STRUCTURES

Concrete designed for removal, break into pieces and use for rip-rap. Volume, minimum 0.5 cubic foot; 75% of pieces shall be between 1.5 and 2.0 cubic feet. Stockpile at designated locations.

C. PIPE REMOVAL

Remove pipe, exercising care to avoid breaking or damaging. Store pipe to be re-laid as directed.

3.2 EXPLOSIVES

A. LEGAL REQUIREMENTS

Comply with all applicable Federal, State, and local laws and regulations pertaining to the use, storage, and handling of explosives. It is the intent of these specifications to comply with such laws and regulations. In the event of inconsistencies between these specifications and the laws and regulations, the laws and regulations take precedence, subject to final determination by the Engineer.

B. PROTECTION

The Contractor shall exercise the utmost care not to endanger life and property. Make proper use of blasting mats and other protective devices adopting whatever additional precautions are deemed necessary to prevent damage to trees, shrubs, other landscape features, buildings, utilities, monuments, and other structures. Make every effort to prevent damage to the natural and the constructed surroundings. Should damage occur, make restoration as required by the Engineer.

C. PERSONNEL

One competent, experienced person shall be specifically designated in charge of explosives. The designated person must present certification to the Engineer that he has successfully completed a course in the handling and use of explosives, given by an accredited institution such as the U.S. Bureau of Mines, DuPont, or other explosive manufacturing company. He shall exercise careful supervision of all work related to the use, storage, and handling of explosives. Permit only a minimum number of competent, experienced men, consistent with efficient operation, to handle explosives. Exclude anyone demonstrating carelessness, incompetence, or inexperience from further handling of explosives.

D. GENERAL REQUIREMENTS

The Contractor shall give special attention to the following specific rules:

1. Locate magazines in accordance with the American Tale of Distances for Storage of Explosives and only at sites approved by the Engineer.

2. Magazines shall be bulletproof, fireproof, burglarproof, weather resistant, constructed with adequate screened ventilation and dry wood floors. Countersink all nails exposed to the interior of magazines.

3. Do not store detonators with other explosives but in separate magazines.

4. Magazines shall not be provided with artificial heat or lights.

5. Securely lock magazines.

6. Mark magazines and roads in area with appropriate caution and danger signs.

7. Clear blast area of unnecessary personnel and equipment before delivery of any explosives to the site.

8. Keep no more than a one-day supply of explosives at or near the work site. Keep explosives in approved portable magazines in locations approved by the Engineer.

9. Use only wooden tamping bars for charging explosives into drill holes.

10. Do not use electricity from light of power circuits for firing shots unless the electrical connection to the circuit is made within an enclosed switch box securely locked with switch in open position.

11. Provide a positive warning system to give adequate warning in every direction immediately prior to firing explosives. Guard all access points to the blast area to halt personnel and vehicles a safe distance from the blast. Maintain intercommunication between guards and person firing the blast assuring the blast area is clear prior to firing.

12. Provide special signs or signals at all access points including a warning to turn off radio transmitters whenever electrical detonators are used.

3.3 DISPOSAL

A. Dispose of debris from demolition operations in an approved and satisfactory manner.

END OF SECTION

SECTION 310519

ENGINEERING FABRICS

PART 1 GENERAL

1.1 SCOPE OF WORK

The work covered by this Section consists of the installation of an acceptable engineering fabric (filter fabric) appropriate for the application(s) called for on the plans. Placement of the fabric shall be an integral function of the construction of shoulder drains, subsurface drainage systems, temporary silt fences and placement of erosion control stone or rip rap facilities. The Contractor shall furnish all equipment, tools, labor and materials necessary to complete the work in accordance with the plans and specifications.

PART 2 PRODUCTS

2.1 MATERIALS

Engineering fabric shall have material properties strictly conforming to those specified in Section 1056 of the "Standard Specifications for Roads and Structures" dated January 1, 2018, published by the North Carolina Department of Transportation. The Contractor shall provide engineering fabric(s) for various applications which meet or exceed the corresponding criteria for each different fabric utilized per the subject specification.

PART 3 EXECUTION

3.1 INSTALLATION

A. GENERAL REQUIREMENTS

1. Engineering fabric installed under erosion control stone or rip rap shall be placed at locations, to the dimensions as shown on the plans or as directed by the Engineer.

2. Surfaces to receive filter fabric shall be graded to the lines and grades as shown on the plans, unless otherwise directed by the Engineer. The surface shall be free of obstructions, debris and pockets of soft or low density material.

3. At the time of installation, the fabric shall be free of defects, rips, holes, flaws, deterioration or damage incurred during manufacture, transportation or storage.

4. The filter fabric shall be laid smooth and free from tension, stress, folds, wrinkles, or creases. Horizontal overlaps shall be a minimum of l2 inches with the upper fabric overlapping the lower fabric. Vertical overlaps shall be a minimum of l8 inches with the upstream fabric overlapping the downstream fabric. In the event that the fabric is displaced or damaged during stone placement, the stone shall be removed and the fabric repositioned or replaced prior to replacement of the stone, all at no additional cost to the Owner.

5. The placement of the filter fabric and stone shall be performed in a continuous manner as directed by the Engineer. The filter fabric shall be protected from damage due to the placement of stone or other materials by limiting the height of drop of the material or by placing a cushioning layer of sand on top of the fabric before dumping the material.

6. No more than 72 hours shall elapse from the time the fabric is unwrapped to the time the fabric is covered with stone or sand.

7. Filter fabric installed in association with shoulder drains or other subsurface drainage systems shall be installed in such a manner that all splice joints are provided with a minimum overlap of 2 feet. The overlap of the closure at the top of the trench shall be at least 6 inches and secured with mechanical ties. Where outlet pipe passes through the fabric, a separate piece of fabric shall be wrapped around the outlet pipe, flared against the side of the filled drain, and secured with anchor pins.

8. Field splices of filter fabric shall be anchored with anchor pins to insure that required overlap is maintained.

9. At the time of installation, the fabric will be rejected if it has defects, rips, holes, flaws, deterioration, or damage incurred during manufacture, transportation, or storage.

10. Aggregate placement operations and the pipe installation shall be done so as to prevent damage to the filter fabric. Damaged sections of filter fabric shall be replaced at no cost to the Owner.

11. The aggregate shall be compacted to a degree acceptable to the Engineer by the use of a vibratory compactor before making the filter fabric closure at the top of the trench.

12. Filter fabric installed in association with temporary silt fences shall be a water permeable filter type for the purpose of removing suspended particles from the water passing through it. Silt fences shall be constructed in accordance with Section 1605 of the "Standard Specifications for Roads and Structures" dated January l, 2018, published by the North Carolina Department of Transportation in the locations and to the configurations as shown in the plans and as directed by the Engineer. Should the requirements of local, regional or state authorities having jurisdiction over the project exceed the requirements of this section or other sections in this specification regarding temporary silt fences, the more stringent shall govern.

B. PHYSICAL PROPERTIES OF ENGINEERING FABRICS

PHYSICAL PROPERTIES OF ENGINEERING FABRICS					
Physical Property	Test Method (Article 1056-2)	Type 1	Type 2	Type 3 Class A	Class B

Min. Roll Width	---	---	---	36"	36"
Min. Fabric Weight	1	4.0 oz/yd^2	---	---	---
Min. Tensile Strength	2	90 lb.	200 lb.	50 lb.	100 lb.
Elongation	2	80% Max.	15% Min.	30% Max.	25% Max.
Min. Burst Strength	3	150 psi	400 psi	100 psi	180 psi
Min. Puncture Strength	4	45 lb.	80 lb.	30 lb.	60 lb.
Apparent Opening Opening Size - Max/Min (U.S. Std. Sieve)	5	60/100	30/130	20/50	20/50
Min. Ultra-Violet Exposure Strength Retention	6	80 lb.	140 lb.	40 lb.	80 lb.
Fungus Resistance	7	No Growth	No Growth	No Growth	No Growth
Min. Permeability (Thickness x Permittivity)	8	0.2 cm/sec.	---	---	---
Min. Flow Rate	8	---	---	10 gal/min/ft^2	10 gal/min/ft^2
Typical Application	--	Shoulder Drain	Under Riprap	Temporary Silt Fence	

END OF SECTION

SECTION 311005

WASTE MATERIAL DISPOSAL

PART 1 GENERAL

1.1 SCOPE OF WORK

A. The work covered by this section consists of the disposal of waste and debris in accordance with the requirements of these specifications. Waste will be considered to be all excavated, grubbed or removed materials, which are not utilized in the construction of the project.

PART 2 NOT USED

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

A. Waste shall be disposed of in areas that are outside of the project area and provided by the Contractor, unless otherwise required by the plans or special provisions or unless disposal within the project area is permitted by the Engineer.

B. The Contractor shall maintain the earth surfaces of all waste areas, both during the work and until the completion of all seeding and mulching or other erosion control measures specified, in a manner which will effectively control erosion and siltation.

C. The following requirements shall also be applicable to all waste or disposal areas other than active public waste or disposal areas:

1. Rock waste shall be shaped to contours which are comparable to and blend in with the adjacent topography where practical, and shall be covered with a minimum 6" thick layer of earth material either from the project waste or from borrow.

2. Earth waste shall be shaped to contours which are comparable to and blend in with the adjacent topography where practicable, but in no case will slopes steeper than 2:1 be permitted.

3. Construction debris, grubbed debris and all broken concrete and masonry shall be covered with a minimum 6" thick layer of earth waste material from the project or borrow. The completed waste area shall be shaped as required above for disposal of earth waste. (Broken concrete must be taken to landfill)

4. Seeding and mulching shall be performed over all earth or earth covered waste areas. The work of seeding and mulching shall be performed in accordance with Section 32 92 19 – Seeding and Mulching.

5. Where the Engineer has granted permission to dispose of waste and debris within the project, the Engineer will have the authority to establish whatever

additional requirements may be necessary to insure the satisfactory appearance of the completed project.

Disposal of waste or debris in active public waste or disposal areas will not be permitted without prior approval by the Engineer. Such disposal will not be permitted when, in the opinion of the Engineer, it will result in excessive siltation or pollution.

END OF SECTION

SECTION 311100

CLEARING AND GRUBBING

PART 1 GENERAL

1.1 SCOPE OF WORK

A. Clearing and grubbing shall consist of the removal and satisfactory disposal of all trees, brush, stumps, logs, grass, weeds, roots, decayed vegetable matter, posts, fences, stubs, rubbish and all other objectionable matter resting on or protruding through the original ground surface and occurring within the construction limits or right-of-way of any excavation, borrow area, or embankment.

PART 2 NOT USED

PART 3 EXECUTION

3.1 GENERAL

A. Clearing and grubbing operations shall be completed sufficiently in advance of grading operations as may be necessary to prevent any of the debris from the clearing and grubbing operations from interfering with the excavation or embankment operations. All work under this section shall be performed in a manner which will cause minimum soil erosion. The Contractor shall perform such erosion control work, temporary or permanent, as may be directed by the Engineer in order to satisfactorily minimize erosion resulting from clearing and grubbing operations.

1. Clearing:

a. The work of clearing shall be performed within the limits established by the plans, specifications, or the Engineer.

b. Clearing shall consist of the felling and cutting up, or the trimming of trees, and the satisfactory disposal of the trees and other vegetation together with the down timber, snags, brush and rubbish occurring within the areas to be cleared. Trees and other vegetation, except such individual trees, groups of trees, and vegetation, as may be indicated on the plans to be left standing, and all stumps, roots and brush in the areas to be cleared shall be cut off six inches above the original ground surface.

c. Individual trees and groups of trees designated to be left standing within cleared areas shall be trimmed of all branches to such heights and in such manner as may be necessary to prevent interference with construction operations. All limbs and branches required to be trimmed shall be neatly cut close to the whole of the tree or to main branches, and the cuts thus made shall be painted with an approved tree wound paint. Individual trees, groups of trees, and other vegetation, to be left

standing shall be thoroughly protected from damage incident to construction operations by the erection of barriers or by such other means as the circumstances require.

d. The Engineer will designate all areas of growth or individual trees which are to be preserved due to their desirability for landscape or erosion control purposes. When the trees to be preserved are located within the construction limits, they will be shown on the plans or designated by the Engineer.

e. Clearing operations shall be conducted so as to prevent damage by falling trees to trees left standing, to existing structures and installations, and to those under construction, and so as to provide for the safety of employees and others. When such damages occur, all damaged areas shall be repaired, removed or otherwise resolved utilizing generally accepted practices at the Contractor's expense.

2. Grubbing:

a. Grubbing shall consist of the removal and disposal of all stumps, roots and matted roots from all cleared areas, except as herein specified.

b. In embankment areas, when the depth of embankment exceeds 3’-6” in height sound stumps shall be cut off not more than 6” above the existing ground level and not grubbed. Unsound or decayed stumps shall be removed to a depth of approximately two feet below the natural ground surface.

c. All depressions excavated below the natural ground surface for or by the removal of stumps and roots shall be refilled with suitable material and compacted to make the surface conform to the surrounding ground surface.

3. Disposal of Cleared and Grubbed Material:

Saw logs, pulp wood, cord wood or other merchantable timber removed incidental to clearing and grubbing shall become the property of the Contractor. All combustible matter shall be deposited at locations approved by the Engineer. Combustible matter may be burned or may be disposed of as stated above. Debris shall not be burned unless written permission or permit is issued by the Fire Marshall having jurisdiction in the area if applicable. The Contractor shall adhere to all limitations and conditions set forth in the permit. Burning shall be done at such time and such manner as to prevent fire from spreading and to prevent any damage to adjacent cover and shall further be subject to all requirements of State or Federal Governments pertaining to the burning. Disposal by burning shall be kept under constant attendance until all fires have burned out or have been extinguished.

END OF SECTION

SECTION 312200

GRADING

PART 1 GENERAL

1.1 SCOPE OF WORK

A. This portion of the project includes the excavation, undercut excavating, grading, earthwork and compaction required as shown on the plans and all other associated miscellaneous items of earthwork construction, as shown on the plans. The Contractor shall furnish all materials, labor, equipment and incidental items necessary to complete this portion of the work as detailed on the plans and as called for in these Specifications.

1. All classified excavation shall be in accordance with Section 226 of the "Standard Specifications for Roads and Structures" dated February 2018, published by the North Carolina Department of Transportation, unless otherwise directed herein.

2. Site grading shall conform to the grades indicated by the finish contours on the plans. Where topsoil, pavement, gravel or crushed stone surfacing and other items are shown, rough grade shall be finished to such depth below finish grade as necessary to accommodate these items. All areas where structures are to be built on fill shall be stripped to such depth as necessary to remove turf, roots, organic matter and other objectionable materials.

PART 2 PRODUCTS

2.1 MATERIALS

A. Topsoil shall be considered to mean original surface soil, typical of the area, which is capable of supporting native plant growth, and shall be free of large stones, roots, brush, waste, construction debris and other undesirable material or contamination.

B. All fill used for site grading operations should consist of a clean (free of organics and debris) low plasticity soil (plasticity index less than 30).

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

A. Construction stakeout will be provided by the Contractor. Exact locations and grade points are to be staked or fixed by the Contractor before construction. The Contractor shall not disturb any bench marks, reference stakes or property line monuments. In the event it becomes necessary to remove any bench mark, reference stake or property line monument in the performance of the work, the Contractor shall reference such points in preparation for replacement. If any such points are disturbed or damaged, they shall be replaced by a North Carolina Registered Land Surveyor at the expense of the Contractor.

B. Existing utility lines (either overhead or underground), sidewalks, fencing, pavement or other structures shown on the drawings, shown to the Contractor or mentioned in the plans and specifications shall be kept free of damage by the Contractor's operations. It shall be the responsibility of the Contractor to verify the existence and location of all underground utilities within the Project Site. The omission from or the inclusion of utility

locations on the plans is not to be considered as the non-existence of or a definite location of existing underground utilities. Any existing construction damaged by the Contractor shall be restored to an equal condition as that existing at the time prior to damage, at the Contractor's expense. If any existing utility is inadvertently damaged during construction, the Contractor shall notify the utility, the Engineer and the Owner of said damaged utility at once so that emergency repairs may be made at the Contractor's expense and to the satisfaction of the party having jurisdiction of the utility.

3.2 CLASSIFIED EXCAVATION

A. Excavation is classified and includes all excavation to the required elevations. Excavation shall be classified as earth excavation (includes borrow and waste materials as required), trench rock excavation, mass rock excavation, undercut excavation. There shall be no additional payment made for earth excavation. Trench rock excavation, mass rock excavation and undercut excavation shall be paid at the unit prices as provided in the bid form. The Engineer should be notified immediately if rock is encountered. All excavated materials which are not required or suitable for fills shall be considered as waste and shall be disposed of off the Owner’s property at the Contractor’s expense.

B. Earth excavation includes excavation of pavements and other obstructions visible on the surface, underground structures, utilities, and other items indicated to be demolished and removed in order to reach subgrade elevation; together with soils and other materials encountered that are not classified as trench rock excavation, mass rock excavation or undercut excavation.

C. Trench rock excavation shall be considered any naturally occurring material which cannot be removed with a Caterpillar 225 backhoe or equal, equipped with rock teeth, and which requires for its removal drilling and blasting, or wedging or sledging and barring.

1. In addition, classification as trench rock is only applicable when encountered, as described above, during the installation of storm drainage lines, water lines or services, sewer lines or services and associated structures as represented on the design drawings. Where trench rock excavation is necessary, the Contractor shall excavate the same as near the neat lines of the trench as practicable and the Contractor shall take all due precautions in the pursuance of the work. The Contractor will be held strictly responsible for all injury to life and to public and private property.

2. Trench rock shall be removed from the applicable excavation to the following limits:

   a. Trenches: The diameter of the pipe plus 8 inches on each side, extending 6 inches below the pipe wall and bell.

   b. Structures: 12 inches beyond the vertical plane of the structure on all sides and on the bottom only to the depth necessary for proper installation.

3. Trench rock excavation includes removal and off-site disposal of rock material and obstructions encountered in trench excavations that cannot be removed without systematic drillings, blasting, or ripping; and backfilling with the specified compaction of the trench with suitable material.

D. Mass rock excavation shall be considered any naturally occurring material, in the opinion of the Engineer, cannot be removed with a Caterpillar D-9 or equal, equipped with a properly fitted single tooth ripper, or removed by a Caterpillar 225 backhoe or equal, equipped with rock teeth. Mass rock in the bottom of roadway cuts shall be excavated to a depth of one foot below the roadbed and ditches. Mass rock in building pad areas shall be excavated to a depth of one foot below finished grade, or as directed by the Engineer. Where mass rock excavation is necessary, the Contractor shall excavate the same as near the neat limits of excavation as practicable and the Contractor shall take all due precautions in the pursuance of the work. The Contractor will be held strictly responsible for all injury to life and to public and private property.

1. Mass rock excavation includes removal and off-site disposal of rock material and obstructions encountered in excavations that cannot be removed without systematic drillings, blasting, or ripping; and backfilling with the specified compaction of the undercut rock with suitable material.

E. Undercut excavation shall be any natural soil materials, not including topsoil, situated at or below the proposed subgrade elevation that is deemed unsuitable or undesirable in their location or condition as determined by a qualified Geotechnical Engineer, employed by the Owner. The Geotechnical Engineer may require that the Contractor remove this undesirable material and backfill with approved material properly compacted. Moisture content shall not be an acceptable means for declaring a soil unsuitable. It is the responsibility of the contractor to properly condition the soil to an acceptable moisture content prior to use in grading operations.

1. Undercut excavation includes excavation and off-site disposal of undesirable material; any backfilling in the undercut area from an approved borrow source; and proper compaction of the borrow material. Topsoil, regardless of depth, shall not be classified as undercut excavation material and the replacement thereof shall be covered in the price for earth excavation as described above. Topsoil depth may be specified by the geotechnical report.

F. Borrow material shall be suitable material from an approved off-site area that is required to; backfill undercut areas; bring the site to the proposed grades in the absence of sufficient material on-site; backfill trenches and other excavations as required. The borrow material shall be checked for suitability for compaction and approved by a qualified Geotechnical Engineer prior to placement on-site at the Contractor's expense. Borrow excavation shall be performed in accordance with Section 230 of the NCDOT Standard Specifications for Roads and Structures except where modified herein. All borrow material required shall be permitted, acquired and placed at the Contractor's sole expense. Borrow material required to bring the site to proposed grades in the absence of sufficient material on site shall be considered part of earth excavation and, therefore, no additional payment shall be made.

G. The Contractor shall provide all sheeting, shoring, underpinning and bracing required to hold the sides of any excavation and for the protection of all adjacent structures. The Contractor shall be held responsible for any damage to any part of the work by failure of excavated sides or bottoms.

3.3 BLASTING

A. Any and all blasting operations shall be conducted in strict accordance with existing ordinances and regulations relative to storage and use of explosives. Blasting shall be done only by experienced and qualified personnel and extreme caution and care shall be

exercised to prevent injury to persons or damage to any pipe, mains, wires, drains, buildings, railroad tracks or other property above or below the surface of the ground. The Contractor shall use safety nets or other equivalent measures as approved by the Engineer to reduce the possibility of flying rock as a result of blasting operations. The Contractor shall be held strictly responsible for any injury to persons or damage to public or private property.

B. The Contractor shall submit blasting plans to the Engineer for review and shall not proceed with blasting operations until approval has been granted. As directed by the Engineer, blasting operations shall be monitored to insure that vibration levels produced by blasting are within tolerable limits.

C. The Contractor shall obtain at his expense, all Federal, State and Local permits required to perform blasting operations.

3.4 DEWATERING

The Contractor shall control the grading in all areas so that the surface of the ground will be properly sloped, diked or ditched to prevent water from entering into excavated areas. The Contractor shall maintain sufficient personnel and equipment to promptly and continuously remove all water, from any source, entering or accumulating in the excavation or other parts of the work. All water pumped or drained from these areas shall be disposed of in a suitable manner without damaging adjacent property or other work under construction.

3.5 EMBANKMENTS, FILLS, & BACKFILLS

A. Upon completion of the stripping operations, the exposed subgrade in areas to receive fill should be proof rolled with a loaded dump truck or similar pneumatic-tired vehicle with a minimum loaded weight of 20 tons, under the supervision of the geotechnical engineer. The proofrolling procedure should consist of four complete passes of the exposed areas with two of the passes being in a direction perpendicular to the preceding ones. Any areas which deflect, rut or pump excessively during the proofrolling or fail to "tighten up" after successive passes should be undercut to suitable soils and replaced with compacted fill.

B. Embankments and fills shall be constructed at the locations and to the lines and grades indicated on the drawings. Material shall be placed in horizontal layers not to exceed 8 inches in loose depth and thoroughly compacted prior to placing each following layer. All fill material shall be free from roots or other organic material, trash, and from all stones having any one dimension greater than 6 inches. Stones larger than 4 inches, maximum dimension, shall not be permitted in the upper 6 inches of fill or embankment. Fill areas shall be kept level with graders or other approved devices. Fill shall not be placed on surfaces that are muddy, frozen, or contain frost or ice.

C. Embankment and fill compaction shall be accomplished by thoroughly compacting each layer with sheep foot rollers, pneumatic rollers, and mechanical tampers in places inaccessible to rollers, or other equipment. When material has too much moisture, grading operations shall be limited to drying soil by spreading and turning for drying by the sun and aeration. When material is dry, moisture shall be added by sprinkling by approved means.

D. Where natural slopes exceed 4:1, horizontal benches shall be cut to receive fill material. Slopes of less than 4:1 and other areas shall be scarified prior to placing fill material.

E. All embankments and fills shall be compacted to the following percentages of the maximum dry density as determined by the Standard Proctor Density Test, ASTM D-698, Method C.

F. The following table shall be used throughout the project unless otherwise directed by the Engineer:

TABLE OF COMPACTION

Type Fill or Embankment	Zone	Minimum Density %
Structures	All Depths	98
Paved Areas	All Depths	98
Yard or Field Areas	All Depths	95

1. Embankment types are defined as follows:

   Structure- beneath concrete slabs of buildings, floors, foundations, etc.

   Paved Areas- beneath all roads, tracks, runways, pads, streets, truck operations, and automobile parking lots.

G. Where backfilling is required after the completion of drainage structures, all forms, trash, and construction debris shall be removed from excavation before backfilling begins. Backfill shall be placed in horizontal layers of 6 inches in loose depth. Compaction shall conform to requirements in the above table. Heavy rollers, crawler equipment, trucks or other heavy equipment shall not be used for compacting backfill within 5 feet of structure walls or other facilities which may be damaged by their weight or operation. No backfilling shall begin until concrete and masonry walls are properly cured.

H. The Contractor shall carry the top of embankments, fills, or backfills to the surrounding grade so that upon compaction and subsequent settlement, the grade will be at proper elevation. Should settlement occur during the guarantee period of the contract, the Contractor shall provide sufficient fill to bring area up to finished grade and shall reseed as required.

3.6 PROOFROLLING

A. Proofrolling under the observation of the Soils Engineer will be performed using a loaded dump truck or similar pneumatic-tired vehicle with a minimum loaded weight of 20 tons as specified herein and as follows: The proofrolling procedure should consist of four complete passes of the exposed areas with two of the passes being in a direction perpendicular to the preceding ones. Any areas which deflect, rut or pump excessively during the proofrolling or fail to "tighten up" after successive passes should be undercut to suitable soils and replaced with compacted fill.

B. Immediately following stripping, all areas to receive fill shall be proof rolled as specified herein.

C. Immediately following the completion of excavation to proposed grades in cut areas, proofrolling shall be performed as specified herein.

D. Immediately prior to stone base course placement in pavement areas and following final floor slab preparation, all subgrade areas will be proof rolled. Any local areas which deflect, rut or pump under the roller shall be undercut and replaced with compacted fill material as specified herein. Undercut will not be paid for in fill areas where proof roll does not pass.

3.7 AIR POLLUTION

A. Comply with all pollution control rules, regulations, ordinances, and statutes which apply to any work performed under the Contract, including any air pollution control rules, regulations, ordinances and statutes, or any municipal regulations pertaining to air pollution.

B. During the progress of the work, maintain the area of activity, including sweeping and sprinkling of streets as necessary, so as to minimize the creation and dispersion of dust. If the Engineer decides that it is necessary to use calcium chloride or more effective dust control, furnish and spread the material, as directed, and without additional compensation.

3.8 SOIL INSPECTION AND TESTS

A. All excavated and fill material shall be removed, selected, placed and compacted under supervision of a representative of a commercial soils testing laboratory which will be selected by the Owner. A commercial soils testing laboratory shall be any firm properly equipped to perform such compaction tests and who has in their employment a Professional Engineer experienced in testing and soil mechanics. The laboratory representative shall have the authority to approve or disapprove the condition of the subgrade on which fill is to be placed, filled material, placement methods, compaction methods, and shall make compaction density tests as necessary to determine that the specified density is obtained. The Contractor shall notify the laboratory at least three (3) days prior to starting fill operations in order that suitability of material for compaction may be checked and no material shall be used that has not been previously checked and approved by the laboratory. The laboratory shall be notified before any cut is made or fill is placed in order that the laboratory representative may be present during all grading operations. The Contractor shall remove, replace, recompact and retest all fills failing to meet the density requirements at no additional expense to the Owner.

B. A soils testing laboratory shall be retained by the Owner to supervise fill placement and compaction at no expense to the Contractor. However, extra time and trips caused by excessive delay, failure of the Contractor to properly coordinate with the laboratory, or failure of the Contractor to properly compact fill material shall be back charged to the Contractor.

C. Field density tests shall be performed by the Owner's testing agency for each one foot of fill material placed at the following frequency:

D. A minimum of one field density test shall be made for each 2,000 square feet/vertical foot of fill placement in building areas.

E. A minimum of one field density test shall be made for each 5,000 square feet/vertical foot of fill placement in all other areas where pavement is to be placed.

F. Prior to final acceptance, the Soils Engineer and Surveyor shall submit certification specifying that the project compaction criteria and subgrade elevations have been satisfactorily obtained. The Contractor is responsible for the certification statement from the Surveyor. This certification should be in the form of a letter accompanied by a stamped as-built drawing showing spot elevations.

3.9 BORROW AND WASTE MATERIALS

A. Borrow:

In the event borrow material is required, the borrow material shall be checked for suitability for compaction and approved by the soils testing laboratory. The Contractor shall notify the laboratory at least three (3) days in advance of beginning borrow operations. Borrow excavation shall be performed in accordance with Section 230 of the NCDOT Standard Specifications for Roads and Structures except where modified herein. The Contractor shall be responsible for any erosion control, seeding, and stabilization of any borrow area regardless of whether such area is located on or off the Owners property.

B. Waste:

Excavated materials not suited for backfill and excavated material in excess of that needed to complete the work shall be hauled off the Owner's property at the Contractor's expense. The Contractor shall be responsible for any erosion control, seeding and stabilization at any waste site at no additional cost to the Owner. See section "31 10 05 - Waste Material Disposal."

3.10 RESIDUAL SOIL AREAS

If proofrolling indicates that on-site virgin soils supporting any roadway, parking, building or other structural areas are not adequate as determined by the Soils Engineer, then these unsuitable areas shall be classified as undercut and be repaired by the Contractor. The necessary repair procedure shall be determined by the Soils Engineer and may include scarifying, drying and recompaction procedures or undercutting and replacement procedures.

3.11 FINAL GRADING

A. On completion of all grading, all graded areas (except building pads and pavement areas and all cut slopes steeper than 4:l slope) shall be provided with 4 inches of topsoil and brought to the finished grades shown on the drawings. Areas disturbed by operations of the Contractor shall be properly returned to their original condition with a topsoil covering of 4 inches.

B. After the entire graded area has been brought to the finished grades shown on drawings, all areas shall be left smooth and free from erosion, ridges, ditches and evidence of ponding. Final grades shall be free from all roots, debris, rock and soil lumps and left in readiness for seeding.

C. Prior to acceptance of the entire project, the Contractor shall correct all embankments and graded areas of all damages due to washes, settlement, erosion, equipment ruts or any other cause at his expense.

D. Prior to final acceptance, the Contractor shall provide certification as specified in paragraph 3.7.6 that all grades are ± 0.l foot of the finished grades shown on project drawings.

E. The Contractor shall stabilize all disturbed areas, unless otherwise directed, by seeding and mulching per section 32 32 00 of these specifications or other means of stabilization called for by the contract drawings.

3.12 CLEAN UP

Upon completion or termination of the work, and before final payment is made, the Contractor shall remove from site all equipment, waste materials and rubbish resulting from his operations. In the event of his failure to do so, the same may be done by the Owner at the expense of the Contractor.

END OF SECTION

SECTION 312313

SUBGRADE

PART 1 GENERAL

1.1 SCOPE OF WORK

The work covered by this section consists of the preparation, shaping, and compaction of that portion of the roadbed upon which base or pavement, including base and paving for shoulders, is to be placed.

PART 2 NOT USED

PART 3 EXECUTION

3.1 CONSTRUCTION

A. The subgrade shall be shaped to the lines, grades, and typical sections shown on the plans. All unsuitable material, boulders, and all vegetative matter shall be removed and replaced with suitable material. Suitable material, when not available from the subgrade work, shall be taken from roadway excavation or borrow pits.

B. Material excavated in preparing the subgrade shall be stored or stockpiled in such a manner as to not interfere with proper drainage or any of the subsequent operations of placing base or pavement.

C. The top 24" of subgrade in paved areas shall be compacted at a moisture content required to produce 98% of maximum density. All other areas subgrade will be compacted to 95% of maximum density at the optimum moisture content. The Contractor shall dry or add moisture to the subgrade when required to provide a uniformly compacted and acceptable subgrade.

3.2 QUALITY CONTROL

A. Refer to Section 31 23 00 "Excavating, Backfilling, and Compacting for Utilities" for testing scenarios.

B. A tolerance of plus or minus 1/2" from the established grade will be permitted after the subgrade has been graded to a uniform surface.

C. Ditches and drains shall be provided and maintained when required to satisfactorily drain the subgrade. Where previously approved subgrade is damaged by natural causes, by hauling equipment, or by other traffic, the Contractor shall restore the subgrade to the required lines, grades, and typical sections and to the required density at no cost to the Owner.

END OF SECTION

SECTION 312500

EROSION AND SEDIMENT CONTROL

1. DESCRIPTION

1.1 Erosion and sedimentation control shall be provided by the Contractor for all areas of the site denuded or otherwise disturbed during construction. The Contractor shall be responsible for all installation, materials, labor, and maintenance of erosion and sediment control devices, as well as removal of temporary erosion and sediment control devices shown on the plans or required to protect all downstream properties, natural waterways, streams, lakes, ponds, catch basins, drainage ditches, roads, gutters, natural buffer zones, and man-made structures.

1.2 Erosion and sediment control procedures and facilities shall conform to the "Erosion and Sediment Control Planning and Design Manual" as published by the North Carolina Sedimentation Control Commission, Sections 1607 and 1610 of the "Standard Specifications for Roads and Structures" dated January 1, 2018, as published by the North Carolina Department of Transportation and to all applicable local codes or ordinances, whichever is more stringent.

1.3 Related Work: See the following sections for related work.

1. 31 32 00 Site Stabilization

2. MATERIALS

2.1 Washed stone to be used in temporary sediment basins shall be of strong, durable nature, resistant to weathering and shall be graded to conform to Standard Size Number 57 per Section l008 of the "Standard Specifications for Road and Structures" dated January 1, 2018, as published by the North Carolina Department of Transportation.

2.2 Refer to other sections within these specifications as listed in Item l.3 above for other material specification required in the installation of erosion and sediment control facilities.

3. INSTALLATION

3.1 General Requirements

3.2 The Contractor shall follow the erosion control construction sequence schedule as shown on the contract drawings, except that should circumstances dictate that extra precaution be taken to prohibit erosion and sedimentation on the project, the Contractor will, at his own expense, take preventative measures as needed.

3.3 The Contractor is required to maintain all erosion and sediment control facilities to insure proper performance throughout the construction phase and until such time all disturbed areas are permanently stabilized.

3.4 Upon completion of construction or successful permanent stabilization of all areas which were disturbed before or during construction operations or as indicated on the construction drawings, whichever occurs last, the Contractor shall remove all temporary erosion and sediment control devices and facilities from the project site. The Contractor shall retain these items for future use or properly dispose of these items offsite.

3.5 The Contractor shall provide temporary or permanent ground cover as called for on the construction plans.

END OF SECTION

SECTION 312513

TEMPORARY SILT FENCE

PART 1 DESCRIPTION

1.1 The work covered by this Section consists of the furnishing, installing, maintaining, replacing as needed, and removing of temporary silt fence. The Contractor shall furnish all equipment, tools, labor and materials necessary to complete the work in accordance with the plans and specifications. All materials and procedures shall conform to Section 1605 of the "Standard Specifications for Roads and Structures", dated January l, 2018, published by the North Carolina Department of Transportation, Section 4.3.1 of the "Erosion and Sediment Control Planning and Design Manual", published by the North Carolina Sediment Control Commission and all local codes and ordinances, whichever is more stringent.

PART 2 MATERIALS

2.1 General Requirements

2.2 Temporary silt fence shall be a water permeable filter type fence for the purposes of removing suspended particles from the water passing through it.

2.3 Posts

2.4 Either wood posts or steel posts may be used. Wood posts shall be a minimum of 6 feet long, at least 3 inches in diameter, and straight enough to provide a fence without noticeable misalignment. Steel posts shall be at least 5 feet in length, approximately 1-3/8 inches wide measured parallel to the fence, and have a minimum weight of 1.25 lb/ft of length. The post shall be equipped with an anchor plate having a minimum area of l4.0 square inches, and shall have a means of retaining wire and fabric in the desired position without displacement.

2.5 Woven Wire Fence

2.6 Wire fence fabric shall be at least 32 inches high, and shall have at least 6 horizontal wires. Vertical wires shall be spaced l2 inches apart. The top and bottom wires shall be at least l0 gage. All other wires shall be at least l2-l/2 gage.

2.7 Silt Fence Filter Fabric

2.8 Filter fabric shall meet the requirements of Type 3 Engineering Fabric, Class A or B, per Section 1056 of the "Standard Specifications for Roads and Structures" dated January 1, 1990, published by the North Carolina Department of Transportation. Silt fence which incorporates filter fabric meeting the requirements of Section 1056 but which fails to perform in an acceptable manner shall be replaced with silt fence which is capable of acceptable performance. Silt fence should also meet the requirements of the "NCDENR Erosion Control Planning and Design Manual", latest revision.

2.9 Wire Staples

2.10 Wire staples shall be a No. 9 staple and shall be at least 1½ inches long.

PART 3 Installation

3.1 General Requirements

3.2 The Contractor shall install temporary silt fence as shown on the plans. The silt fence shall be constructed at the locations shown on the plans and at all other locations necessary to prevent sediment transport, as directed by the Engineer.

3.3 Class A synthetic filter fabric may be used only in conjunction with woven wire fence fabric backing. Filter fabric shall be attached to the wire fence fabric by wire or other acceptable means.

3.4 Class B synthetic filter fabric may be used without the woven wire fence fabric backing, subject to the following conditions:

3.5 Post spacing is reduced to a maximum of 6 feet.

3.6 The proposed fabric has been approved by the Engineer as being suitable for use without the woven wire fence fabric backing.

3.7 Fence posts shall be inclined toward the runoff source at an angle of not more than 20^{O} from vertical.

3.8 Posts shall be installed so that no more than 3 feet of the post shall protrude above the ground. Where possible, the filter fabric from a continuous roll cut to the length of the barrier shall be used to avoid joints. When joints are necessary, securely fasten the filter cloth only at a support post with overlap to the next post. At the time of installation, the fabric will be rejected if it has defects, rips, holes, flaws, deterioration, or damage incurred during manufacture, transportation, or storage.

3.9 Maintenance and Removal

3.10 The Contractor shall inspect temporary silt fences at least once a week and after each rainfall and shall make any required repairs and remove and dispose of silt accumulation immediately. Should the fabric of the silt fence collapse, tear, decompose or become ineffective, the Contractor will replace it promptly at his own expense.

The Contractor shall remove sediment deposits as necessary to provide adequate storage volume for the next rain and to reduce pressure on the fence.

3.11 The Contractor shall remove all temporary silt fence and associated appurtenances once all disturbed areas upland of the fence are properly and satisfactorily stabilized as called for on the plans.

END OF SECTION

SECTION 313200

SITE STABILIZATION

PART 1 GENERAL

1.1 SCOPE OF WORK

A. This section covers the furnishing of all labor, equipment and materials necessary for the establishment of vegetation of all areas of the site disturbed by construction operations and all earth surfaces of embankments including rough and fine grading, topsoil if required, fertilizer, lime, seeding and mulching. The Contractor shall adapt his operations to variations in weather or soil conditions as necessary for the successful establishment and growth of the grasses and legumes.

PART 2: PRODUCTS

2.1 MATERIALS

A. FERTILIZER

1. The quality of fertilizer and all operations in connection with the furnishing of this material shall comply with the requirements of the North Carolina Fertilizer Law and regulations adopted by the North Carolina Board of Agriculture.

2. Fertilizer shall be 10-10-10 grade. Upon written approval of the Engineer a different grade of fertilizer may be used, provided the rate of application is adjusted to provide the same amounts of plant food.

3. During handling and storing, the fertilizer shall be cared for in such a manner that it will be protected against hardening, caking, or loss of plant food values. Any hardened or caked fertilizer shall be pulverized to its original conditions before being used.

B. LIME

1. The quality of lime and all operations in connection with the furnishing of this material shall comply with the requirements of the North Carolina Lime Law and regulations adopted by the North Carolina Board of Agriculture.

2. During the handling and storing, the lime shall be cared for in such a manner that it will be protected against hardening and caking. Any hardened or caked lime shall be pulverized to its original conditions before being used.

3. Lime shall be agriculture grade ground dolomitic limestone. It shall contain not less than 85% of the calcium and magnesium carbonates and shall be of such fineness that at least 90% will pass a No. 10 sieve and at least 50% will pass a No. 100 sieve.

C. SEED

1. The quality of seed and all operations in connection with the furnishing of this material shall comply with the requirements of the North Carolina Seed Law and regulations adopted by the North Carolina Board of Agriculture. Seed shall have been approved by the North Carolina Department of Agriculture or any agency approved by the Engineer before being sown, and no seed will be accepted with a date of test more than 9 months prior to the date of sowing. Such testing however, will not relieve the Contractor from responsibility for furnishing and sowing seed that meets these specifications at the time of sowing. When a low percentage of germination causes the quality of the seed to fall below the minimum pure live seed specified, the Contractor may elect, subject to the approval of the Engineer, to increase the rate of seeding sufficiently to obtain the minimum pure live seed contents specified, provided that such an increase in seeding does not cause the quantity of noxious weed seed per square yard to exceed the quantity that would be allowable at the regular rate of seed.

2. During handling and storing, the seed shall be cared for in such a manner that it will be protected from damage by heat, moisture, rodents or other causes.

3. Seed shall be entirely free from bulblets or seed of Johnson Grass, Nutgrass, Sandbur, Wild Onion, Wild Garlic, and Bermuda Grass. The specifications for restricted noxious weed seed refers to the number per pound, singly or collectively, of Blessed Thistle, Wild Radish, Canada Thistle, Corncockle, Field Bindweed, Quackgrass, Dodders, Dock, Horsenettle, Bracted Plantain, Buckhorn or Wild Mustard; but in no case shall the number of Blessed Thistle or Wild Radish exceed 27 seeds of each per pound. No tolerance on weed seed will be allowed.

D. MULCH

Straw Mulch shall be threshed straw of oats, rye or wheat free from matured seed of obnoxious weeds or other species which would grow and be detrimental to the specified grass.

E. TACKIFIER

Emulsified asphalt or organic tackifier such as Reclamare R2400 shall be sprayed uniformly on mulch as it is ejected from blower or immediately thereafter. Tackifier shall be applied evenly over area creating uniform appearance. Rates of application will vary with conditions. Asphalt shall not be used in freezing weather.

PART 3 EXECUTION

3.1 PREPARATION

A. PROTECTION OF EXISTING TREES AND VEGETATION

1. Protect existing trees and other vegetation indicated to remain in place against cutting, breaking or skinning of roots, skinning and bruising of bark, smothering

of trees by stockpiling construction materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line. Provide wood or metal stakes set on 8 to 10 foot centers and connected at a 4'-0" height by 2" minimum brightly colored flagging tape to protect trees and vegetation to remain. Set perimeter of protection at the drip line of trees to remain unless approved otherwise by the Engineer.

2. Provide protection for roots over 1-1/2" diameter cut during construction operations. Cleanly cut off end of damaged root and coat cut faces with an emulsified asphalt, or other acceptable coating, formulated for use on damaged plant tissues. Temporarily cover exposed roots with wet burlap to prevent roots from drying out and cover with earth as soon as possible.

3. The Contractor shall not remove or damage trees and shrubs which are outside the Clearing Limits established by the Owner or those within the Clearing Limits designated to remain.

4. Repair trees scheduled to remain and damaged by construction operations in a manner acceptable to the Engineer. Repair damaged trees promptly to prevent progressive deterioration caused by damage.

5. Replace trees scheduled to remain and damaged beyond repair by construction operations, as determined by the Engineer with trees of similar size and species. Repair and replacement of trees scheduled to remain and damaged by construction operations or lack of adequate protection during construction operations shall be at the Contractor's expense.

B. GRADING

1. Rough grading shall be done as soon as all excavation required in the area has been backfilled. The necessary earthwork shall be accomplished to bring the existing ground to the desired finish elevations as shown on the Contract Drawings or otherwise directed.

2. Fine grading shall consist of shaping the final contours for drainage and removing all large rock, clumps of earth, roots and waste construction material. It shall also include thorough loosening of the soil to a depth of 6" by plowing, discing, harrowing or other approved methods until the area is acceptable as suitable for subsequent landscaping operations. The work of establishing vegetation shall be performed on a section by section basis immediately upon completion of earthwork or pipeline installation.

3. Upon failure or neglect on the part of the Contractor to coordinate his grading with seeding and mulching operations and diligently pursue the control of erosion and siltation, the Engineer may suspend the Contractor's grading operations until such time as the work is coordinated in a manner acceptable to the Engineer.

C. SEEDBED PREPARATION

1. The Contractor shall cut and satisfactorily dispose of weeds or other unacceptable growth on the areas to be seeded. Uneven and rough areas outside the graded section, such as crop rows, farm contours, ditches and ditch spoil banks, fence line and hedgerow soil accumulations, and other minor irregularities which cannot be obliterated by normal seedbed preparation operations, shall be shaped and smoothed as directed by the Engineer to provide for more effective seeding and for ease of subsequent mowing operations.

2. The soil shall then be scarified or otherwise loosened to a depth of not less than 6" except as otherwise provided below or otherwise directed by the Engineer. Clods shall be broken and the top 2" to 3" of soil shall be worked into an acceptable seedbed by the use of soil pulverizers, drags, or harrows; or by other methods approved by the Engineer.

3. On 2:1 slopes a seedbed preparation will be required that is the same depth as that required on flatter areas, although the degree of smoothness may be reduced from that required on the flatter areas if so permitted by the Engineer.

4. On cut slopes that are steeper than 2:1, both the depth of preparation and the degree of smoothness of the seedbed may be reduced as permitted by the Engineer, but in all cases the slope surface shall be scarified, grooved, trenched, or punctured so as to provide pockets, ridges, or trenches in which the seeding materials can lodge.

5. On cut slopes that are either 2:1 or steeper, the Engineer may permit the preparation of a partial or complete seedbed during the grading of the slope. If at the time of seeding and mulching operations such preparation is still in condition acceptable to the Engineer, additional seedbed preparation may be reduced or eliminated.

6. The preparation of seedbeds shall not be done when the soil is frozen, extremely wet, or when the Engineer determines that it is in an otherwise unfavorable working condition.

3.2 APPLICATION

A. Seed shall be applied by means of a hydro-seeder or other approved methods. The rates of application of seed, fertilizer and limestone shall be as stated in Table I.

B. Equipment to be used for the application, covering or compaction of limestone, fertilizer, and seed shall have been approved by the Engineer before being used on the project. Approval may be revoked at any time if equipment is not maintained in satisfactory working condition, or if the equipment operation damages the seed.

C. Limestone, fertilizer, and seed shall be applied within 24 hours after completion of seedbed preparation unless otherwise permitted by the Engineer, but no limestone or fertilizer shall be distributed and no seed shall be sown when the Engineer determines that weather and soil conditions are unfavorable for such operations.

D. Limestone may be applied as a part of the seedbed preparation, provided it is immediately worked into the soil. If not so applied, limestone and fertilizer shall be distributed uniformly over the prepared seedbed at the specified rate of application and then harrowed, raked, or otherwise thoroughly worked or mixed into the seedbed. Seed shall be distributed uniformly over the seedbed at the required rate of application, and immediately harrowed, dragged, raked, or otherwise worked so as to cover the seed with a layer of soil. The depth of covering shall be as directed by the Engineer. If two kinds of seed are to be used which require different depths of covering, they shall be sown separately.

E. When a combination seed and fertilizer drill is used, fertilizer may be drilled in with the seed after limestone has been applied and worked into the soil. If two kinds of seed are being used which require different depths of covering, the seed requiring the lighter covering may be sown broadcast or with a special attachment to the drill, or drilled lightly following the initial drilling operation.

F. When a hydraulic seeder is used for application of seed and fertilizer, the seed shall not remain in water containing fertilizer for more than 30 minutes prior to application unless otherwise permitted by the Engineer.

G. Immediately after seed has been properly covered the seedbed shall be compacted in the manner and degree approved by the Engineer.

H. When adverse seeding conditions are encountered due to steepness of slope, height of slope, or soil conditions, the Engineer may direct or permit that modifications be made in the above requirements which pertain to incorporating limestone into the seedbed; covering limestone, seed, and fertilizer; and compaction of the seedbed.

Such modifications may include but not be limited to the following:

1. The incorporation of limestone into the seedbed may be omitted on (a) cut slopes steeper than 2:1; (b) on 2:1 cut slopes when a seedbed has been prepared during the excavation of the cut and is still in an acceptable condition; or (c) on areas of slopes where the surface of the area is too rocky to permit the incorporation of the limestone.

2. The rates of application of limestone, fertilizer, and seed on slopes 2:1 or steeper or on rocky surfaces may be reduced or eliminated.

3. Compaction after seeding may be reduced or eliminated on slopes 2:1 or steeper, on rocky surfaces, or on other areas where soil conditions would make compaction undesirable.

I. MULCHING

1. All seeded areas shall be mulched unless otherwise indicated in the special provisions or directed by the Engineer.

2. It shall be spread uniformly at a rate of two tons per acre in a continuous blanket over the areas specified.

3. Before mulch is applied on cut or fill slopes which are 3:1 or flatter, and ditch slopes, the Contractor shall remove and dispose of all exposed stones in excess of 3" in diameter and all roots or other debris which will prevent proper contact of the mulch with the soil. Mulch shall be applied within 24 hours after the completion of seeding unless otherwise permitted by the Engineer. Care shall be exercised to prevent displacement of soil or seed or other damage to the seeded area during the mulching operation.

4. Mulch shall be uniformly spread by hand or by approved mechanical spreaders or blowers which will provide an acceptable application. An acceptable application will be that which will allow some sunlight to penetrate and air to circulate but also partially shade the ground, reduce erosion, and conserve soil moisture.

5. Mulch shall be held in place by applying a sufficient amount of asphalt or other approved binding material to assure that the mulch is properly held in place. The rate and method of application of binding material shall meet the approval of the Engineer. Where the binding material is not applied directly with the mulch it shall be applied immediately following the mulch application.

6. The Contractor shall take sufficient precautions to prevent mulch from entering drainage structures through displacement by wind, water, or other causes and shall promptly remove any blockage to drainage facilities which may occur.

3.3 MAINTENANCE

A. The Contractor shall keep all seeded areas in good condition, reseeding if and when necessary, until an acceptable stand of grass is established over the entire area seeded and shall maintain these areas in an approved condition until final acceptance of the Contract. Any of these additional efforts will be at no additional cost to the Owner.

B. Grassed areas will be accepted when a 95% cover by permanent grasses is obtained and weeds are not dominant. On slopes, the Contractor shall provide against washouts by an approved method. Any washouts which occur shall be regraded and reseeded until a good sod is established.

C. Areas of damage or failure due to any cause shall be corrected by being repaired or by being completely redone as may be directed by the Engineer. Areas of damage or failure resulting either from negligence on the part of the Contractor in performing subsequent construction operations or from not taking adequate precautions to control erosion and siltation as required throughout the various sections of the specifications, shall be repaired by the Contractor as directed by the Engineer at no cost to the Owner.

TABLE I - APPLICATION RATES

A. LIME AND FERTILIZER

In the absence of a soil test, the following rates of application of limestone and fertilizer shall be:

1. 4,000 pounds limestone per acre

2. 1000 pounds 10-10-10 (N-$P_2 0_5$-$K_2 0$) fertilizer per acre and the remaining quantity applied when vegetation is three inches in height or 45 days after seeding, whichever comes first.

B. MULCH

Mulch shall be applied at the following rates per acre:

1. 3,000-4,000 pounds straw mulch, or

2. 1,500-2,000 pounds wood cellulose fiber.

3. 35-40 cubic yards of shredded or hammermilled hardwood bark

4. 1,200-1,400 pounds of fiberglass roving

C. TEMPORARY SEED

The kinds of seed and the rates of application shall be as contained in this table. All rates are in pounds per acre. See Notes 1 and 2.

1. Fall and Winter (Normally August 1 to June 1)

80 pounds of Ky-31 tall fescue and 15 pounds of rye grain

2. Summer (Normally May 1 to September 1)

100 pounds of Ky-31 tall fescue

NOTES

1. On cut and fill slopes having 2:1 or steeper slopes, add 40 pounds of sericea lespedeza per acre to the planned seeding (hulled in spring and summer unhulled in fall and winter) plus 15 pounds of sudangrass in summer seeding or 25 pounds of rye cereal per acre in fall and winter seeding, if seeded September to February.

2. These seeding rates are prescribed for all sites with less than 50% ground cover and for sites with more than 50% ground cover where complete seeding is necessary to establish effective erosion control vegetative cover. On sites having 50% to 80% ground cover where complete seeding is not necessary to establish vegetative cover, reduce the seeding rate at least one-half the normal rate.

END OF SECTION

SECTION 320100

RESTORATION OF SURFACES

PART 1 GENERAL

1.1 SCOPE OF WORK

A. This section covers the furnishing of all labor, equipment and materials necessary for the proper restoration of existing surfaces disturbed or damaged as a result of construction operations which are not specifically scheduled or specified for topsoil and seeding, paving, landscaping or other surfacing.

B. In general, the types of replacement included in this section are seeding along pipelines, concrete sidewalks, driveways, roadways, ditches, lawns and landscaped areas, curb and gutter.

C. Any damage to existing structures shall be repaired using materials and workmanship equal to those of original construction.

PART 2 NOT USED

PART 3 EXECUTION

3.1 RESTORATION OF SURFACES

A. SEEDING ALONG PIPELINES

1. All ground surfaces along pipelines, which are not classified as lawns, landscaped areas, or pavement areas, but would be classified as open fields, shall be raked smooth and seeded in accordance with the section entitled Site Stabilization. Large rocks, clumps of earth and excessive spoil material shall be removed from the area prior to seeding.

2. Shoulders of all roads shall be restored as specific for lawns and landscaped areas.

3. Wooded areas, not classified as lawns shall be restored to as near their original condition as possible.

B. CONCRETE SIDEWALKS

1. Concrete walks removed in connection with, or damaged as a result of, construction operations under the Contract shall be replaced with new construction. Such walks shall be constructed of Class B concrete on a

thoroughly compacted subgrade, shall have a vertical thickness of not less than 4" or the thickness of the replaced walk where greater than 4".

2. Walks shall be float finished, edged with an edging tool, and grooved at intermediate intervals not in excess of the width of the walk, uniform throughout the length of the walk in any one direction.

C. DRIVEWAYS

1. Unpaved driveways shall be surfaced with not less than 3" of Crusher-run gravel, topped with 3" of stone, gravel, or other materials equal to that found in the original driveway. Driveways shall be left in a condition better than their original condition.

2. Concrete drives shall be replaced with Class B concrete and shall have equal thickness and reinforcing steel to that of the original drive. Prior to placing the concrete, a 6" aggregate base course shall be placed in the drive area.

3. Bituminous or Asphaltic concrete drives shall be restored with a 6" aggregate base course and a 2" surface course, as defined in the section entitled Asphalt Pavement Repairs.

D. ROADWAY REPLACEMENT

1. Bituminous or Asphaltic pavements shall include all areas paved with blacktop; built-up pavements or oil and stone, tar and stone and similar pavements constructed with a bituminous or asphalt and stone materials.

2. Immediately upon completion of installation of underground piping and structures, the trench shall be backfilled and the roadway shall be repaired. In the excavated area, the repair shall consist of an 8" aggregate base course, 4" HB Binder Course and a 2" surface course as defined in the section entitled Bituminous Pavement Repairs. If, in the opinion of the Engineer, the area adjacent to the excavation has not been damaged to the extent that the base course need to be replaced, restoration may consist of a surface course of sufficient thickness to meet the existing pavement.

3. Portland cement concrete roadways shall be replaced with Class B Concrete and shall have equal thickness and reinforcing steel as the original roadway. An aggregate of 6" shall be placed prior to the placing of concrete.

4. Differential settlement of restored pavements shall be corrected immediately.

5. The Contractor shall repair and restripe any traffic markings that were damaged, removed or covered during construction. All work shall be done in accordance with TDOT requirements and specifications.

6. All existing manhole and valve covers shall be raised as required by the Contractor prior to paving. The cost of this work shall be included in the unit bid prices for other related work and no additional payment shall be made.

E. DITCHES

Ditches shall be regraded to the original grade and line. The surface of all ditches shall be returned to the same condition as found before commencing work.

F. LAWNS AND LANDSCAPED AREAS

1. Lawns and landscaped areas shall be regraded and replaced as follows:

   a. Grading shall be to the grade existing before construction of the work under this Contract.

   b. Lawn replacement shall be in accordance with the section entitled Landscaping. Topsoiled areas shall be replaced with topsoil of equal quality and quantity.

2. Landscaped areas shall be replaced with shrubs, hedges, ornamental trees, flowers, or other items to original condition.

G. CURB AND GUTTER

Curb and gutter removed with, or damaged as a result of construction operations, injured or disturbed by the Contractor, his agents, or employees, shall be replaced with new construction to a condition similar and equal to that existing before damage was incurred. Class B Concrete shall be used in curb and gutter replacement.

H. DAMAGE TO STRUCTURES

Any damage to existing structures shall be repaired of materials and workmanship equal to those of original construction. Extensively damaged structures, where the structural stability has been affected or which cannot be repaired in a suitable fashion shall be replaced entirely. Replacement shall not commence until approval of the plan of replacement has been given by the Engineer. Replacement costs shall be responsibility of the Contractor.

END OF SECTION

SECTION 320117

ASPHALT PAVEMENT REPAIRS

PART 1 GENERAL

1.1 SCOPE OF WORK

This section covers the repairs of pavement for all asphalt surfaces.

1.2 PERFORMANCE

Construction of the subgrade, base course and paving shall be undertaken immediately after completion of all underground piping and structures, all curbs and gutters, all yard piping, conduits and other facilities passing beneath paved areas, and all structural slabs and foundations required within or adjacent to the paved areas.

1.3 REFERENCES

All work and materials required under this section of the specifications shall conform to the applicable sections of the North Carolina Department of Transportation, Division of Highways, Standard Specifications for Roads and Structures - Latest Edition.

PART 2 NOT USED

PART 3 EXECUTION

3.1 INSTALLATION

A. PREPARATION OF SUBGRADE

The work covered under this section of this specification shall be performed in strict accordance with Section 500 or Section 505 whichever is applicable, of the Standard Specifications for Road and Structures - Latest Edition, of the North Carolina Department of Transportation, Division of Highways.

B. APPLICATION OF AGGREGATE BASE COURSE

The work covered under this section of this specification shall be performed in strict accordance with Section 520 of the Standard Specification for Road Structures - Latest Edition, of the North Carolina Department of Transportation, Division of Highways.

C. ASPHALT PLANT MIX - GENERAL

The work covered under this section of this specification shall be performed in strict accordance with Section 610 and Section 620 of the Standard Specifications for Roads and Structures - Latest Edition, of the North Carolina Department of Transportation, Division of Highways.

D. TACK COAT

1. Materials used as a tack coat shall meet the requirements for the grades indicated below unless otherwise indicated in the contract. Any of the grades of tack coat material noted in this specification may be used:

    - Asphalt Binder, Grade PG 64-22
    - Emulsified Asphalt, Grade RS-1H, CRS-1H, CRS-1, HFMS-1, CRS-2

2. Do not dilute or mix the tack coat with water, solvents, or other materials prior to application.

3. When tack coat is required beneath an open-graded asphalt friction course, the asphalt grade and rate of application to be used will be specified on the job mix formula.

4. Surface Preparation

    a. The surface to which the tack coat is to be applied shall be cleaned of dust, dirt, clay, and any other deleterious matter prior to placing the tack coat.

    b. The Contractor shall remove grass, dirt and other materials from the edge of the existing pavement prior to the placement of tack coat.

5. Weather Limitations

    a. Tack shall be applied only when the surface to be treated is sufficiently dry and the atmospheric temperature in the shade away from artificial heat is 35° F or above.

    b. Tack coat shall not be applied when the weather is foggy or rainy.

6. Application Rates and Temperatures

    a. Tack coat shall be uniformly applied at a rate from 0.04 to 0.08 gallons per square yard. The exact rate of application will be established by the Engineer and will be based on the volume of material at the actual application temperature. When tack coat is required beneath an open-graded asphalt friction course, an asphalt binder Grade PG 64-22 material shall be used. The exact rate of application will be specified on the job mix formula and will be within the range of 0.06 to 0.08 gallons per square yard.

    b. The temperature of the material at the time of application shall be within the ranges shown in the table below:

Application Temperatures for Tack Coat

Asphalt Material	Temperature Range
Asphalt Binder, Grade PG 64-22	375 - 425°F
Emulsified Asphalt, Grade RS-1H, CRS-1, CRS-1H	90 - 150°F
Emulsified Asphalt, Grade HFMS-1	90 - 160°F
Emulsified Asphalt, Grade CRS-2	125 - 185°F

7. Application

   a. No more tack coat material shall be applied than can be covered with base, intermediate, or surface course during the following day's paving operations.

   b. Tack coat material shall be uniformly applied to the entire surface utilizing an adjustable spray bar. Areas of tack coat application should be uniformly and completely covered.

   c. Tack coat shall be applied only in the presence of and as directed by the Engineer. No base or surface mixture shall be deposited onto the tacked pavement until the tack coat has sufficiently cured.

   d. Contact surfaces of headers, curbs, gutters, manholes, vertical faces of old pavements, and all exposed transverse and longitudinal edges of each course shall be painted or sprayed with tack coat before new asphalt mixture is placed adjacent to such surfaces.

   e. Bridge floors, curbs and handrails of structures, and all other appurtenances shall be covered to prevent tack coat from being tracked or splattered on the structures or appurtenances.

8. Protection

   a. Protect the tack coat after application until it has cured for a sufficient length of time to prevent if from being picked up by traffic.

   b. Contractor shall take the necessary precautions to minimize tracking and/or accumulation of tack coat material on existing or newly constructed pavements. Corrective measures may be required in areas where an excessive accumulation of tack has occurred.

E. BASE COURSE (B 25.0X); INTERMEDIATE COURSE (I 19.0X); SURFACE COURSES (S 12.5X, S AND SF 9.5X)

1. Weather and Temperature Limitations

a. Asphalt mixtures shall not be produced or placed during rainy weather, when the subgrade or base course is frozen, or when the moisture on the surface to be paved would prevent proper bond. Asphalt material shall not be placed when the air temperature, measured in the shade away from artificial heat at the location of the paving operations, is less than the temperatures noted in the table on the following page.

b. Where the surface course is to be placed on the intermediate course, the surface course shall be placed as soon as possible after the intermediate course has been placed, and in all cases during the same paving season.

Minimum Paving Temperatures

Asphalt Mixture	Minimum Air Temperature (ºF)	Minimum Road Surface Temperature (ºF)
B 25.0B B 25.0C	35	35
I 19.0B I 19.0C	35	35
S 9.5C, S 9.5D, S 12.5C, S 12.5D	50	50
SF 9.5A S 9.5B	40	50

2. Spreading and Finishing

a. Coat surface of manhole frames and inlet frames with oil to prevent bonding with asphalt pavement. Do not tack or prime coat these surfaces.

b. Tack coat shall be applied to the existing pavement, when necessary, in accordance with the provisions of these specifications.

c. The asphalt mixture shall be spread and struck off to the required grades, cross sections, and thicknesses.

d. Should unevenness of texture, tearing, segregation, or shoving occur during the paving operation due to unsatisfactory methods or equipment, the Contractor shall immediately take such action as may be necessary to correct such unsatisfactory work. Excessively throwing back material will not be permitted.

3. Compaction

a. Immediately after the asphalt mixture has been spread, struck off, shaped to the required width, depth, cross-section, and surface and edge irregularities adjusted, it shall be thoroughly and uniformly

compacted. Compaction must be obtained in a manner that provides uniform density over the pavement and meets the required degree of compaction for the type of mixture being placed. Compaction rolling shall be complete before material temperature drops below 185ºF.

b. Compaction rolling should be performed at the maximum temperature at which the mix will support the rollers without moving horizontally. The number and weight of rollers shall be sufficient to compact the mixture to the required density while it is still in a workable condition. Adjustments to the compaction equipment may be required where uniform density is not being obtained throughout the depth of the layer being tested.

c. All final wearing surfaces, except open-graded asphalt friction course, shall be compacted using a minimum of 2 steel wheel tandem rollers. Pneumatic-tired rollers with smooth tread tires may be used after the breakdown roller and prior to finish rolling. Vibratory rollers must not be operated in vibratory mode during finish rolling on any mix type or pavement layer.

d. Rollers used to compact the mixture shall be in good condition and capable of reversing without backlash. The rollers shall be operated with the drive wheels nearest the paver and at uniform speeds slow enough to avoid displacement of the mixture. Steel wheel rollers shall be equipped with wetting devices to prevent the mixture from sticking to the roller wheels. Fuel oil shall not be used to moisten roller wheels.

e. All asphalt mixtures, except open-graded asphalt friction course and type SF 9.5A, shall be compacted to at least 92 percent of the mixtures maximum specific gravity. An SF 9.5A mixture shall be compacted to at least 90 percent of the mixtures maximum specific gravity.

f. Rolling for open-graded asphalt friction course shall consist of one coverage with a tandem steel wheel roller weighing a maximum of 10 tons, with additional rolling limited to one coverage with the roller where necessary to improve riding surface.

g. The use of rolling equipment that results in excessive crushing of the aggregate or excessive displacement of the mixture will not be permitted.

h. In areas inaccessible to standard rolling equipment, the mixture shall be thoroughly compacted by the use of hand tampers, hand operated mechanical tampers, or other approved equipment.

i. The tolerance of the final compacted pavement shall be within 1/4” of the typical cross-sections shown on the plans.

4. Joints

a. Placement of surface course material as the final layer of pavement should not be placed between November 15 and April 1 of the next year unless otherwise approved by the Engineer. In addition, open-graded asphalt friction course shall not be placed between October 31 and April 1, unless otherwise approved.

b. As an exception to the above, when in any day's operations the placement of a layer of asphalt base course material or intermediate course material 2 inches or greater in thickness has started, it may continue until the temperature drops to 32° F.

F. TRAFFIC MARKINGS

The Contractor shall repair and restripe any traffic markings that were damaged, removed or covered during construction. All work shall be done in accordance with NCDOT requirements and specifications. The cost of this work shall be included in the unit bid prices for other related work and no additional payment shall be made.

G. EXISTING UTILITIES

All existing manhole and valve covers shall be raised by the Contractor as necessary prior to paving so that the tops of the covers are flush with the final surface. The cost of this work shall be included in the unit bid prices for other related work and no additional payment shall be made.

3.2 TESTING

All of the above work will be subject to thickness and compaction tests as deemed necessary by the Engineer. Such tests will be at the Expense of the Owner.

END OF SECTION

SECTION 320523

MISCELLANEOUS CONCRETE CONSTRUCTION

PART 1 GENERAL

1.1 SCOPE OF WORK

A. This section covers concrete construction, complete, including reinforcement therefore.

PART 2 PRODUCTS

2.1 MATERIALS

A. REINFORCING

Bar reinforcement shall be intermediate grade new billet steel conforming to the requirements of ASTM A-615. Unless otherwise noted, all reinforcing bars shall be grade 60. Wire fabric reinforcement shall consist of steel wire conforming to the requirements of ASTM A-185, latest revision.

B. CONCRETE

All concrete shall be equivalent to ready mix concrete manufactured and delivered in accordance with the requirements of ASTM C-94, latest revision and having a compressive strength at 28 days of 4000 psi, except as noted herein. The concrete manufacturer shall assume the responsibility of the design of the concrete mix in accordance with Alternate No. 2 of ASTM C-94. Air entrained concrete shall be used for all concrete exposed to the elements.

a. Cement shall be Type 1 or Type 1A "Portland" cement conforming to ASTM C-150, latest revision or ASTM C-175, latest revision respectively.

b. Aggregates shall conform to ASTM C-33, latest revision. Coarse aggregate shall be crushed rock or gravel and graded from 3/4" to #4 sieve for walls and slabs and from 2" to #4 sieve for mass or foundation concrete. Fine aggregate shall be natural sand.

c. Mixing water shall be proportioned so that slump when measured with standard slump cone does not exceed the following:

i. Slabs in grade.....Max. 4", Min. 3"
ii. Footings.....Max. 5", Min. 3"
iii. All others.....Max. 6", Min. 3"

d. Premolded joint filler strips shall be resilient compressive, bituminous and fiber material saturated, with at least 35% and not over 50% by weight of asphalt. Poured type joint composition for expansion joints shall be elastic compound made up of asphalt and colloidal mineral fillers.

PART 3 EXECUTION

3.1 FORMS

A. Forms shall be wood, metal, structural hardboard or other suitable material that will produce the required surface finish. Forms placed for successive pours for continuous surfaces shall be fitted to accurate alignment to assure a smooth completed surface free from irregularities, and shall be sufficiently tight to prevent the loss of mortar. No forms shall be left permanently in place without approval of the Engineer. Holes resulting from removal of form ties shall be filled solid within 12 hours after removal of forms with cement mortar.

3.2 PLACEMENT

A. Concrete shall be placed as nearly as possible in its final position. Runways for wheeled equipment shall not be supported on the reinforcement. Concrete shall be placed and compacted in layers not over 18 inches deep. Vibrators may be used provided they are used under experienced supervision and the mixture is dry enough to prevent segregation. Form vibrators shall not be used. Vibration shall not be used for transporting or moving concrete inside the forms. No more concrete shall be placed than can be consolidated and finished the same day as placed. Free fall of concrete shall be limited so that no segregation of materials occurs.

3.3 JOINTS

A. Construction of joints not indicated on drawing shall be approved by the Engineer in advance of pour. Joints in foundation walls shall be keyed. Before depositing of concrete is resumed, the hardened surface shall be roughened, cleaned and wetted surfaces shall be slushed with a coating of neat cement grout against which the new concrete shall be placed before the new grout has attained its set.

3.3 FINISHING

A. After stripping forms, all voids and honeycombs shall be patched by chipping and scarifying the defective area and treating it with an approved bonding tended that all such voids be patched, not merely plastered. Grout mixture shall consist of one part Portland cement and one part sand. Immediately following removal of forms, all fins and irregular projections shall be removed from all surfaces except from those which are not to be exposed or waterproofed.

B. Slabs shall be struck off and consolidated by approved machine or hand methods, so that upon completion, the surface shall be true to grade as shown on drawings and free of surface voids. All floors shall have monolithic steel trowel finish unless otherwise

indicated on the drawings. Exterior walks shall be compacted, screeded and floated to a true even surface with wood floats and then broomed.

END OF SECTION

SECTION 321123

AGGREGATE BASE COURSE

PART 1 GENERAL

1.1 SCOPE OF WORK

The work covered by this section consists of the construction of a base composed of an approved aggregate material hauled to the site, placed on the site, compacted, and shaped to conform to the lines, grades, depths, and typical sections shown on the plans or established by the Engineer.

PART 2 PRODUCTS

2.1 MATERIALS

A. Aggregate base course materials shall consist of crushed stone or uncrushed gravel, or other similar material having hard, strong, durable particles free of adherent coatings.

C. The Contractor shall furnish aggregate base course material produced in accordance with the requirements indicated herein for Type A, aggregate unless otherwise specified in the special provisions.

D. All aggregates shall be from approved sources. Sources will not be approved unless the material has satisfactory soundness and satisfactory resistance to abrasion. Satisfactory soundness will be considered to be a weighted average loss of not greater than 15% when subjected to five (5) alternations of the sodium sulfate soundness test in accordance with AASHTO T104. Satisfactory resistance to abrasion will be considered to be a percentage of wear of not greater than 55% when tested in accordance with AASHTO T96.

E. Aggregates shall be handled in such a manner as to minimize segregation.

F. Sites for aggregate stockpiles shall be grubbed and cleaned prior to storing aggregates, and the ground surface shall be firm, smooth, and well drained. A cover of at least 3" of aggregate shall be maintained over the ground surface in order to avoid the inclusion of soil or foreign material. Stockpiles shall be built in such a manner as to minimize segregation. When it is necessary to operate trucks or other equipment on a stockpile in the process of building the stockpile, it shall be done in a manner approved by the Engineer.

G. Stockpiles of different types or sizes of aggregates shall be spaced far enough apart, or else separated by suitable walls or partitions, to prevent the mixing of the aggregates.

H. Any method of stockpiling aggregates which allows the stockpile to become contaminated with foreign matter or causes excessive degradation of the aggregate will not be permitted. Excessive degradation will be determined by sieve tests of samples taken from any portion of the stockpile over which equipment has been operated, and

failure of such samples to meet all grading requirements for the aggregate will be considered cause for discontinuance of such stockpiling procedure.

I. GRADATION

All standard sizes of aggregates shall meet the gradation requirements when tested in accordance with AASHTO T27.

PART 3 EXECUTION

3.1 CONSTRUCTION OF STONE BASE

A. The aggregate material shall be spread on the subgrade to a uniform loose depth and without segregation.

B. Where the required compacted thickness of base is 8" or less the base material may be spread and compacted in one layer. Where the required compacted thickness of base is more than 8", the base material shall be spread and compacted in 2 or more approximately equal layers. The minimum compacted thickness of any one layer shall be approximately 4".

C. Each layer of material shall have been sampled, tested, compacted, and approved prior to placing succeeding layers of base material or pavement.

D. No base material shall be placed on frozen subgrade or base. Hauling equipment shall not be operated on subgrade or a previously completed layer of base material soft enough to rut or weave beneath the equipment.

E. The maximum speed of trucks hauling or traveling over any part of the subgrade or base shall be 5 miles per hour.

F. The Contractor shall utilize methods of handling, hauling, and placing which will minimize segregation and contamination. If segregation occurs, the Engineer may require that changes be made in the Contractor's methods to minimize segregation, and may also require mixing on the road which may be necessary to correct any segregated material. No additional compensation will be allowed for the work of road mixing as may be required under this provision. Aggregate which is contaminated with foreign materials to the extent the base course will not adequately serve its intended use shall be removed and replaced by the Contractor at no additional cost to the Owner. The above requirements will be applicable regardless of the type of aggregate placed and regardless of prior acceptance.

G. The Engineer or the owner's representative will have the right to require that any portion of the work done in his presence and if the work is covered up after such instruction, is shall be exposed by the contractor for observation at no additional cost to the owner.

3.2 QUALITY CONTROL

A. TOLERANCES

1. After final shaping and compacting the base, the Engineer will check the surface of the base for conformance to grade and typical section and will determine the base thickness.

2. The thickness of the base shall be within a tolerance of ±1/2" of the base thickness required by the plans.

B. MAINTENANCE

Where the base material is placed in a trench section, the Contractor shall provide adequate drainage through the shoulders to protect the subgrade and base until such time as shoulders are completed. The Contractor shall maintain the surface of the base by watering, machining, and rolling or dragging when necessary to prevent damage to the base by weather or traffic.

C. TESTING

1. There will be at least one base density test performed per 5,000 square feet. Compaction will be 100% of the maximum laboratory dry density as determined by ASTM D 1557 or AASHTO T 180. This test procedure will be the Owners responsibility to have done and at the owner's cost.

2. Depth measurements for compacted thickness shall be made by test holes through the base course. Where the base course is deficient, correct such areas by scarifying, adding base material and recompacting as directed by the Engineer. At staggered intervals not to exceed 250 feet for two lane streets and roads.

END OF SECTION

SECTION 321216

ASPHALT PAVING

PART 1 GENERAL

1.1 SCOPE OF WORK

The work covered by this section shall consist of the production, delivery, and placement of asphalt plant mix base, intermediate, and surface courses properly laid on a prepared aggregate base course, in accordance with these specifications and in conformity with the lines, grades, thickness, and typical sections shown on the plans.

1.2 SUBMITTALS

A. Prior to paving operations, the contractor should supply the engineer with the appropriate job mix formulas (JMF) for review and approval.

B. The quantity of asphalt materials, measured as provided in Section 31 12 16, will be paid for at the contract prices as specified in the bidding documents. In all cases, the Contractor shall furnish copies of certified weight tickets for all asphalt materials placed on the project.

1.3 QUALITY ASSURANCE

A. The Owner's Representative or Engineer will have the right to require that any portion of the work be performed in his presence and if the work is covered up after such instruction, it shall be exposed by the Contractor for observation at no additional cost to the Owner. However, if the Owner's Representative or Engineer fails to appear within 48 hours, the Contractor may proceed without him.

B. All work done and materials furnished shall be subject to review by the Owner, Engineer or Project Representative. Improper work shall be reconstructed, and all materials which do not conform to the requirements of the specifications, shall be removed from the work upon notice being received from the Engineer for the rejection of such materials. The Engineer shall have the right to mark rejected materials so as to distinguish them as such.

The Contractor shall give the Owner, Project Engineer or Project Representative a minimum of 48 hours notice for all required observations or tests.

C. When required by the Engineer, the automatic weighing and recording system shall be checked by weighing a truck load of mix with an approved set of platform scales. Other means of checking the automatic weighing and recording system will be designated by the Engineer if such checking becomes necessary.

D. The Contractor will not be permitted to use an asphalt mixture delivered to the road which is not accompanied by a load ticket signed by the weighman or an automatic printout ticket in accordance with the above requirements.

E. The original of all tickets, including any voided tickets or tickets for rejected mixture, shall become the property of the Engineer.

F. Asphalt materials will be accepted at the source of shipment subject to the following conditions:

1. All asphalt transport tankers shall have a sampling valve in accordance with the requirements outlined by the Asphalt Institute and ASTM D140, or a comparable device acceptable to the Engineer.

2. Each transport tanker delivering asphalt materials to the project shall keep a running log showing the date, destination, type and grade of material hauled on each trip. The tanker number shall be printed, stamped, or written in ink on each logbook. The logbook shall be available for examination upon request of the Engineer at any time.

3. The Contractor shall furnish with each shipment two (2) copies of the delivery ticket. One copy shall accompany the shipment and be delivered to the Engineer or his representative at the destination. The delivery ticket shall contain the following information: Delivery ticket number, date shipped, state project or purchase order number, destination, name of consignee, trailer number, storage tank or batch number, quantity loaded (tons or gallons), loading temperature, specific gravity or pounds per gallon at 60ºF, and net gallons at 60ºF.

4. The Engineer reserves the right to sample and test any shipment regardless of whether or not the above conditions have been met and to reject any material not meeting the requirements of the specifications.

1.4 STORAGE AND DELIVERY

A. ASPHALT MIXTURE STORAGE SYSTEM

1. The asphalt mixture storage system shall be capable of conveying the mix from the plant to the storage bin while minimizing production interruptions and ensuring the mixture discharged from the storage bin meets the job mix formula requirements.

2. The mixture shall be stored without a loss in temperature, segregation, or oxidation of the mix. Storage time should be limited to the ability of the storage system to maintain the mixture within the specification requirements.

B. TRANSPORTATION OF ASPHALT MIXTURE

1. The mixture shall be transported from the mixing plant to the point of use in vehicles which have tight, clean, smooth metal beds that have been lightly coated with a release agent to prevent the mixture from adhering to the bed. The release agent should be a material that is approved by the North Carolina

Department of Transportation (NCDOT) Materials and Test Unit. Each vehicle shall be equipped with a canvas or other suitable material that will cover the bed of the vehicle. All covers shall be constructed and secured as to prevent the entrance of moisture and the rapid loss of temperature. A 3/8" diameter hole shall be provided on each side of the vehicle body near the center of the body and 6" above the bed of the vehicle for the purpose of inserting a thermometer.

2. The temperature of the mixture immediately prior to discharge from the hauling vehicle shall be within a tolerance of plus 15°F to minus 25°F of the specified job mix temperature. The asphalt mixture temperature should not exceed 350ºF. Asphaltic concrete shall not be placed once the temperature of the mix falls below 250º F.

PART 2 PRODUCTS

2.1 MATERIALS

A. COMPOSITION OF MIXTURES

1. Asphalt mixtures noted herein refers to mix types for base (B 25.0X), intermediate (I 19.0X), and surface (S 12.5X, S and SF 9.5X) courses.

2. The asphalt plant mix shall be composed of a mixture of course and fine aggregate, asphalt binder, and mineral filler. The aggregate components shall be sized, uniformly graded, and combined in such proportions that the resulting mixture meets the grading and physical requirements of the NCDOT specifications for the specified mix type. Materials which will not produce an asphalt mixture within the full allowable tolerances required by these specifications will be rejected.

3. If a recycled mixture is used, reclaimed asphalt pavement (RAP) may constitute up to 50 percent of the total material used.

4. Asphalt mixtures should be designed and produced in accordance with the gradation and design criteria for the specified mix type outlined in Table 610-1 and Table 610-2 of the most current NCDOT Standard Specifications for Roads and Structures.

5. The job mix formula shall be established with the allowable tolerances within the design limits specified for the particular type of asphalt mixture. At a minimum, each job mix formula should include the following information:

- Asphalt mixture type
- Asphalt mixture identification number (JMF#)
- Source and percentage of each aggregate and recycled asphalt pavement (RAP) component to be used.
- JMF combined gradation including target value for percent passing each standard sieve.
- Percentage of asphalt binder in RAP.
- Supplier and percentage of anti-strip additive.
- Suppler, grade, and percentage of asphalt binder.

- Target value (percentage) of asphalt binder content by weight of total mix and required design properties at that percentage.
- Mix temperature.
- Volumetric properties of compacted mixture.
- Required Field Density.

6. The job mix formula for each mixture shall be in effect until modified in writing by the Engineer.

7. All mixtures furnished for the work shall conform to the job mix formula within the tolerance ranges specified for the particular mix.

8. Should a change in sources of aggregate, RAP, or asphalt binder materials be made, a new job mix formula will be required before the new mixture is produced.

9. When unsatisfactory results or other conditions make it necessary, the Engineer may establish a new job mix formula.

10. The asphalt binder for the mixtures shall be a performance graded binder meeting the requirements of AASHTO M320. The binder grade used in standard asphalt mixtures in North Carolina is Performance Grade 64-22 (PG 64-22). Depending on traffic conditions and other factors, other grades of asphalt binder may be used.

B. ASPHALT MATERIALS

1. Asphalt Tack Coat

a. Materials used as a tack coat shall meet the requirements for the grades indicated below unless otherwise indicated in the contract. Any of the grades of tack coat material noted in this specification may be used:

- Asphalt Binder, Grade PG 64-22
- Emulsified Asphalt, Grade RS-1H, CRS-1H, CRS-1, HFMS-1, CRS-2

b. Do not dilute or mix the tack coat with water, solvents, or other materials prior to application.

c. When tack coat is required beneath an open-graded asphalt friction course, the asphalt grade and rate of application to be used will be specified on the job mix formula.

PART 3 EXECUTION

3.1 CONSTRUCTION REQUIREMENTS

A. BASE COURSE (B 25.0X); INTERMEDIATE COURSE (I 19.0X); SURFACE COURSES (S 12.5X, S AND SF 9.5X)

1. Weather and Temperature Limitations:

   a. Asphalt mixtures shall not be produced or placed during rainy weather, when the subgrade or base course is frozen, or when the moisture on the surface to be paved would prevent proper bond. Asphalt material shall not be placed when the air temperature, measured in the shade away from artificial heat at the location of the paving operations, is less than the temperatures noted in the table on the following page.

   b. Where the surface course is to be placed on the intermediate course, the surface course shall be placed as soon as possible after the intermediate course has been placed, and in all cases during the same paving season.

Minimum Paving Temperatures

Asphalt Mixture	Minimum Air Temperature (ºF)	Minimum Road Surface Temperature (ºF)
B 25.0B B 25.0C	35	35
I 19.0B I 19.0C	35	35
S 9.5C, S 9.5D, S 12.5C, S 12.5D	50	50
SF 9.5A S 9.5B	40	50

2. Spreading and Finishing:

   a. Coat surface of manhole frames and inlet frames with oil to prevent bonding with asphalt pavement. Do not tack or prime coat these surfaces.

   b. Tack coat shall be applied to the existing pavement, when necessary, in accordance with the provisions of these specifications.

   c. The asphalt mixture shall be spread and struck off to the required grades, cross sections, and thicknesses by self contained, power propelled pavers. The pavers shall be equipped with an activated screed plate assembly which is designed to be preheated. The screed unit shall be equipped with a sliding shoe attachment that will form a slope on the edge of the mixture to help prevent edge raveling when the mixture is compacted. The paver shall be equipped with a receiving hopper and an automatically controlled distribution system capable of maintaining a uniform load of material in front of the full length of the screed.

   d. A string line shall be placed by the Contractor for the first lane of each layer of mixture placed to provide alignment control for the paver, except when the first layer is placed adjacent to a curb section.

e. Pavers shall be operated at forward speeds consistent with plant production, mixture delivery and satisfactory laying of the mixture in order to provide a uniform and continuous laydown operation. Paving and loading operations should be coordinated such that an adequate amount of asphalt mixture is maintained in the paver hopper between trucks. Do not allow the hopper to become empty between loads. Should unevenness of texture, tearing, segregation, or shoving occur during the paving operation due to unsatisfactory methods or equipment, the Contractor shall immediately take such action as may be necessary to correct such unsatisfactory work. Excessively throwing back material will not be permitted.

f. Pavers shall be equipped with an electronic screed which will automatically control the longitudinal profile and cross slope of the pavement by the use of either a mobile grade reference(s), or string line(s), joint matching shoes, or other approved methods. When a fixed string line is required, the Engineer will furnish grade stakes for the finished pavement grade and the Contractor shall furnish and erect the necessary guide line for the equipment.

g. A mobile grade reference system or non-contacting laser or sonar type ski shall me used during placement of the initial lanes and all adjacent lanes of all layers to control the longitudinal profile. A joint matching device may only be used where approved by the Engineer.

h. An automatic slope control system shall be utilized, unless otherwise approved. The Engineer may waive the requirement for automatic slope controls in areas where the use of such equipment is impractical due to irregular cross section or shape. Mobile grade references may be required when the use of automatic slope controls is waived. Manual screed operation will be permitted based on approval from the Engineer for construction of irregularly shaped and minor areas.

i. In the case of malfunction of the automatic control equipment, the Contractor may manually operate the paver for the remainder of the workday only provided acceptable results are obtained.

j. The Engineer will waive the requirement for use of pavers for spreading and finishing where irregularities or obstacles make their use impractical and the Contractor shall spread, rake, and lute the mixture by hand methods.

k. Roadway paving shall be as continuous as possible. Intersections, auxiliary lanes, and irregular areas shall be paved after the adjacent roadway has been paved.

3. Compaction:

a. Immediately after the asphalt mixture has been spread, struck off, shaped to the required width, depth, cross-section, and surface and

edge irregularities adjusted, it shall be thoroughly and uniformly compacted. Compaction must be obtained in a manner that provides uniform density over the pavement and meets the required degree of compaction for the type of mixture being placed. Compaction rolling shall be complete before material temperature drops below 185ºF.

b. Compaction rolling should be performed at the maximum temperature at which the mix will support the rollers without moving horizontally. The number and weight of rollers shall be sufficient to compact the mixture to the required density while it is still in a workable condition. Adjustments to the compaction equipment may be required where uniform density is not being obtained throughout the depth of the layer being tested.

c. All final wearing surfaces, except open-graded asphalt friction course, shall be compacted using a minimum of 2 steel wheel tandem rollers. Pneumatic-tired rollers with smooth tread tires may be used after the breakdown roller and prior to finish rolling. Vibratory rollers must not be operated in vibratory mode during finish rolling on any mix type or pavement layer.

d. Rollers used to compact the mixture shall be in good condition and capable of reversing without backlash. The rollers shall be operated with the drive wheels nearest the paver and at uniform speeds slow enough to avoid displacement of the mixture. Steel wheel rollers shall be equipped with wetting devices to prevent the mixture from sticking to the roller wheels. Fuel oil shall not be used to moisten roller wheels.

e. All asphalt mixtures, except open-graded asphalt friction course and type SF 9.5A, shall be compacted to at least 92 percent of the mixtures maximum specific gravity. An SF 9.5A mixture shall be compacted to at least 90 percent of the mixtures maximum specific gravity.

f. Rolling for open-graded asphalt friction course shall consist of one coverage with a tandem steel wheel roller weighing a maximum of 10 tons, with additional rolling limited to one coverage with the roller where necessary to improve riding surface.

g. The use of rolling equipment that results in excessive crushing of the aggregate or excessive displacement of the mixture will not be permitted.

h. In areas inaccessible to standard rolling equipment, the mixture shall be thoroughly compacted by the use of hand tampers, hand operated mechanical tampers, or other approved equipment.

i. The tolerance of the final compacted pavement shall be within 1/4” of the typical cross-sections shown on the plans.

4. Joints:

a. Transverse Joints-

i. Transverse joints shall be constructed when the laying of the mixture is to be suspended long enough to permit the mixture to become cooled. At the end of each day's paving operation, the Contractor shall construct a sloped wedge ahead of the end of the full depth pavement to provide for proper compaction and protection of the full depth pavement. The Contractor shall place a paper parting strip beneath this wedge to facilitate joint construction, unless otherwise waived by the Engineers.

ii. Before paving operations are resumed, the Contractor shall remove the sloped wedge and cut back into the previously constructed pavement to the point of full pavement depth. The exposed edge of the previously constructed pavement shall then be lightly coated with tack coat.

iii. When laying of the mixture is resumed at the joint, the construction of the joint shall be completed while the mixture is still in a workable condition.

b. Longitudinal Joints-

i. The exposed edge of all longitudinal joints should be lightly coated with tack coat prior to placing the adjoining pavement.

ii. Longitudinal joints shall be formed by allowing the paver to deposit the mixture adjacent to the joint to such depth that maximum compaction can be obtained along the joint. The joint shall be pinched by rolling immediately behind the paver.

iii. When multi-lane multi-layer construction is required, the longitudinal joint in each layer shall offset that in the layer immediately below by approximately 6 inches. The joint in the top layer shall be constructed, where possible, between design travel lanes.

c. Placement of surface course material as the final layer of pavement should not be placed between November 15 and April 1 of the next year unless otherwise approved by the Engineer. In addition, open-graded asphalt friction course shall not be placed between October 31 and April 1, unless otherwise approved.

d. As an exception to the above, when in any day's operations the placement of a layer of asphalt base course material or intermediate course material 2 inches or greater in thickness has started, it may continue until the temperature drops to 32° F.

B. ASPHALT TACK COAT

1. Surface Preparation:

a. The surface to which the tack coat is to be applied shall be cleaned of dust, dirt, clay, and any other deleterious matter prior to placing the tack coat.

b. The Contractor shall remove grass, dirt and other materials from the edge of the existing pavement prior to the placement of tack coat.

2. Weather Limitations:

a. Tack shall be applied only when the surface to be treated is sufficiently dry and the atmospheric temperature in the shade away from artificial heat is 35° F or above.

b. Tack coat shall not be applied when the weather is foggy or rainy.

3. Application Rates and Temperatures:

a. Tack coat shall be uniformly applied at a rate from 0.04 to 0.08 gallons per square yard. The exact rate of application will be established by the Engineer and will be based on the volume of material at the actual application temperature. When tack coat is required beneath an open-graded asphalt friction course, an asphalt binder Grade PG 64-22 material shall be used. The exact rate of application will be specified on the job mix formula and will be within the range of 0.06 to 0.08 gallons per square yard.

b. The temperature of the material at the time of application shall be within the ranges shown in the table below:

Application Temperatures for Tack Coat

Asphalt Material	Temperature Range
Asphalt Binder, Grade PG 64-22	375 - 425°F
Emulsified Asphalt, Grade RS-1H, CRS-1, CRS-1H	90 - 150°F
Emulsified Asphalt, Grade HFMS-1	90 - 160°F
Emulsified Asphalt, Grade CRS-2	125 - 185°F

4. Application:

a. No more tack coat material shall be applied than can be covered with base, intermediate, or surface course during the following day's paving operations.

b. Tack coat material shall be uniformly applied to the entire surface utilizing an adjustable spray bar. Areas of tack coat application should be uniformly and completely covered.

c. Tack coat shall be applied only in the presence of and as directed by the Engineer. No base or surface mixture shall be deposited onto tacked the tacked pavement until the tack coat has sufficiently cured.

d. Contact surfaces of headers, curbs, gutters, manholes, vertical faces of old pavements, and all exposed transverse and longitudinal edges of each course shall be painted or sprayed with tack coat before new asphalt mixture is placed adjacent to such surfaces.

e. Bridge floors, curbs and handrails of structures, and all other appurtenances shall be covered to prevent tack coat from being tracked or splattered on the structures or appurtenances.

5. Protection:

a. Protect the tack coat after application until it has cured for a sufficient length of time to prevent it from being picked up by traffic.

b. Contractor shall take the necessary precautions to minimize tracking and/or accumulation of tack coat material on existing or newly constructed pavements. Corrective measures may be required in areas where an excessive accumulation of tack has occurred.

3.2 QUALITY CONTROL AND TESTING

A. SAMPLES AND TESTING

1. It will be the responsibility of the Owner to hire and pay for an independent testing agency to perform quality control testing during paving operations.

2. Density testing to verify compaction may be performed by either Nuclear density procedures or Core Sampling procedures, and will be designated by the Engineer.

3. Nuclear density testing shall be performed the same day the mix being tested is placed and compacted. Nuclear density tests must be performed at a frequency of no less than 1 test every 400 linear feet for each mix type and layer, with a minimum of 5 nuclear density readings on a given day's paving.

4. Core samples shall be 6 inches in diameter and obtained no later than the beginning of the next production day, not to exceed 3 calendar days. Core samples shall be tested and test results submitted to the Engineer within one working day from the time the cores are taken. Cores must be obtained at a minimum frequency of 1 core every 1000 linear feet for each mix type and layer, with a minimum of 3 cores obtained on a given day's paving.

5. Cores shall be obtained from the full layer depth of compacted pavement at random locations. Artificial methods may be utilized to cool the pavement layers to allow cutting the core samples as quickly as possible.

6. Where cores have been taken, clean the inside surfaces of the core hole, dry, apply tack coat, place and compact the same type asphalt mixture to conform with the surrounding area.

7. It will be the responsibility of the Contractor to perform sufficient testing at the plant to verify mix production is in accordance with the specified job mix formulas being used.

8. During mix production, samples of the asphalt mixture should be obtained at a minimum frequency of 1 sample every 750 tons produced, with a minimum of 1 sample for each day's production for each asphalt mixture produced. Each sample should be tested to determine binder content, gradation, and maximum specific gravity. As requested by the Engineer, additional tests may be performed to verify the volumetric properties of the asphalt mixture being produced. The Engineer may also request that the independent testing agency oversee the testing, or perform testing on additional samples.

B. SURFACE REQUIREMENTS

1. The surface of the plant mix base or pavement after compaction shall be smooth and true to the required cross section and grade. Any defective areas shall be corrected with satisfactory material which shall be immediately compacted to conform with the surrounding area. Any area showing an excess of asphalt cement shall be removed and replaced.

2. The surface will be tested by the Engineer at all joints and at other selected locations using a 10'-0" straightedge. The variation of the surface from the testing edge of the straightedge, when applied parallel to the centerline of the surface, shall not exceed 1/8" between any two contact points. Areas found to exceed this tolerance shall be corrected by the Contractor by removal of the defective work and replacement with new material unless other corrective measures are permitted by the Engineer. The work and materials required in the correction of defective work shall be provided by the Contractor at no cost.

3. The Contractor shall repaint and restripe any traffic markings that were damaged, removed or covered during construction. All work shall be done in accordance with NCDOT requirements and specifications. The cost of this work shall be included in the unit bid prices for other related work and no additional payment shall be made.

4. All existing manhole, inlet, and valve covers shall be raised by the Contractor as necessary prior to paving so that the tops of the covers are flush with the final surface. Any pavement left on covers shall be removed as necessary by the contractor. The cost of this work shall be included in the unit bid prices for other related work and no additional payment shall be made.

END OF SECTION

SECTION 321613

CONCRETE CURB AND GUTTER

PART 1 GENERAL

1.1 SCOPE OF WORK

The work covered by this section consists of the construction of Portland cement concrete curb/curb and gutter, in accordance with the requirements shown on the plans and the provisions of the specifications.

1.2 QUALITY ASSURANCE

Concrete curb/curb and gutter shall meet the requirements of Section 846-3 of the NCDOT Standard Specifications for Roads and Structures (latest edition). The requirements for horizontal and vertical alignment as indicated in the applicable sections of the Specifications shall be strictly adhered to.

PART 2 PRODUCTS

2.1 MATERIALS

A. Concrete shall be constructed in accordance with Section 03 30 00, except as otherwise provided herein. 4,000-PSI concrete shall be used. Prior to placing forms, the base or subgrade shall have been compacted to the degree required by the applicable section of these specifications. Concrete shall be air entrained with 5 to 7% air. Retarders and accelerators shall be used only as directed by the engineer.

B. Concrete curb/curb and gutter shall meet the requirements of Section 846-3 of the NCDOT Standard Specifications for Roads and Structures (latest edition). The requirements for horizontal and vertical alignment as indicated in the applicable sections of the Specifications shall be strictly adhered to.

PART 3 EXECUTION

3.1 INSTALLATION

A. FORMS

Forms shall be of such section and design that they will adequately support the concrete and any construction equipment used to construct the work. Straight forms shall be within a tolerance of 1/8” in 10’-0” from a true line horizontally and vertically. Form pins shall be metal and shall be capable of holding the forms rigidly in place during construction operations. The form sections shall be connected by a locking joint, which shall keep the forms free from vertical and horizontal movement. The Engineer shall have approved all forms before concrete is placed. Forms shall be clean, straight and true. The Engineer has the right to reject forms not properly placed, aligned or cleaned.

B. When the concrete will be machine placed the surface over which the machine will be operated will have been approved by the Engineer before placing concrete.

C. FINISHING

The concrete shall be given a light broom finish with the brush marks parallel to the curb line or gutter line.

D. CURBING

Curing shall be in accordance with Article 825-9 and Subarticle 700-14(b) of the above referenced NCDOT Specifications. Curing compounds shall be Type 2, white pigmented, in accordance with AASHTO M148 and applied in accordance with Article 420-17(c).

E. JOINTS

1. Joints shall be located as shown on the details except as otherwise provided herein. Where concrete is placed adjacent to Portland cement concrete pavement, the joints shall be located so as to line up with the joints in the concrete pavement.

2. Grooved contraction joints shall be formed by the use of templates or by other approved methods. Where templates do not form such joints, the groove shall be of the depth shown on the details.

3. Grooved butt joints shall be placed between the work and adjacent pavement except where expansion joints are required by the details.

4. All joints shall be hot pour sealed with rubber asphalt joint sealer meeting the requirements of AASHTO M173 except for joints in curb sections. In curb and gutter the joint sealer shall not be poured above the top surface of the gutter. Joints in gutter shall be filled with joint sealer to the top surface of the gutter. Joints shall be sealed before backfilling or other adjacent operations are performed. Joint sealer shall be in accordance with Article 928-2 of the above referenced NCDOT Specifications.

F. BACKFILLING

No earth backfill or pavement shall be placed adjacent to the curb and gutter until at least three curing days have elapsed. Backfill shall be compacted to a degree satisfactory to the Engineer.

G. OPENING TO TRAFFIC

Vehicles may be permitted on the completed work after seven curing days have elapsed. When high early strength concrete is used, vehicles will be permitted on the completed work after three curing days have elapsed.

3.2 QUALITY CONTROL & TESTING

A. All sampling and testing services shall be performed, at the Owners expense, by a testing agency which operates in accordance to ASTM D 3740 and E 329 latest edition and accepted by the Engineer.

B. The Contractor shall submit for review a design mix for each class of concrete proposed for use. An approved testing laboratory shall prepare the mix. Compressive strength of at least four (4) specimens of the design mix shall indicate 15% higher than 28-day strengths specified. During the work, the Contractor shall make 3 test cylinders for each 30 cubic yards, or fraction thereof, of concrete placed each day. One cylinder shall be tested at 7 days and the other two at 28 days in accordance with ASTM C 39. Copies of all test reports shall be furnished to the Engineer.

C. A slump test is to be performed at the same time the cylinders are pulled for each 30cy of concrete placed each day. Slump is to be 4" with a tolerance of +/- 1". Anything out of this range is to be approved by the engineer prior to placement

END OF SECTION

SECTION 321623

CONCRETE WALKS

PART 1 GENERAL

1.1 SCOPE OF WORK

A. The work covered by this section consists of the construction of Portland cement concrete sidewalks in accordance with the requirements shown on the plans and the provisions of these specifications.

PART 2 PRODUCTS

2.1 MATERIALS

A. Concrete shall be constructed in accordance with Section 03 30 00 and shall be given a sidewalk finish, except as otherwise provided herein. 4000 psi concrete shall be used.

PART 3 EXECUTION

3.1 INSTALLATION

A. Brooming of the concrete surface shall be done transverse to the direction of traffic. Joint spacing shall not be less than 5'-0". Where existing sidewalks are being widened, transverse joints shall be located so as to line up with existing joints in the adjacent sidewalk. Joints shall not be sealed.

B. Backfill shall be compacted to a degree comparable to the adjacent undisturbed material.

C. Vehicles may be permitted on the completed work after seven curing days have elapsed. When high early strength concrete is used, vehicles will be permitted on the completed work after three curing days have elapsed.

3.2 QUALITY CONTROL & TESTING

A. All sampling and testing services shall be performed, at the Owners expense, by a testing agency which operates in accordance to ASTM D 3740 and E 329 latest edition and accepted by the Engineer. Refer to section 03 11 00 for procedures.

END OF SECTION

SECTION 321723

PAVEMENT MARKINGS

PART 1 GENERAL

1.1 SCOPE OF WORK

A. PAINT

The work under this section shall consist of furnishing all labor, equipment, materials and services for the proper placement and installation of all pavement markings in accordance with the requirements shown on the plans and the provisions of these specifications.

B. THERMOPLASTIC PAVING MARKING

This specification covers a reflectorized pavement striping material of the type that is applied to a road surface in a molten state with premixed glass beads by spray or extrusion means, with a supplemental surface application of glass spheres. When applied properly and at the designated thickness and width the stripe shall, upon cooling, be reflectorized and be able to resist deformation by traffic. The applied material shall be impervious to degradation by motor oil, diesel fuel, grease deposits and ice-preventative chemicals.

1.2 DELIVERY, STORAGE, AND HANDLING

Contractor shall deliver paint to site in sealed and labeled containers. Upon Engineer's request, the Contractor shall make containers available for inspection to verify acceptance of product. Paint shall be stored at a minimum ambient temperature of 45°F and a maximum of 90°F, in well ventilated areas, unless required otherwise by manufacturer's instructions.

1.3 RELATED DOCUMENTS

All pavement markings shall be in accordance with the latest edition of the Manual of Uniform Traffic Control Devices (MUTCD) published by the Federal Highway Administration and the North Carolina Supplement to the MUTCD.

PART 2 PRODUCTS

2.1 MATERIALS

A. STANDARDS

The following are minimum requirements and shall govern except all local, state and/or federal highway or transportation department standard specifications shall govern when their requirements are in excess thereof.

B. PAINT

Paint shall be chlorinated rubber-alkyd type meeting the requirements of AASHTO M 248 (FS TT-P-ll5), Type III factory mixed, quick drying and non-bleeding.

C. THERMOPLASTIC MATERIALS

1. The thermoplastic pavement marking materials used in this contract shall meet the following specifications. This specification covers reflectorized oil and grease impervious thermoplastic road marking materials which are (1) hot extrusion applied with a surface application of glass spheres and (2) heat fused applied. The properly applied markings shall be reflectorized and able to durably resist degradation and deformation by traffic.

2. The thermoplastic materials shall be homogenously composed of pigment, filler, resins, and glass reflectorizing sphere and shall be available in both yellow and white.

3. Composition: The pigment, beads and filler shall be uniformly dispersed in the resin. The materials shall be free from all skins, dirt, and foreign objects and shall comply with requirements according to Table 1. Only new materials shall be acceptable for use on this project.

Table 1

COMPONENT	WHITE	YELLOW
Binder (see note A)	18.0% min	18.0% min
Glass Beads (AAASHTO M247 Type D)	30.0 - 40.0%	30.0 - 40.0%
Titanium Dioxide	10.0% min	----
Yellow Pigments	----	2.0% min
Calcium Carbonate	42.0% max	50.0% max

Note A: The alkyd binder shall consist of a mixture of synthetic resins (at least one of which is solid at room temperature) and a high boiling point plasticizer. At least one third of binder composition shall be solid maleic modified glycerol ester resin and shall be no less than 8% by eight of the entire material formulation. The alkyd binder shall not contain petroleum based hydrocarbon resins.

Note B: The percentage of yellow pigment can be reduced if lead pigments are eliminated from the formulation.

4. Specifications:

a. Temperature- The molten material temperature shall be between 400 and 440 F unless otherwise recommended by the manufacturer and approved by the Engineer.

b. Primer- A primer shall be used if thermoplastic is applied to Portland cement concrete. Any primer used shall be compatible with the thermoplastic material.

c. Thickness- The pavement markings shall yield a solid thickness range of 80 to 95 mils above the roadway surface across the middle two-thirds of the line width when tested as specified in MSMT 729.

d. Glass Beads- Glass beads shall be uniformly applied to the surface of the molten thermoplastic at the minimum rate of 7 to 9 lb./100ft/^{2} as specified in MSMT 729

e. Color- The color of the dry markings shall match Federal Standard 595 (13538-yellow or 17886-white). The Contractor shall supply the specified color chips for the Engineer's use to visually determine that the thermoplastic material matches the specified color.

f. Retro reflectance- The millicandela/lux/square meter values taken anytime within the first 30 days shall conform to the following:

Retroreflectance

COLOR	RETROREFLECTIVITY	CORRECTIVE ACTION
White	≥ 250	None
Yellow	≥ 150	
White	< 250	Necessary corrective actions including grinding and, if necessary, re-tracing
Yellow	< 150	

g. The "Drop-On" glass beads shall conform to AASHTO specifications M-247-81 except as follows:

Glass Bead Gradation

US SIEVE NUMBER	PERCENT PASSING
20	100
30	75-95
50	15-35
80	0-5
100	0

The "Drop-On" glass beads shall be smooth, clear and free from air inclusions. The beads shall have a minimum refractive index of 1.50 and shall be a minimum of 80% true spheres overall and minimum 70% true spheres on each sieve. The beads shall be moisture proof coated and shall meet the requirements of AASHTO M-247-81 Section 4.4.2 to insure optimum embedment of 60-65 percent (60-65%) in various thermoplastic traffic marking systems. The material shall set to bear traffic in not more than 2 minutes when the air temperature is 50

degrees F and not more than 10 minutes when the air temperature is 90 degrees F.

h. Bond Strength- After heating the thermoplastic material for four hours at 425 degrees F the bond strength to Portland Cement Concrete shall exceed 180 psi (1.24 Mpa Method ASTMD4796-88)

i. Cracking Resistance- For at least 90 days after application the materials shall show no cracks other than with substrate cracking.

j. Smear and Softening Resistance- During the life of the materials, the applied markings shall not smear or soften apart from substrate movement.

D. TRAFFIC AND LINE MARKINGS

1. Unless otherwise noted, paint for traffic and line markings shall be white in color.

2. Dimensions and spacing of markings shall be in accordance with MUTCD and as indicated in the pavement markings detail included in the contract drawings.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Contractor must insure that pavement surface to be painted shall be clean and dry before application. All surface contamination such as oil, grease, dirt, foreign matter, or other deleterious materials will be removed by the Contractor prior to application of paint.

3.2 INSTALLATION

A. PAINT

1. No paint shall be applied when the atmospheric, surface, or material temperature is less than 40°f or when the relative humidity is greater than 85%.

2. No paint shall be applied until the layout and placement has been verified by the Engineer.

3. Paint shall be applied with mechanical equipment to produce uniform straight edges in strict compliance with the manufacturer's instructions. Paint shall be applied in two (2) coats at the manufacturer's recommended rates.

B. THERMOPLASTIC PAVING MARKINGS

1. The molten applied thermoplastic material shall readily screed/extrude at temperatures between 400 degrees F and 440 degrees F from the approved equipment to produce a line which shall be continuous and uniform in shape having sharp dimensions. The application of additional glass beads by drop-on methods shall be at a minimum rate of 8 lbs. per 100 sq ft of marking. Ambient

and surface temperatures shall be at least 50 degrees F and rising at the time of application.

2. Method of Application

The Contractor shall furnish and install machine-applied extruded and/or sprayed hot thermoplastic with glass spheres (pre mixed and drop-on) in the proper ratio to immediately produce a highly reflective marking as described elsewhere in these specifications, in accordance with the details in this contract and the following provisions.

3. Primer-Sealer:

It shall be the responsibility of the contractor to recommend to the Engineer and obtain the Engineer's concurrence as to whether primer-sealer is required on a given pavement in order to meet the material manufacturer's warranty conditions. Generally, on all Portland Cement concrete pavement surfaces and aged asphalt-concrete pavements having less than eighty percent (80%) bituminous concrete, primer-sealer shall be applied to the area where the thermoplastic pavement markings are to be placed. Also, the Owner reserves the right to direct the Contractor to apply primer/sealer for any given markings. The primer/sealer shall be that recommended by the manufacturer of the thermoplastic material, and approved by the Engineer. The material shall form a continuous film which shall dry rapidly and adhere to the pavement. The material shall not discolor nor cause any noticeable change in the appearance of the pavement outside of the finished pavement markings. All solvents shall have evaporated from the primer/sealer prior to the application of the molten thermoplastic materials. A sample of the primer/sealer and the recommended method of application must be submitted to the Engineer, and shall have been approved by the Engineer and the manufacturer of the material before application. The Engineer has the authority to require the Contractor to apply the primer/sealer using a separate vehicle which may require additional traffic control. Payment for application of primer/sealer and any additional traffic control will be incidental to the marking item.

4. Removal of Existing Plastic or Pavement Markings

When called for in the contract or otherwise as directed by the Engineer, removal of existing painted or plastic pavement markings shall be accomplished by the Contractor using equipment sand methods specifically approved by the Engineer. Marking removal shall not be by the "painting out" with black paint method nor shall it result in excessive scarring of the pavement. No more than 1/8-inch depth of scarred pavement will be allowed. At least 90 percent of all markings shall be removed.

As directed by the Engineer, the Contractor shall be responsible for sweeping or otherwise adequately cleaning up debris after completion of markings required to be removed by the Engineer because they are improperly located or otherwise incorrect or improper. Unless permitted otherwise by the Engineer, where old markings are removed, the new markings must be applied the same day as the

old markings are removed. Whenever grinding, scraping, sandblasting, or other operations are performed, the work shall be conducted in such manner that the finished pavement surface is not damaged or left in a pattern that will mislead or misdirect motorists. When these operations are completed, the pavement markings shall be cleaned to remove residue and debris resulting from the cleaning work.

Where cleaning and/or removal of pavement paint striping or objectionable material is being performed within ten (10) feet of a lane occupied by traffic, the residue removal shall be by method(s) approved by the Engineer.

Any damage to the pavement or pavement joint materials caused by pavement marking removal shall be repaired by the Contractor at no cost to the Owner by methods acceptable to the Engineer.

5. Pre-marking of Lines

When a line is required to be placed in the same location as an existing painted line, and existing painted markings not required to be removed are visible, they shall be retraced (i.e. new markings installed in exactly the same locations, patterns, and dimensions as the old markings). However, if the existing markings are to be removed or are not visible, or if new roadway surface has been placed before markings installation occurs, or if the contract requires a line to be installed where none currently exists, the Contractor will be required to pre-mark as directed by the Engineer and subsequently shall install the required markings in accordance with the requirement of other sections of the specifications. The actual placement of the pavement markings at any such site shall not be performed until the pre-marking has been inspected and approved by the Engineer. Pre-marking is incidental to the pavement marking installation work and there will be no separate payment for pre-marking.

6. Traffic Maintenance

All work shall be performed in accordance with Part VI of the Manual on Uniform Traffic Control Devices (MUTCD) and section 104 of the MSHA Standard Specifications for Construction and Materials. The Contractor shall furnish and place all warning devices, flag persons, and other traffic control devices required to direct, control and protect the traveling public while marking operations are in progress. Maintenance of traffic for this work will be paid under the Maintenance of Traffic item if an item is included in the bid proposal, otherwise it will be considered incidental to the work.

3.3 WARRANTIES

A. THERMOPLASTIC PAVING MARKINGS

The Thermoplastic pavement marking materials and glass beads furnished under this contract shall assume the manufacturer's warranty for these materials and shall be guaranteed by the supplier against failure due to traffic oil degradation.

The contractor shall assume all costs arising from the use of patented materials, equipment, devices or processes used on or incorporated in the work, and agrees to indemnify and hold harmless the Owner and its duly authorized representatives from all suits at law or action of every nature for, or on account of, the use of any patented materials equipment, devices or processes. Further, the material shall meet the requirements of this specification for a period of one year.

END OF SECTION

SECTION 329113

SOIL PREPARATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes planting soils specified by composition of the mixes.

B. Related Requirements:

1. Section 311000 "Site Clearing" for topsoil stripping and stockpiling.
2. Section 329300 "Plants" for placing planting soil for plantings.

1.2 DEFINITIONS

A. AAPFCO: Association of American Plant Food Control Officials.

B. Backfill: The earth used to replace or the act of replacing earth in an excavation. This can be amended or unamended soil as indicated.

C. CEC: Cation exchange capacity.

D. Compost: The product resulting from the controlled biological decomposition of organic material that has been sanitized through the generation of heat and stabilized to the point that it is beneficial to plant growth.

E. Duff Layer: A surface layer of soil, typical of forested areas, that is composed of mostly decayed leaves, twigs, and detritus.

F. Imported Soil: Soil that is transported to Project site for use.

G. Layered Soil Assembly: A designed series of planting soils, layered on each other, that together produce an environment for plant growth.

H. Manufactured Soil: Soil produced by blending soils, sand, stabilized organic soil amendments, and other materials to produce planting soil.

I. NAPT: North American Proficiency Testing Program. An SSSA program to assist soil-, plant-, and water-testing laboratories through interlaboratory sample exchanges and statistical evaluation of analytical data.

J. Organic Matter: The total of organic materials in soil exclusive of undecayed plant and animal tissues, their partial decomposition products, and the soil biomass; also called "humus" or "soil organic matter."

K. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified as specified with soil amendments and perhaps fertilizers to produce a soil mixture best for

plant growth.

L. RCRA Metals: Hazardous metals identified by the EPA under the Resource Conservation and Recovery Act.

M. SSSA: Soil Science Society of America.

N. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

O. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.

P. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil"; but in disturbed areas such as urban environments, the surface soil can be subsoil.

Q. USCC: U.S. Composting Council.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include recommendations for application and use.
2. Include test data substantiating that products comply with requirements.
3. Include sieve analyses for aggregate materials.
4. Material Certificates: For each type of imported soil and soil amendment and fertilizer before delivery to the site, according to the following:

    a. Manufacturer's qualified testing agency's certified analysis of standard products.
    b. Analysis of fertilizers, by a qualified testing agency, made according to AAPFCO methods for testing and labeling and according to AAPFCO's SUIP #25.
    c. Analysis of nonstandard materials, by a qualified testing agency, made according to SSSA methods, where applicable.

B. Sustainable Design Submittals:

1. Third-Party Certifications: For each product.
2. Third-Party Certified Life Cycle Assessment: For each product.

C. Samples: For each bulk-supplied material, 1-quart volume of each in sealed containers labeled with content, source, and date obtained. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of composition, color, and texture.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For each testing agency.

B. Preconstruction Test Reports: For preconstruction soil analyses specified in "Preconstruction Testing" Article.

C. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent, state-operated, or university-operated laboratory; experienced in soil science, soil testing, and plant nutrition; with the experience and capability to conduct the testing indicated; and that specializes in types of tests to be performed.

1. Soil Testing Laboratory Qualifications: An independent laboratory, recognized by the North Carolina State Department of Agriculture, with experience and capabilities to conduct the testing indicated and that specializes in the types of test to be performed.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction soil analyses on existing, on-site soil.

1. Notify Architect seven days in advance of the dates and times when laboratory samples will be taken.

B. Preconstruction Soil Analyses: For each unamended soil type, perform testing on soil samples and furnish soil analysis and a written report containing soil-amendment and fertilizer recommendations by a qualified testing agency performing the testing according to "Soil-Sampling Requirements" and "Testing Requirements" articles.

1. Have testing agency identify and label samples and test reports according to sample collection and labeling requirements.

1.8 SOIL-SAMPLING REQUIREMENTS

A. General: Extract soil samples according to requirements in this article.

B. Sample Collection and Labeling: Have samples taken and labeled by soil classifier (CPSC) certified by SSSA under the direction of the testing agency.

1. Number and Location of Samples: Minimum of three representative soil samples from varied locations for each soil to be used or amended for landscaping purposes.
2. Procedures and Depth of Samples: According to USDA-NRCS's "Field Book for Describing and Sampling Soils."
3. Division of Samples: Split each sample into two, equal parts. Send half to the testing agency and half to Owner for its records.
4. Labeling: Label each sample with the date, location keyed to a site plan or other location

system, visible soil condition, and sampling depth.

1.9 TESTING REQUIREMENTS

A. General: Perform tests on soil samples according to requirements in this article.

B. Physical Testing:

1. Soil Texture: Soil-particle, size-distribution analysis by[one of] the following methods according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods":

   a. Sieving Method: Report sand-gradation percentages for very coarse, coarse, medium, fine, and very fine sand; and fragment-gradation (gravel) percentages for fine, medium, and coarse fragments; according to USDA sand and fragment sizes.
   b. Hydrometer Method: Report percentages of sand, silt, and clay.

2. Total Porosity: Calculate using particle density and bulk density according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
3. Water Retention: According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
4. Saturated Hydraulic Conductivity: According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods"; at 85% compaction according to ASTM D698 (Standard Proctor).

C. Chemical Testing:

1. CEC: Analysis by sodium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."
2. Clay Mineralogy: Analysis and estimated percentage of expandable clay minerals using CEC by ammonium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 1- Physical and Mineralogical Methods."
3. Metals Hazardous to Human Health: Test for presence and quantities of RCRA metals including aluminum, arsenic, barium, copper, cadmium, chromium, cobalt, lead, lithium, and vanadium. If RCRA metals are present, include recommendations for corrective action.
4. Phytotoxicity: Test for plant-available concentrations of phytotoxic minerals including aluminum, arsenic, barium, cadmium, chlorides, chromium, cobalt, copper, lead, lithium, mercury, nickel, selenium, silver, sodium, strontium, tin, titanium, vanadium, and zinc.

D. Fertility Testing: Soil-fertility analysis according to standard laboratory protocol of SSSA NAPT SERA-6, including the following:

1. Percentage of organic matter.
2. CEC, calcium percent of CEC, and magnesium percent of CEC.
3. Soil reaction (acidity/alkalinity pH value).
4. Buffered acidity or alkalinity.
5. Nitrogen ppm.
6. Phosphorous ppm.
7. Potassium ppm.
8. Manganese ppm.

9. Manganese-availability ppm.
10. Zinc ppm.
11. Zinc availability ppm.
12. Copper ppm.
13. Sodium ppm and sodium absorption ratio.
14. Soluble-salts ppm.
15. Presence and quantities of problem materials including salts and metals cited in the Standard protocol. If such problem materials are present, provide additional recommendations for corrective action.
16. Other deleterious materials, including their characteristics and content of each.

E. Organic-Matter Content: Analysis using loss-by-ignition method according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."

F. Recommendations: Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated to produce satisfactory planting soil suitable for healthy, viable plants indicated. Include, at a minimum, recommendations for nitrogen, phosphorous, and potassium fertilization, and for micronutrients.

1. Fertilizers and Soil Amendment Rates: State recommendations in weight per 1000 sq. ft. for 6-inchdepth of soil.
2. Soil Reaction: State the recommended liming rates for raising pH or sulfur for lowering pH according to the buffered acidity or buffered alkalinity in weight per 1000 sq. ft. for 6-inchdepth of soil.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and compliance with state and Federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Do not move or handle materials when they are wet or frozen.
4. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Regional Materials: Imported soil and soil amendments and fertilizers shall be manufactured within 500 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site. If materials are transported by rail or water, the distance transported by rail or water shall be multiplied by 0.25

to determine the distance to Project site.

2.2 PLANTING SOILS SPECIFIED BY COMPOSITION

A. General: Soil amendments, fertilizers, and rates of application specified in this article are guidelines that may need revision based on testing laboratory's recommendations after preconstruction soil analyses are performed.

1. Ratio of amendments as recommended by the required soil analysis.

B. Planting-Soil Type If surface soil is determined useable by soil testing: Existing, on-site surface soil, with the duff layer, if any, retained; and stockpiled on-site; modified to produce viable planting soil. Blend existing, on-site surface soil with the following soil amendments and fertilizers in the following quantities to produce planting soil:

1. Ratio of Loose Compost to Soil: 1:4 by volume.
2. Ratio of Loose Sphagnum Peat to Soil: 1:4 by volume.
3. Ratio of amendments as recommended by the required soil analysis.

C. Planting-Soil Type If soil test determans existing soils should not be used: Imported, naturally formed soil from off-site sources and consisting of sandy loam soil fertile, drainable according to USDA textures; and modified to produce viable planting soil.

1. Sources: Take imported, unamended soil from sources that are naturally well-drained sites where topsoil occurs at least 4 inches deep, not from agricultural land,bogs, or marshes; and that do not contain undesirable organisms; disease-causing plant pathogens; or obnoxious weeds and invasive plants including, but not limited to, quackgrass, Johnsongrass, poison ivy, nutsedge, nimblewill, Canada thistle, bindweed, bentgrass, wild garlic, ground ivy, perennial sorrel, and bromegrass.
2. Additional Properties of Imported Soil before Amending: Soil reaction of pH 6 to 7 and minimum of 4 percent organic-matter content, friable, and with sufficient structure to give good tilth and aeration.
3. Unacceptable Properties: Clean soil of the following:

    a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
    b. Unsuitable Materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand that exceed a combined maximum of 8 percent by dry weight of the imported soil.
    c. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding 2 inches in any dimension.

D. Planting-Soil Type If soils testing confirms this process is required: Manufactured soil consisting of manufacturer's basic topsoil, blended in a manufacturing facility with sand, stabilized organic soil amendments, and other materials to produce viable planting soil.

1. Additional Properties of Manufacturer's Basic Soil before Amending: Soil reaction of pH 6 to 7 and minimum of 4 percent organic-matter content, friable, and with sufficient structure to give good tilth and aeration.
2. Unacceptable Properties: Manufactured soil shall not contain the following:

a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
b. Unsuitable Materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand that exceed a combined maximum of 5 percent by dry weight of the manufactured soil.
c. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding 2 inches in any dimension.

2.3 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter produced by composting feedstock, and bearing USCC's "Seal of Testing Assurance," and as follows:

1. Reaction: pH of 5.5 to 8.
2. Soluble-Salt Concentration: Less than 4 dS/m.
3. Moisture Content: 35 to 55 percent by weight.
4. Organic-Matter Content: 30 to 40 percent of dry weight.
5. Particle Size: Minimum of 98 percent passing through a 1-inch sieve.

B. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, debris, and material harmful to plant growth.

2.4 FERTILIZERS

A. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

B. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: 1 lb/1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.

C. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.

PART 3 - EXECUTION

3.1 GENERAL

A. Place planting soil and fertilizers according to requirements in other Specification Sections.

B. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in planting soil.

C. Proceed with placement only after unsatisfactory conditions have been corrected.

3.2 PREPARATION OF UNAMENDED, ON-SITE SOIL BEFORE AMENDING

A. Excavation: Excavate soil from designated area(s) to a depth of 6 inches and stockpile until amended.

B. Unacceptable Materials: Clean soil of concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.

C. Unsuitable Materials: Clean soil to contain a maximum of 8 percent by dry weight of stones, roots, plants, sod, clay lumps, and pockets of coarse sand.

D. Screening: Pass unamended soil through a 2-inch sieve to remove large materials.

3.3 PLACING AND MIXING PLANTING SOIL OVER EXPOSED SUBGRADE

A. General: Apply and mix unamended soil with amendments on-site to produce required planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

B. Subgrade Preparation: Till subgrade to a minimum depth of 8 inches. Remove stones larger than 1-1/2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1. Apply, add soil amendments, and mix approximately half the thickness of unamended soil over prepared, loosened subgrade according to "Mixing" Paragraph below. Mix thoroughly into top 4 inches of subgrade. Spread remainder of planting soil.

C. Mixing: Spread unamended soil to total depth of 4 inches, but not less than required to meet finish grades after mixing with amendments and natural settlement. Do not spread if soil or subgrade is frozen, muddy, or excessively wet.

1. Amendments: Apply soil amendments, except compost, and fertilizer, if required, evenly on surface, and thoroughly blend them with unamended soil to produce planting soil.

a. Mix lime and sulfur with dry soil before mixing fertilizer.
b. Mix fertilizer with planting soil no more than seven days before planting.

2. Lifts: Apply and mix unamended soil and amendments in lifts not exceeding 8 inches in loose depth for material compacted by compaction equipment, and not more than 6 inches in loose depth for material compacted by hand-operated tampers.

D. Compaction: Compact each blended lift of planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D698 and tested in-place except where a different compaction value is indicated on Drawings.

E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.4 PLACING MANUFACTURED PLANTING SOIL OVER EXPOSED SUBGRADE

A. General: Apply manufactured soil on-site in its final, blended condition. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

B. Subgrade Preparation: Till subgrade to a minimum depth of 8 inches. Remove stones larger than 1-1/2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1. Apply approximately half the thickness of planting soil over prepared, loosened subgrade. Mix thoroughly into top 4 inches of subgrade. Spread remainder of planting soil.

C. Application: Spread planting soil to total depth of 8 inches, but not less than required to meet finish grades after natural settlement. Do not spread if soil or subgrade is frozen, muddy, or excessively wet.

1. Lifts: Apply planting soil in lifts not exceeding 4 inches in loose depth for material compacted by compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

D. Compaction: Compact each lift of planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D698 except where a different compaction value is indicated on Drawings.

E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.5 BLENDING PLANTING SOIL IN PLACE

A. General: Mix amendments with in-place, unamended soil to produce required planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

B. Preparation: Till unamended, existing soil in planting areas to a minimum depth of of 8 inches. Remove stones larger than 1-1/2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

C. Mixing: Apply soil amendments, except compost, and fertilizer, if required, evenly on surface, and thoroughly blend them into full depth of unamended, in-place soil to produce planting soil.

1. Mix lime and sulfur with dry soil before mixing fertilizer.

2. Mix fertilizer with planting soil no more than seven days before planting.

D. Compaction: Compact blended planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D698 except where a different compaction value is indicated on Drawings.

E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.6 APPLYING COMPOST TO SURFACE OF PLANTING SOIL

A. Application: Apply 4 inches of compost to surface of in-place planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

B. Finish Grading: Grade surface to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform the following tests and inspections:

1. Compaction: Test planting-soil compaction after placing each lift and at completion using a densitometer or soil-compaction meter calibrated to a reference test value based on laboratory testing according to ASTM D698. Space tests at no less than one for each 1000 sq. ft. of in-place soil or part thereof.

C. Soil will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Label each sample and test report with the date, location keyed to a site plan or other location system, visible conditions when and where sample was taken, and sampling depth.

3.8 PROTECTION

A. Protection Zone: Identify protection zones according to Section 015639 "Temporary Tree and Plant Protection."

B. Protect areas of in-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to perform planting operations:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Vehicle traffic.
4. Foot traffic.
5. Erection of sheds or structures.
6. Impoundment of water.

7. Excavation or other digging unless otherwise indicated.

C. If planting soil or subgrade is over compacted, disturbed, or contaminated by foreign or deleterious materials or liquids, remove the planting soil and contamination; restore the subgrade as directed by Architect and replace contaminated planting soil with new planting soil.

3.9 CLEANING

A. Protect areas adjacent to planting-soil preparation and placement areas from contamination. Keep adjacent paving and construction clean and work area in an orderly condition.

B. Remove surplus soil and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off Owner's property unless otherwise indicated.

1. Dispose of excess subsoil and unsuitable materials on-site where directed by Owner.

END OF SECTION 329113

SECTION 329300

PLANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plant materials.
2. Fertilizers.
3. Weed-control barriers.
4. Mulches.
5. Herbicides and pesticides.
6. Tree-stabilization materials.
7. Landscape edgings.

B. Related Requirements:

1. Section 015639 "Temporary Tree and Plant Protection" for protecting, trimming, pruning, repairing, and replacing existing trees to remain that interfere with, or are affected by, execution of the Work.
2. Section 311000 "Site Clearing".
3. Section 310000 "Earthwork".

1.2 COORDINATION

A. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.

1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Plant materials.
2. Fertilizers.
3. Weed-control barriers.
4. Mulches.
5. Herbicides and pesticides.

6. Tree-stabilization materials.
7. Landscape edgings.

B. Product Data Submittals: For each product.

1. Plant Materials: Include quantities, sizes, quality, and verified sources for plant materials.

C. Samples for Verification: Actual sample of finished products for each of the following:

1. Organic Mulch: 1-pint volume of each organic mulch required; typical of the lot of material to be furnished, in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Provide an accurate representation of color, texture, and organic makeup.
2. Mineral Mulch: 2 lb of each mineral mulch required; typical of the lot of material to be furnished, in sealed plastic bags labeled with source of mulch. Provide accurate indication of color, texture, and makeup.
3. Weed-Control Barrier: 12 by 12 inches.
4. Proprietary Root-Ball-Stabilization Device: One unit.
5. Slow-Release, Tree-Watering Device: One unit of each size required.
6. Edging Materials and Accessories: Manufacturer's standard size, to verify color selected.
7. Root Barrier: Width of panel by 12 inches.

1.5 INFORMATIONAL SUBMITTALS

A. Field Quality-Control Reports: Percolation tests for tree pits. Include the following:

1. Tree identification number matching the plans.
2. Date of test.
3. Time when water was added to tree pit to start percolation test.
4. Time with photo documentation showing increments of testing with water level in tree pit.
5. Identification of tester.

B. Qualification Statements: For landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.

C. Product Certificates: For each type of manufactured product, from manufacturer, and complying with manufacturer's certified analysis of standard products.

D. Pesticides and Herbicides: Product label and manufacturer's written application instructions specific to Project.

E. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before expiration of required maintenance periods.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in the successful establishment of plants.

1. Professional Membership: Member in good standing of either the National Association of Landscape Professionals or AmericanHort.
2. Experience: Three years' experience in landscape installation in addition to requirements in Section 014000 "Quality Requirements."
3. Installer's Field Supervision: Maintain an experienced full-time supervisor on Project site when work is in progress.
4. Personnel Certification: Installer's field supervisor certified in all of the following categories from the National Association of Landscape Professionals:

    a. Landscape Industry Certified Technician - Exterior.
    b. Landscape Industry Certified Interior.
    c. Landscape Industry Certified Horticultural Technician.

5. Pesticide Applicator: State licensed, commercial.

B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.

1. Selection of plants purchased under allowances is made by Architect, who tags plants at their place of growth before they are prepared for transplanting.

C. Measurements: Measure in accordance with ANSI Z60.1. Do not prune to obtain required sizes.

1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container-grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.
2. Other Plants: Measure with stems, petioles, and foliage in their normal position.

D. Plant Material Observation: Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Architect may also observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and may reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.

1. Notify Architect of sources of planting materials 14 days in advance of delivery to site.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, or walkways and pavements; or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk materials with appropriate certificates.

C. Deliver bare-root stock plants within 24 hours of digging. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting. Transport in covered, temperature-controlled vehicles, and keep plants cool and protected from sun and wind at all times.

D. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

E. Handle planting stock by root ball.

F. Store bulbs, corms, and tubers in a dry place at 60 to 65 deg F until planting.

G. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.

1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.

H. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.

I. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.

1. Heel-in bare-root stock. Soak roots that are in less than moist condition in water for two hours. Reject plants with dry roots.
2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
3. Do not remove container-grown stock from containers before time of planting.
4. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly wet condition.

1.9 FIELD CONDITIONS

A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.

B. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.

1. Spring Planting: March 1 to May 1.
2. Fall Planting: October 1 to December 1.

C. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions in accordance with manufacturer's written instructions and warranty requirements.

1.10 WARRANTY

A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner.
b. Structural failures, including plantings falling or blowing over.
c. Faulty performance of tree stabilization.
d. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Periods: From date of Substantial Completion.

a. Trees, Shrubs, Vines, and Ornamental Grasses: 12 months.
b. Ground Covers, Biennials, Perennials, and Other Plants: 12 months.
c. Annuals: Three months.

3. Include the following remedial actions as a minimum:

a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
c. A limit of one replacement of each plant is required except for losses or replacements due to failure to comply with requirements.
d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

PART 2 - PRODUCTS

2.1 PLANT MATERIALS

A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant List, Plant Schedule, or Plant Legend indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock,

densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

1. Trees with damaged, crooked, or multiple leaders; with tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); with crossing trunks; with cut-off limbs more than 3/4 inch in diameter; or with stem girdling roots are unacceptable.
2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.

B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Architect, with a proportionate increase in size of roots or balls.

C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which begins at root flare in accordance with ANSI Z60.1.

D. Labeling: Label at least one plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for plant.

E. If formal arrangements or consecutive order of plants is indicated on Drawings, select stock for uniform height and spread, and number the labels to ensure symmetry in planting.

F. Annuals and Biennials: Provide healthy, disease-free plants of species and variety shown or listed, with well-established root systems reaching to sides of the container to maintain a firm ball, but not with excessive root growth encircling the container. Provide only plants that are acclimated to outdoor conditions before delivery and that are in bud but are not yet in bloom.

2.2 FERTILIZERS

A. Granular Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition:

a. 0.75 lb/1000 sq. ft.3 percent of actual nitrogen, 4 percent phosphorous, and 3 percent potassium, by weight.
b. Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

B. Mycorrhizal Fungi: Dry, granular inoculant containing at least 5300 spores per lb of vesicular-arbuscular mycorrhizal fungi and 95 million spores per lb of ectomycorrhizal fungi, 33 percent hydrogel, and maximum of 5.5 percent inert material.

2.3 WEED-CONTROL BARRIERS

A. Nonwoven Geotextile Filter Fabric: Polypropylene or polyester fabric, 3 oz./sq. yd. minimum, composed of fibers inert to biological degradation and naturally resistant to chemicals, alkalis, and acids, formed into a stable network so that fibers retain their relative position.

B. Composite Fabric: Woven, needle-punched polypropylene substrate bonded to a nonwoven polypropylene fabric, 4.8 oz./sq. yd..

2.4 MULCHES

A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:

1. Type: Shredded hardwood.
2. Size Range: 3 inches maximum, 1/2 inch minimum.
3. Color: Natural.

B. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through a 1-inch sieve; soluble-salt content of 2 to 5 dS/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

1. Organic Matter Content: 50 to 60 percent of dry weight.
2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.

C. Mineral Mulch: Hard, durable stone, washed free of loam, sand, clay, and other foreign substances, of the following type, size range, and color:

2.5 HERBICIDES AND PESTICIDES

A. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

B. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

C. Pesticides: Registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended in writing by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

2.6 TREE-STABILIZATION MATERIALS

A. Trunk-Stabilization Materials:

1. Upright and Guy Stakes: Rough-sawn, sound, new hardwood, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal by length indicated, pointed at one end.
2. Wood Deadmen: Timbers measuring 8 inches in diameter and 48 inches long, treated with specified wood pressure-preservative treatment.
3. Flexible Ties: Wide rubber or elastic bands or straps of length required to reach stakes or turnbuckles.
4. Guys and Tie Wires: ASTM A641/A641M, Class 1, galvanized-steel wire, two-strand, twisted, 0.106 inch in diameter.
5. Tree-Tie Webbing: UV-resistant polypropylene or nylon webbing with brass grommets.

6. Guy Cables: Five-strand, 3/16-inch- diameter, galvanized-steel cable, with zinc-coated turnbuckles, a minimum of 3 inches long, with two 3/8-inch galvanized eyebolts.
7. Flags: Standard surveyor's plastic flagging tape, white, 6 inches long.

B. Root-Ball Stabilization Materials:

1. Upright Stakes and Horizontal Hold-Down: Rough-sawn, sound, new hardwood or softwood, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal by length indicated; stakes pointed at one end.
2. Wood Screws: ASME B18.6.1.

2.7 TREE-WATERING DEVICES

A. Watering Pipe: PVC pipe 4 inches in diameter, site-cut to length as required, and with snug-fitting removable cap.

2.8 MISCELLANEOUS PRODUCTS

A. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix in accordance with manufacturer's written instructions.

B. Planter Drainage Gravel: Washed, sound crushed stone or gravel complying with ASTM D448 for Size No. 8.

C. Planter Filter Fabric: Nonwoven geotextile manufactured for separation applications and made of polypropylene, polyolefin, or polyester fibers or combination of them.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive plants, with Installer present, for compliance with requirements and conditions affecting installation and performance of the Work.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Verify that plants and vehicles loaded with plants can travel to planting locations with adequate overhead clearance.
3. Suspend planting operations during periods of excessive soil moisture until moisture content reaches acceptable levels to attain required results.
4. Uniformly moisten excessively dry soil that is not workable or which is dusty.

B. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove soil and contamination as directed by Architect and replace with new planting soil.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Architect's acceptance of layout before excavating or planting. Make minor adjustments as required.

D. Lay out plants at locations directed by Architect. Stake locations of individual trees and shrubs and outline areas for multiple plantings.

3.3 PLANTING AREA ESTABLISHMENT

A. General: Prepare planting area for soil placement and mix planting soil in accordance with Section 329113 "Soil Preparation."

B. Placing Planting Soil: Place and mix planting soil in-place over exposed subgrade.

C. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

D. Application of Mycorrhizal Fungi: At time directed by Architect, broadcast dry product uniformly over prepared soil at application rate in accordance with manufacturer's written instructions.

3.4 EXCAVATION FOR TREES AND SHRUBS

A. Planting Pits and Trenches: Excavate circular planting pits.

1. Excavate planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are unacceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
2. Excavate approximately three times as wide as ball diameter for balled and burlapped stock.
3. Excavate at least 12 inches wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
4. Do not excavate deeper than depth of root ball, measured from the root flare to the bottom of root ball.
5. If area under the plant was initially dug too deep, add soil to raise it to correct level and thoroughly tamp the added soil to prevent settling.
6. Maintain angles of repose of adjacent materials to ensure stability. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
7. Maintain supervision of excavations during working hours.
8. Keep excavations covered or otherwise protected overnight.
9. If drain tile is indicated on Drawings or required under planting areas, excavate to top of

porous backfill over tile.

B. Backfill Soil: Subsoil and topsoil removed from excavations may be used as backfill soil unless otherwise indicated.

C. Obstructions: Notify Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.

1. Hardpan Layer: Drill 6-inch- diameter holes, 24 inches apart, into free-draining strata or to depth of 10 ft., whichever is less, and backfill with free-draining material.

D. Drainage: Notify Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.

E. Fill excavations with water and allow to percolate away before positioning trees and shrubs.

3.5 TREE, SHRUB, AND VINE PLANTING

A. Inspection: At time of planting, verify that root flare is visible at top of root ball in accordance with ANSI Z60.1. If root flare is not visible, remove soil in a level manner from root ball to where the top-most root emerges from the trunk. After soil removal to expose root flare, verify that root ball still meets size requirements.

B. Roots: Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.

C. Balled and Burlapped Stock: Set each plant plumb and in center of planting pit or trench with root flare 2 inches above adjacent finish grades.

1. Backfill: Planting soil as shown on plans. For trees, use excavated soil for backfill.
2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
4. Distribute granular fertilizer around each planting pit when pit is approximately one-half filled. Do not place in bottom of the hole.

    a. Quantity: Two per plant.

5. Continue backfilling process. Water again after placing and tamping final layer of soil.

D. Slopes: When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of root ball.

3.6 MECHANIZED TREE-SPADE PLANTING

A. Plant trees with approved mechanized tree spade at designated locations. Do not use tree

spade to move trees larger than maximum size allowed for similar field-grown, balled-and-burlapped, root-ball diameter in accordance with ANSI Z60.1, or trees larger than manufacturer's maximum size recommendation for tree spade being used, whichever is smaller.

B. Use same tree spade to excavate the planting hole as will be used to extract and transport the tree.

C. When extracting tree, center the trunk within the tree spade and move tree with solid ball of earth.

D. Cut exposed roots cleanly during transplanting operations.

E. Plant trees following procedures in "Tree, Shrub, and Vine Planting" Article.

F. Where possible, orient the tree in same direction as in its original location.

3.7 TREE, SHRUB, AND VINE PRUNING

A. Remove only dead, dying, or broken branches. Do not prune for shape.

B. Prune, thin, and shape trees, shrubs, and vines as directed by Architect.

C. Prune, thin, and shape trees, shrubs, and vines in accordance with standard professional horticultural and arboricultural practices. Unless otherwise indicated by Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.

D. Do not apply pruning paint to wounds.

3.8 INSTALLATION OF TREE-STABILIZATION MATERIALS

A. Trunk Stabilization by Upright Staking and Tying: Install trunk stabilization as follows unless otherwise indicated:

1. Upright Staking and Tying:

    a. Stake trees of 2- through 5-inch caliper. Stake trees of less than 2-inch caliper only as required to prevent wind tip out. Use a minimum of two stakes of length required to penetrate at least 18 inches below bottom of backfilled excavation and to extend one-third of trunk height above grade. Set vertical stakes and space to avoid penetrating root balls or root masses.
    b. Stake trees with two stakes for trees up to 12 ft. high and 2-1/2 inches or less in caliper; three stakes for trees less than 14 ft. high and up to 4 inches in caliper. Space stakes equally around trees.

2. Support trees with bands of flexible ties at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.
3. Support trees with two strands of tie wire, connected to the brass grommets of tree-tie webbing at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.

B. Trunk Stabilization by Staking and Guying: Install trunk stabilization as follows unless otherwise indicated on Drawings. Stake and guy trees more than 14 ft. in height and more than 3 inches in caliper unless otherwise indicated.

1. Site-Fabricated, Staking-and-Guying Method: Install no fewer than three guys spaced equally around tree.

a. Securely attach guys to stakes 30 inches long, driven to grade. Adjust spacing to avoid penetrating root balls or root masses. Provide turnbuckle for each guy wire and tighten securely.
b. For trees more than 6 inches in caliper, anchor guys to wood deadmen buried at least 36 inches below grade. Provide turnbuckle for each guy wire and tighten securely.
c. Support trees with bands of flexible ties at contact points with tree trunk and reaching to turnbuckle. Allow enough slack to avoid rigid restraint of tree.
d. Support trees with guy cable, connected to brass grommets of tree-tie webbing at contact points with tree trunk and reaching to turnbuckle. Allow enough slack to avoid rigid restraint of tree.
e. Attach flags to each guy wire, 30 inches above finish grade.
f. Paint turnbuckles with luminescent white paint.

2. Proprietary Staking and Guying Device: Install staking and guying system sized and positioned as recommended by manufacturer unless otherwise indicated and in accordance with manufacturer's written instructions.

C. Root-Ball Stabilization: Install at- or below-grade stabilization system to secure each new planting by root ball unless otherwise indicated.

1. Proprietary Root-Ball Stabilization Device: Install root-ball stabilization system sized and positioned as recommended by manufacturer unless otherwise indicated and in accordance with manufacturer's written instructions.

3.9 INSTALLATION OF ROOT BARRIER

A. Install root barrier where trees are planted within 60 inches of paving or other hardscape elements, such as walls, curbs, and walkways, unless otherwise indicated on Drawings.

B. Align root barrier vertically, and run it linearly along and adjacent to paving or other hardscape elements to be protected from invasive roots.

C. Install root barrier continuously for distance of 60 inches in each direction from tree trunk, for total distance of 10 ft. per tree. If trees are spaced closer, use single continuous piece of root barrier.

1. Position top of root barrier in accordance with manufacturer's written instructions.
2. Overlap root barrier minimum of 12 inches at joints.
3. Do not distort or bend root barrier during construction activities.
4. Do not install root barrier surrounding the root ball of tree.

3.10 PLACING SOIL IN PLANTERS

A. Place a layer of drainage gravel at least 4 inches thick in bottom of planter. Cover bottom with filter fabric and wrap filter fabric 4 inches up on all sides. Duct tape along the entire top edge of filter fabric, to secure filter fabric against the sides during soil-filling process.

B. Fill planter with planting soil as shown on drawings. Place soil in lightly compacted layers to elevation of 1-1/2 inches below top of planter, allowing natural settlement.

3.11 GROUND COVER AND PLANT PLANTING

A. Set out and space ground cover and plants other than trees, shrubs, and vines 18 inches apart in even rows with triangular spacing.

B. Use planting soil per soil analysis requirements for backfill.

C. Dig holes large enough to allow spreading of roots.

D. For rooted cutting plants supplied in flats, plant each in a manner that minimally disturbs the root system but to depth not less than two nodes.

E. Work soil around roots to eliminate air pockets and leave slight saucer indentation around plants to hold water.

F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.12 INSTALLATION OF MULCHES

A. Install weed-control barriers before mulching in accordance with manufacturer's written instructions. Completely cover area to be mulched, overlapping edges minimum of 6 inches, and secure seams with galvanized pins.

B. Mulch backfilled surfaces of planting areas and other areas indicated.

1. Trees and Treelike Shrubs in Turf Areas: Apply organic mulch ring of 3-inch average thickness, with 12-inch radius around trunks or stems. Do not create a mulch cone or place mulch within 3 inches of trunks or stems.
2. Organic Mulch in Planting Areas: Apply 3-inch average thickness of organic mulch extending 12 inches beyond edge of individual planting pit or trench and over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 3 inches of trunks or stems.

3.13 INSTALLATION OF LANDSCAPE EDGINGS

A. Steel Edging: Install steel edging where indicated in accordance with manufacturer's written instructions. Anchor with steel stakes spaced approximately 30 inches apart, driven below top elevation of edging.

3.14 APPLICATION OF HERBICIDES AND PESTICIDES

A. Pre-Emergent Herbicides (Selective and Nonselective): Apply to tree, shrub, and ground-cover areas in accordance with manufacturer's written instructions. Do not apply to seeded areas.

B. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written instructions.

C. Apply pesticides and other chemical products and biological control agents according to authorities having jurisdiction and in accordance with manufacturer's written instructions. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

3.15 PLANT MAINTENANCE

A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings.

B. Fill in, as necessary, soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.

C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices when possible to minimize use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

3.16 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:

1. Perform tree pit percolation tests.
2. Tree pit construction will be considered defective if it does not pass percolation tests and inspections.
3. Do not proceed with planting in tree pits until satisfactory percolation is demonstrated.

C. Prepare test and inspection reports.

3.17 REPAIR AND REPLACEMENT

A. Repair or replace existing or new trees and other plants that are damaged by construction operations, in a manner approved by Architect.

1. Submit details of proposed pruning and repairs.
2. Perform repairs of damaged trunks, branches, and roots within 24 hours, if approved.
3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Architect.

B. Remove and replace trees that are more than 25 percent dead or in unhealthy condition before end of corrections period or are damaged during construction operations that Architect determines are incapable of restoring to normal growth pattern.

1. Provide new trees of same size as those being replaced for each tree of 4 inches or smaller in caliper size.
2. Provide one new tree(s) of 4-inch caliper size for each tree being replaced that measures more than 4 inches in caliper size.
3. Species of Replacement Trees: Species selected by Architect.

3.18 CLEANING AND PROTECTION

A. During planting, keep adjacent paving and construction clean and work area in an orderly condition. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

C. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

D. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

E. At time of Substantial Completion, verify that tree-watering devices are in good working order and leave them in place. Replace improperly functioning devices.

END OF SECTION 329300