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Greenville Transportation Activity Center – Greenville, NC

Project Manual

Issue for Construction

May 10, 2016

Project Number L3005900

333 Fayetteville Street
Suite 1100
Raleigh, North Carolina 27601

P 919.334.3111
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Part 1 General

1.1 Design Professionals Of Record

A. Architect:

1. John A. Stevermer
2. License # 5858
3. Responsible for Divisions 01-49 Sections except where indicated as prepared by other design professionals of record.

B. HVAC/Plumbing Engineer:

1. Robert H. Unger
2. License # 24042
3. Responsible for Divisions 21- 23

C. Electrical Engineer:

1. Mark Willis
2. License # 025653
3. Responsible for Divisions 25-28

Part 2 Products

Not used.

Part 3 Execution

Not used.

END

Greenville Transportation and Activity Center
SPECIFICATIONS LIST

O = Original Issue
REV = Revised
Blank = Future Issue
DEL = Deleted

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000107	Seals Page	O				
000110	Specifications List	O				
000115	List of Drawings	O				
001113	Advertisement for Bids	O				
002113	Instructions to Bidders	O				
002513	Pre-Bid Meetings	O				
003126	Existing Hazardous Material and Removal Information	O				
003132	Geotechnical Data	O				
004113	Bid Form - Stipulated Sum Single-Prime Contract	O				
004313	Bid Security Forms	O				
004325	Substitution Request Form (During Procurement)	O				
005213	Owner-Contractor Agreement	O				
006000	Project Forms	O				
006113	Performance and Payment Bond Form	O				
006239	Disadvantaged Business Enterprise Program	O				
006276.13	Sales Tax Form	O				
008000	Supplementary Conditions	O				
008100	Special Conditions – FTA Terms & Conditions	O				
Division 01 - General Requirements						
010460	Chases, Openings and Inserts	O				
010490	Coordination Drawings	O				
011100	Summary of Work	O				
012200	Unit Prices	O				
012300	Alternates	O				
012513	Product Substitution Procedures	O				
012600	Modification Procedures	O				
012973	Schedule of Values	O				
012976	Application for Payment	O				
013100	Project Coordination	O				
013119	Project Meetings	O				
013200	Progress Reports	O				
013216	Construction Schedules	O				
013300	Submittals	O				
013329	Sustainability Requirements	O				
013410	Submittal Register	O				

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		Issue for Construction, May 10, 2016				
013543	Environmental Protection	O				
014100	Codes, Regulations and Standards	O				
014216	Definitions and Documentation Standards	O				
014523	Inspection and Testing Services	O				
014527	Inspection and Testing of Earthwork	O				
014533	Inspection and Testing of Cast-In-Place Concrete	O				
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014551	Inspection and Testing of Structural Steel	O				
014570	Inspection and Testing of Exterior Enclosure	O				
014571	Inspection and Testing of Roofing and Waterproofing	O				
014900	Methods and Means Engineering	O				
015200	Construction Facilities	O				
015700	Construction Pollution Controls	O				
016000	Material and Equipment	O				
016610	Testing and Balancing of Mechanical Systems	O				
017123	Field Engineering	O				
017329	Cutting and Patching	O				
017400	Warranties and Bonds	O				
017419	Construction Waste Management	O				
017423	Final Cleaning	O				
017700	Project Closeout	O				
017823	Operation and Maintenance Data	O				
017839	Project Record Documents	O				
018120	Construction Indoor Air Quality (IAQ) Management	O				
019113	General Commissioning Requirements	O				
Division 02 - Existing Conditions						
024116.13	Building Demolition	O				
Division 03 - Concrete						
031000	Concrete Formwork	O				
032000	Concrete Reinforcement	O				
032500	Concrete Accessories	O				
033000	Cast-In-Place Concrete	O				
033543	Polished Concrete Finishing	O				
Division 04 - Masonry						
042000	Unit Masonry	O				

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		Issue for Construction, May 10, 2016				
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055000	Metal Fabrications	O				
055213	Pipe and Tube Railings	O				
Division 06 - Wood, Plastic and Composites						
061000	Rough Carpentry	O				
061543	Cross Laminated Timber Panels	O				
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061800	Glue-Laminated Construction	O				
062000	Finish Carpentry	O				
064000	Architectural Woodwork	O				
Division 07 - Thermal and Moisture Protection						
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071352	Modified Bituminous Sheet Waterproofing	O				
072100	Thermal Insulation	O				
072600	Air/Vapor Barriers	O				
074233	Phenolic Wall Panels	O				
075000	Membrane Roofing (Single-Ply)	O				
076000	Flashing and Sheet Metal	O				
077200	Roof Accessories	O				
077210	Fall Arrest Roof Anchors	O				
078400	Firestopping	O				
079200	Joint Sealants	O				
Division 08 - Openings						
081113	Standard Hollow Metal Doors and Frames	O				
081400	Wood Doors	O				
081500	Fiberglass-Reinforced Plastic Doors	O				
083100	Access Doors and Panels	O				
084113	Aluminum Entrances and Storefronts	O				
084413	Glazed Aluminum Curtainwall	O				
087100	Door Hardware	O				
088000	Glazing	O				
088300	Mirrors	O				
089100	Louvers	O				

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		Issue for Construction, May 10, 2016				
Division 09 - Finishes						
092116	Gypsum Board Assemblies	O				
093013	Ceramic Tiling	O				
095100	Acoustical Ceilings	O				
096519	Resilient Tile Flooring	O				
096543	Linolium Flooring	O				
096813	Tile Carpeting	O				
099100	Painting	O				
099600	High Performance Coatings	O				
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101400	Exterior Signs	O				
101401	Interior Signs	O				
102113	Compact Laminate (Solid Phenolic) Toilet Compartments	O				
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104413	Fire Extinguishers and Cabinets	O				
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113113	Residential Kitchen Appliances	O				
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122113	Horizontal Louver Blinds	O				
124813	Entrance Mats and Frames	O				
129300	Site Furnishings and Structures	O				
Division 14 - Conveying Equipment						
142400	Machine Roomless Holesss Hydraulic Elevators	O				
Division 21 - Fire Suppression						
210517	Sleeves and Sleeve Seals for Fire-Suppression Piping	O				
210518	Escutcheons for Fire-Suppression Piping	O				
210523	General-Duty Valves for Water-Based Fire-Suppression Piping	O				
211100	Facility Fire-Suppression Water-Service Piping	O				
211313	Wet-Pipe Sprinkler Systems	O				
211316	Dry-Pipe Sprinkler Systems	O				

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		Issue for Construction, May 10, 2016				
Division 22 - Plumbing						
220513	Common Motor Requirements for Plumbing Equipment	O				
220517	Sleeves and Sleeve Seals for Plumbing Piping	O				
220518	Escutcheons for Plumbing Piping	O				
220519	Meters and Gages for Plumbing Piping	O				
220523	General-Duty Valves for Plumbing Piping	O				
220529	Hangers and Supports for Plumbing Piping and Equipment	O				
220553	Identification for Plumbing Piping and Equipment	O				
220716	Plumbing Equipment Insulation	O				
220719	Plumbing Piping Insulation	O				
220800	Commissioning of Plumbing Systems	O				
221113	Facility Water Distribution Piping	O				
221116	Domestic Water Piping	O				
221119	Domestic Water Piping Specialties	O				
221123	Domestic Water Pumps	O				
221313	Facility Sanitary Sewers	O				
221316	Sanitary Waste and Vent Piping	O				
221319	Sanitary Waste Piping Specialties	O				
221319.13	Sanitary Drains	O				
221413	Facility Storm Drainage Piping	O				
221423	Storm Drainage Piping Specialties	O				
221429	Sump Pumps	O				
223300	Electric, Domestic-Water Heaters	O				
224213.13	Commercial Water Closets	O				
224213.16	Commercial Urinals	O				
224216.13	Commercial Lavatories	O				
224216.16	Commercial Sinks	O				
224713	Drinking Fountains	O				
224723	Remote Water Coolers	O				
Division 23 - HVAC						
230513	Common Motor Requirements for HVAC Equipment	O				
230517	Sleeves and Sleeve Seals for HVAC Piping	O				
230518	Escutcheon for HVAC Piping	O				
230523	General-Duty Valves for HVAC Piping	O				
230529	Hangers and Supports for HVAC Piping and Equipment	O				
230553	Identification for HVAC Piping and Equipment	O				
230593	Testing, Adjusting, and Balancing for HVAC	O				
230713	Duct Insulation	O				
230800	Commissioning of Mechanical Systems	O				
230900	Instrumentation and Control for HVAC	O				
230901	Commissioning of Integrated Automation Systems	O				

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230993	Sequence of Operations for HVAC Controls	O				
232300	Refrigerant Piping	O				
233113	Metal Ducts	O				
233300	Air Duct Accessories	O				
233423	HVAC Power Ventilators	O				
233713	Diffusers, Registers, and Grilles	O				
234100	Particulate Air Filtration	O				
236200	Packaged Compressor and Condenser Units	O				
236313	Air-Cooled Refrigerant Condensers	O				
237433	Dedicated Outdoor-Air Units	O				
238219	Fan Coil Units	O				
238239	Unit Heaters	O				
Division 26 - Electrical						
260519	Low-Voltage Electrical Power Conductors and Cables	O				
260526	Grounding and Bonding for Electrical Systems	O				
260529	Hangers and Supports for Electrical Systems	O				
260533	Raceways and Boxes for Electrical Systems	O				
260543	Underground Ducts and Raceways for Electrical Systems	O				
260544	Sleeves and Sleeve Seals for Electrical Raceways and Cabling	O				
260553	Identification for Electrical Systems	O				
260572	Overcurrent Protective Device Short-Circuit Study	O				
260573	Overcurrent Protective Device Coordination Study	O				
260574	Overcurrent Protective Device Arc-Flash Study	O				
260800	Commissioning of Electrical Systems	O				
260913	Electrical Power Monitoring and Control	O				
260923	Lighting Control Devices	O				
260936	Modular Dimming Controls	O				
262416	Panelboards	O				
262713	Electricity Metering	O				
262726	Wiring Devices	O				
262813	Fuses	O				
262816	Enclosed Switches And Circuit Breakers	O				
265119	LED Interior Lighting	O				
265219	Emergency and Exit Lighting	O				
265613	Lighting Poles and Standards	O				
265619	Exterior Lighting	O				
Division 27 - Communications						
270000	Communications	O				
270526	Grounding and Bonding for Communications Systems	O				
270529	Hangers and Supports for Communications Systems	O				
270533	Conduits and Backboxes for Communications Systems	O				
270536	Cable Tray for Communications Systems	O				
270553	Identification for Communications Systems	O				

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		Issue for Construction, May 10, 2016				
270800	Commissioning of Communications	O				
271116	Communications Cabinets, Racks, Frames and Enclosures	O				
271119	Communications Termination Blocks and Patch Panels	O				
271519	Data Communications Horizontal Cabling	O				
271543	Communications Faceplates and Connectors	O				
275116	Public Address Systems	O				
Division 28 - Electronic Safety and Security						
280513	Conductors and Cables for Electronic Safety and Security	O				
281300	Access Control	O				
282300	Video Surveillance	O				
283111	Digital, Addressable Fire-Alarm System	O				
Division 31 - Earthwork						
312000	Earth Moving	O				
Division 32 - Exterior Improvements						
321216	Asphalt Paving	O				
321313	Concrete for Exterior Improvements	O				
321416	Brick Pavers, Mortar Bed	O				
321723	Pavement Markings	O				
329000	Planting	O				
Division 33 - Utilities						
331000	Water Utilities	O				
333000	Sanitary Sewerage Utilities	O				
334000	Storm Sewer Utilites	O				

END

Section 000115 List Of Drawings

For List of Drawings, refer to Sheet G-001. List of Drawings will be updated and issued with each Addendum and Bulletin.

END

Part 1 General

1.1 Project Information

A. Notice to Bidders: Qualified bidders may submit bids for project as described in this Document. Submit bids according to the Instructions to Bidders.

1. Regulatory Requirements: The General Statues of North Carolina, Section 143-128 et seq shall govern submittal, opening, and award of bids.

B. Project Identification: Greenville Transportation Activity Center.

1. Project Location:

a. Greenville Transportation Activity Center
600 South Pitt Street
Greenville, NC 27834

C. Owner: City of Greenville

1. Owner's Representative:

a. City of Greenville
Attn: Ken Jackson
Public Works Department
Telephone (252) 329-4522
1500 Beatty Street
Greenville, NC 278342
kjackson@greenvillenc.gov

D. Architect:

1. JACOBS

Attn: John WStevermer
Telephone: (919) 334-3115
333 Fayetteville Street
Suite 1100
Raleigh, NC 27601

E. Project Description:

1. Project consists of a new building, exterior canopies and related site work for the City of Greenville's Transportation Activity Center.

F. Construction Contract: Bids will be received for the following Work:

1. General Contract (all trades).

1.2 Bid Submittal And Opening

A. Owner will receive sealed lump sum bids until the bid time and date at the location given below. Owner will consider bids prepared in compliance with the Instructions to Bidders issued by Owner, and delivered as follows:

1. Bid Date: June 23, 2016.

2. Bid Time: 2:00 p.m., local time.

3. Location: Public Works Administrative Conference Room located at 1500 Beatty Street in Greenville, NC.

B. Bids will be thereafter publicly opened and read aloud.

1.3 Bid Security

A. Bid security shall be submitted with each bid in the amount of 5 percent of the bid amount. No bids may be withdrawn for a period of 90 days after opening of bids. Owner reserves the right to reject any and all bids and to waive informalities and irregularities.

1.4 Pre-Bid Meeting

A. Pre-Bid Meeting: See Document 002513 "Prebid Meetings."

1.5 Documents

A. Online Procurement and Contracting Documents: Obtain access to bid documents after May 4, 2016 by visiting. Digital copies of the Bidding Documents are available from Public Works Department website (www.greenvillenc.gov/government/financial-services/current-bid-opportunities) free of charge. The contract documents are also available for examination by the public at the plan room of the Carolina AGC (www.cagc.org); McGraw Hill Dodge (www.dodgeprojects.construction.com); QuestCDN (www.questcdn.com) and the Hispanic Contractors Association of the Carolinas (www.isqft.com).

1.6 Time Of Completion And Liquidated Damages

A. Successful bidder shall begin the Work on receipt of the Notice to Proceed and shall complete the Work within the Contract Time. Work is subject to liquidated damages.

1.7 Bidder's Qualifications

A. Bidders must be properly licensed under the laws governing their respective trades and be able to obtain insurance and bonds required for the Work. A Performance Bond, separate Labor and Material Payment Bond, and Insurance in a form acceptable to Owner will be required of the successful Bidder.

Part 2 Products

Not used.

Part 3 Execution

Not used.

END

Part 1 General

1.1 Basic Information

A. The following is a tabulation of basic bidding information for the convenience of Bidders. Where required, subjects are elaborated upon in this Section.

1. Project Name: Greenville Transportation Activity Center
2. Bids Due: June 23, 2016 by 2:00 PM.
3. Bids to be Addressed to: City of Greenville, Public Works Department, c/o Ken Jackson, 1500 Beatty Street, Greenville, NC 27834.
4. Bids to be Opened: Privately ☐ Publicly ☒.
5. Bids to be Submitted (quantity): One (1) copy.
6. Bid Form to be Used, Enclosed: ☒ Yes ☐ No.
7. Alternates: ☒ Yes ☐ No.
8. Unit Prices: ☒ Yes ☐ No.
9. Bid Security Required: ☒ Yes ☐ No; 5 percent (5%) of proposal Amount.
10. Performance Bond Required: ☒ Yes ☐ No.
11. Labor and Material Payment Bond Required: ☒ Yes ☐ No.
12. Bids Valid for: 60 calendar days from Bid opening.
13. Approximate Date of Start: September 01, 2015.
14. Time for Completion: work shall be completed in 365 calendar days.
15. Liquidated Damages: ☒ Yes ☐ No, except for bid security.
16. AIA Document A201, General Conditions of the Contract for Construction (General Contractor Type): ☒ Yes ☐ No.
17. Supplementary Conditions: ☒ Yes ☐ No.
18. Special Conditions: ☒ Yes ☐ No. – See FTA Terms and Conditions

19. Tax Exempt: ☐ Yes ☒ No.

20. Pre-Bid Conference:

    a. Date: May 19, 2016.
    b. Time: 2:00 PM
    c. Place: TBD.

21. Cut-off for bid questions:

    a. Date: June 10, 2016.
    b. Time: 5:00 PM

22. Selected List of Bidders: ☐ Yes ☒ No.

23. Inquiries - Person to Contact:

    a. Name: John A. Stevermer.
    b. Telephone Number: (919) 334-3115.

1.2 Definitions

A. Bidding Documents include the Advertisement for Bids, Instructions to Bidders, the Bid Form, other sample bidding and contract forms, and the proposed Contract Documents, including all Addenda issued prior to receipt of Bids. Contract Documents proposed for the Work consist of the Owner-Contractor Agreement, the Conditions of the Contract (General and other Conditions), the Drawings, the Specifications and all Addenda issued prior to and all Modifications issued after execution of the Contract.

B. All definitions set forth in AIA Document A201, General Conditions of the Contract for Construction, or in other Contract Documents, are applicable to the Bidding Documents.

C. Addenda are written or graphic instruments, issued by the Design Professional prior to the execution of the Contract, which modify or interpret the Bidding Documents by additions, deletions, clarifications or corrections.

D. A Bid is a complete and properly signed proposal to do the Work or designated portion thereof for the sums stipulated therein, submitted in accordance with the Bidding Documents.

E. Base Bid is the sum stated in the Bid for which the Bidder offers to perform the Work described in the Bidding Documents as the base, to which work may be added or from which work may be deleted, for sums stated in Alternate Bids.

F. An Alternate Bid (or Alternate) is an amount stated in the Bid to be added to or deducted from the amount of the Base Bid if the corresponding change in the Work, as described in the Bidding Documents, is accepted.

G. A Unit Price is an amount stated in the Bid as a price per unit of measurement for materials or services as described in the Bidding Documents or in the proposed Contract Documents.

H. A Bidder is a person or entity who submits a Bid.

I. A Sub-bidder is a person or entity who submits a Bid to a Bidder for materials or labor for a portion of the Work.

1.3 Bidder's Representations

A. Each Bidder, by making his Bid, represents that:

1. Reading and understanding the Bidding Documents and the Bid is made in accordance therewith.

2. Visiting the Project Site, becoming familiar with the local conditions under which the Work is to be performed, and correlating site observations with the requirements of the proposed Contract Documents.

3. Bid is based upon the materials, systems and equipment required by the Bidding Documents, without exception.

B. Owner assumes no responsibility for any misunderstanding or representation concerning the nature of the Work or the general and local conditions made by any of its officers, agents, or employees unless committed to writing in the Contract Documents or referred to in the Agreement.

1.4 Bidding Documents

A. Copies:

1. Bidders may obtain complete sets of the Bidding Documents from the website designated in the Invitation to Bid.

2. Bidding Documents will not be issued directly to Sub-bidders or others unless specifically offered in the Invitation to Bid.

3. Bidders shall use complete sets of Bidding Documents in preparing Bids. Neither the Owner nor the Design Professional assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

4. Owner or Design Professional, in making copies of the Bidding Documents available on the above terms, does so only for the purpose of obtaining Bids on the Work and does not confer a license or grant for any other use.

5. Title to all Bid Documents shall remain with the Owner.

B. Interpretation or Correction of Bidding Documents:

1. Bidders shall promptly notify the Design Professional of ambiguity, inconsistency or error which they may discover upon examination of the Bidding Documents or of the site and local conditions.

2. Bidders requiring clarification or interpretation of the Bidding Documents shall make a written request which shall reach the Design Professional at least seven (7) days prior to the date for receipt of Bids.

3. Any interpretation, correction or change of the Bidding Documents will be made by Addendum. Interpretations, corrections or changes of the Bidding Documents made in any other manner will not be binding, and Bidders shall not rely upon such interpretations, corrections and changes.

C. Substitutions:

1. 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.

2. Requests for Substitutions shall meet the requirements of Division 01.

3. If substitutions are approved prior to receipt of Bids, such approval will be set forth in an Addendum. Bidders shall not rely upon approvals made in any other manner.

D. Addenda:

1. Addenda will be emailed to all persons or entities who are known to have received a complete set of Bidding Documents.

2. Copies of Addenda will be made available for inspection wherever Bidding Documents are on file for that purpose.

3. No Addenda will be issued later than four (4) 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.

4. Each Bidder shall ascertain prior to submitting his Bid that he has received all Addenda issued, and he shall acknowledge their receipt in his Bid.

1.5 Bidding Procedures

A. Form and Style of Bids:

1. Submit Bids on forms provided within this manual. See Bid Form: Section 004113.

2. Fill in blanks on the bid form by typewriter or manually in ink.

3. Where so indicated by the makeup of the bid form, express sums in both words and figures, and, in case of discrepancy between the two, the amount written in words shall govern.

4. Any interlineation, alteration or erasure must be initialed by the signer of the Bid.

5. All requested Alternates shall be bid. If no change in the Base Bid is required, enter "No Change."

6. Each copy of the Bid shall include the legal name of the Bidder and a statement that the Bidder is a sole proprietor, a partnership, a corporation, or some other legal entity. Each copy shall be signed by the person or persons legally authorized to bind the Bidder to a Contract. A Bid by a corporation shall further give 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.

7. Bids shall not contain any conditions or qualifications whatsoever.

B. Bid Security:

1. Each Bid shall be accompanied by a bid security in an amount equal to five (5) percent of the Bid, pledging that the Bidder will enter into a Contract with the Owner on the terms stated in his Bid, and will furnish bonds as described herein covering the faithful performance of the Contract and the 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.

2. If a surety bond is required, it shall be written on AIA Document A310, Bid Bond, and the attorney-in-fact who executes the bond on behalf of the surety shall affix to the bond a certified and current copy of his power-of-attorney.

3. Owner will have the right to retain the Bid Security of Bidders to whom an award is being considered until either (a) the Contract has been executed and bonds, if required, furnished, or (b) the specified time has elapsed so that Bids may be withdrawn, or (c) all Bids have been rejected.

C. Submission of Bids:

1. All copies of the Bid, the Bid Security, if any, and other documents required to be submitted with the Bid shall be enclosed in a sealed opaque envelope. Address the envelope to the party receiving the Bids and identify it 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, enclose the sealed envelope in a separate mailing envelope with the notation "SEALED BID ENCLOSED" on the face thereof.

2. Deposit Bids at the designated location prior to the time and date for receipt of Bids indicated in the Invitation to Bid, or any extension thereof made by Addendum. Bids received after the time and date for receipt of Bids will not be accepted.

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

4. Oral, telephonic, telegraphic or electronic Bids are invalid and will not receive consideration.

D. Modification or Withdrawal of Bid:

1. A Bid may not be modified, withdrawn or canceled by the Bidder after the time and date designated for the receipt of Bids, and each Bidder so agrees in submitting his Bid.

2. Prior to the time and date designated for receipt of Bids, any Bid submitted may be modified or withdrawn by notice to the party receiving Bids at the place designated for receipt of Bids. Such notice shall be in writing over the signature of the Bidder or by telegram. If by telegram, written confirmation over the signature of the Bidder shall be mailed and postmarked on or before the date and time set for receipt of Bids and so worded as not to reveal the amount of the original Bid.

3. Withdrawn Bids may be resubmitted up to the time designated for the receipt of Bids provided that they are then fully in conformance with these Instructions to Bidders.

4. Bid Security shall be in an amount sufficient for the Bid as modified or resubmitted.

1.6 Consideration Of Bids

A. Opening of Bids:

1. Properly identified Bids received on time will be opened publicly.

B. Rejection of Bids:

1. Owner has the right to reject any or all Bids and to reject a Bid not accompanied by any required bid security or by other data required by the Bidding Documents, or to reject a Bid which is in any way incomplete or irregular.

C. Acceptance of Bid (Award):

1. It is the intent of the Owner to award a Contract to the lowest responsible Bidder provided that the Bid has been submitted in accordance with the requirements of the Bidding Documents and does not exceed the funds available. Owner has the right to waive any informality or irregularity in any Bid or Bids received and to accept the Bid which, in his judgment, is in his own best interests.

2. Owner has the right to accept Alternates in any order or combination, unless otherwise expressly provided for, and to determine the low Bidder on the basis of the sum of the Base Bid and the Alternates accepted.

1.7 Post-Bid Information

A. Contractor's Qualification Statement:

1. Bidders to whom award of a Contract is under consideration shall submit, upon request, a properly executed Contractor's Qualification Statement unless such a Statement has been previously required and submitted as a prerequisite to the issuance of Bidding Documents.

B. Disadvantaged Business Enterprise (DBE) Program:

1. See DBE Program: Division 01.

C. Submittals:

1. See Division 01 for time allocations and information to be submitted after Award of Contract.

1.8 Bonds

A. Bond Requirements:

1. Prior to execution of the Contract, if required herein, the Bidder shall furnish bonds covering the faithful performance of the Contract and the payment of all obligations arising thereunder in such form and amount as Owner may prescribe. Bonds may be secured through the Bidder's usual sources. Unless stipulated otherwise, the cost of furnishing such bonds shall be included in the Bid.

2. If the Owner has reserved the right to require that bonds be furnished subsequent to the execution of the Contract, adjust the cost as provided in the Contract Documents.

3. If the Owner requires that bonds be obtained from other than the Bidder's usual source, any change in cost will be adjusted as provided in the Contract Documents.

B. Time of Delivery and Form of Bonds:

1. Bidder shall deliver the required bonds to the Owner not later than the date of execution of the Contract or, if the Work is to be commenced prior thereto, in response to a Letter of Intent. Bidder shall, prior to commencement of the Work, submit evidence satisfactory to the Owner that such bonds will be furnished.

2. See Bidding and Contract Requirements: Section 006000 for forms of bonds to be used.

3. Bidder shall require the attorney-in-fact who executes the required bonds on behalf of the surety to affix thereto a certified and current copy of his power-of-attorney.

1.9 Insurance Certificates

A. Successful Bidder will not be permitted to start any Work under this Contract until he has submitted certificates covering all insurance required and has obtained approval in writing of these certificates from Owner.

Part 2 Products

Not used.

Part 3 Execution

Not used.

END

Part 1 General

1.1 Pre-Bid Meeting

A. A Pre-Bid meeting will be held as indicated below:

1. Meeting Date: May 19, 2016.
2. Meeting Time: 2:00 p.m**.** local time.
3. Location: Room 337 of the Greenville City Hall located at 200 West Fifth Street, Greenville, NC, 27834.

B. Attendance:

1. Prime Bidders: Attendance at Pre-Bid meeting is not mandatory but recommended.
2. Subcontractors: Attendance at Pre-Bid meeting is recommended.
   a. Notice: Bids will only be accepted from prime bidders represented on Pre-Bid Meeting sign-in sheet.

C. Bidder Questions: Submit written questions to be addressed at Pre-Bid meeting minimum of two (2) business days prior to meeting.

D. Agenda: Pre-Bid meeting agenda will include review of topics that may affect proper preparation and submittal of Bids, including the following:

1. Procurement and Contracting Requirements:
   a. Advertisement for Bids.
   b. Instructions to Bidders.
   c. Bidder Qualifications.
   d. Bonding.
   e. Insurance.
   f. Bid Security.
   g. DBE Requirements
   h. Bid Form and Attachments.
   i. Bid Submittal Requirements.
   j. Bid Submittal Checklist.
   k. Notice of Award.
2. Communication during Bidding Period:
   a. Obtaining documents.
   b. Access to Project Web site.

c. Bidder's Requests for Information.
d. Bidder's Substitution Request/Prior Approval Request.
e. Addenda.

3. Contracting Requirements:

a. Agreement.
b. The General Conditions.
c. Other Owner requirements.

4. Construction Documents:

a. Scopes of Work.
b. Temporary Facilities.
c. Use of Site.
d. Work Restrictions.
e. Alternates, Allowances, and Unit Prices.
f. Substitutions following award.

5. Separate Contracts:

a. Work by Owner.
b. Work of Other Contracts.

6. Schedule:

a. Project Schedule.
b. Contract Time.
c. Liquidated Damages.
d. Other Bidder Questions.

7. Site/facility visit.

8. Post-Meeting Addendum.

E. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes to attendees. Minutes of meeting are issued as Available Information and do not constitute a modification to the Procurement and Contracting Documents. Modifications to the Procurement and Contracting Documents are issued by written Addendum only.

1. Sign-in Sheet: Minutes will include list of meeting attendees.

2. List of Planholders: Minutes will include list of known planholders.

Part 2 Products

Not used.

Part 3 Execution

Not used.

END

Part 1 General

1.1 Existing Hazardous Material Information

A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information, but are not a warranty of existing conditions. This Document and its attachments are not part of the Contract Documents.

B. An existing asbestos reports for Project, prepared by Enviro Assessments East, Inc., dated April 29, 2016 for the properties located at 410 Bonners Lane, 400 Bonners Lane (600,602 Pitt Street), 616 Pitt Street and 618 Pitt Street are appended to this Section.

C. Related Requirements:

1. Applicable Sections: Division 00.

2. Building Demolition: Division 02.

1.2 Abatement Of Asbestos Materials

A. Contractor shall furnish all labor, materials, services, permits, equipment, utility and transportation services required and necessary for the removal, transportation and disposal of asbestos containing materials (ACMs) and asbestos contaminated materials. All work to be completed in strict conformance with the OSHA Asbestos Construction Regulation (29 CFR 1926.1101.)

B. The contractor shall prepare and submit an abatement plan with methods and procedures covering each of the identified abatement areas.

1. All procedures used must provide containment of asbestos debris and not allow airborne contamination of adjacent areas.

2. Contractor is solely responsible for preparing all necessary regulatory notifications to meet the time schedule.

3. Contractor shall provide the procedure to be followed for handling waste on removal, packaging, transportation and disposal at an approved public asbestos waste disposal site meeting the requirements of CFR 40, Part 61, Subparts A and M.

4. Contractor shall submit material safety data sheets (MSDS) and manufacturers' literature for all products intended for use in abatement process.

C. Upon completion of the abatement work, the Contractor shall prepare and submit containing the following:

1. Copies of all notifications or permits received from Federal, State and local agencies for the project.
2. A copy of the signed waste manifests indicating the place, time and exact quantity of asbestos received by an approved landfill.
3. A description of any and all problems encountered during the work.
4. A copy of the log maintain at the jobsite throughout the work.
5. A copy of the log of any air monitoring performed by the Contractor, and the lab's analysis, including the location and credentials of the laboratory performing the analysis.
6. The name, title and signature of the person who prepared the report.

Part 2 Products

Not used.

Part 3 Execution

Not used.

END

Asbestos Inspection Report for:

City of Greenville
Vacant Concrete Pad @
410 Bonners Lane
Greenville, NC 27858

Prepared For:
City of Greenville
1500 Beatty Street – Greenville, NC 27858

Prepared By:
Enviro Assessments East, Inc.
10705 Hwy 55 West – Dover, NC 28526
(NC Asbestos Inspector: Jason T. Simpson, # 12882)

Enviro Assessments East, Inc.

Asbestos-Lead-Mold Inspections & Abatement

10705 Hwy 55 West
Dover, NC 28526
Phone (252) 527-3052
FAX (252) 527-3055
Email Josh@eae-inc.com
www.eae-inc.com

Inspection # - ASB16-0429-02

Friday, April 29, 2016

Mr. Devin Thompson
Building and Grounds Supervisor
City of Greenville
1500 Beatty Street
Greenville, NC 27834

Reference: Asbestos Inspection Report
410 Bonners Lane – Vacant Concrete Pad.
Greenville, NC 27858

Dear Mr. Thompson,

Enviro Assessments East, Inc. (EAE, Inc.) has completed the Asbestos Survey of the Property located at 410 Bonners Lane in Greenville, NC. This is a concrete pad that sits to the rear of the building where 400 Bonners Lane is located. We are pleased to provide you with this report, and if there are any questions please let us know.

Description of Services

An Asbestos Survey was performed on April 27th, 2016 by NC Licensed inspector Jason T. Simpson (NC Inspector # 12882). The inspection was conducted in general accordance with the U.S. Environmental Protection Agency requirements and in General accordance with the North Carolina Health Hazards Control Unit. This inspection was performed in preparation for the demolition of the concrete pad located on site.

Inspection Process

EAE, Inc. began the survey by determining homogeneous areas within each structure. Those areas are defined as having suspect materials that are alike based upon location, material type, color, texture, and time period of installation. Representative bulk samples were collected of each homogeneous area of each structure.

As required a minimum of 2 samples were taken of each material. These account for a total of 4 Bulk samples taken for analysis and 4 additional layers separated by the lab for a total of 8 Samples. All samples were double bagged and sent along with a chain of Custody (Attached) to a National Voluntary Laboratory Accreditation Program (NVLAP) approved laboratory for analysis. The samples were analyzed using Polarized Light Microscopy (PLM).

Results and Recommendations

Of the 8 total samples analyzed, 8 were found to contain asbestos. It is required that these materials be properly abated prior to disturbance by renovation activities or demolition. Please see the table below for a description of materials found to contain asbestos.

Sample #	Material Type	Location	% Asbestos	Quantity
1,2	Floor Tile & Mastic	On Right Side of Pad. (Green)	2-5% Chrysotile	Approx. 820 SF
3,4	Floor Tile & Mastic	On Right Side of Pad. (Red)	3-5% Chrysotile	Approx. 820 SF

- **All square footages area approximate and should be verified by the contractor before bidding.**

Limitations

To the best of my knowledge, no other asbestos containing materials were found that were sampled in this survey. Before a building is to be renovated of demolished, all asbestos material that will be disturbed should be removed by a North Carolina State Licensed Asbestos Contractor using only licensed workers and supervisors.

If during demolition or remodeling any other suspect asbestos material is discovered, stop work immediately and test those materials for asbestos.

Sincerely,

William S. Lane Jr., President
Enviro Assessments East, Inc.

NC Asbestos Inspection # 12021
NC Asbestos Supervisor # 33514
NC General Contracting # 60742
NC Lead Firm # FPB-0292
NC RRP # RRP-0943
NC Lead Supervisor # 130279
VA & SC License upon Request

Sincerely,

Jason T. Simpson, Estimator/PM
Enviro Assessments East, Inc.

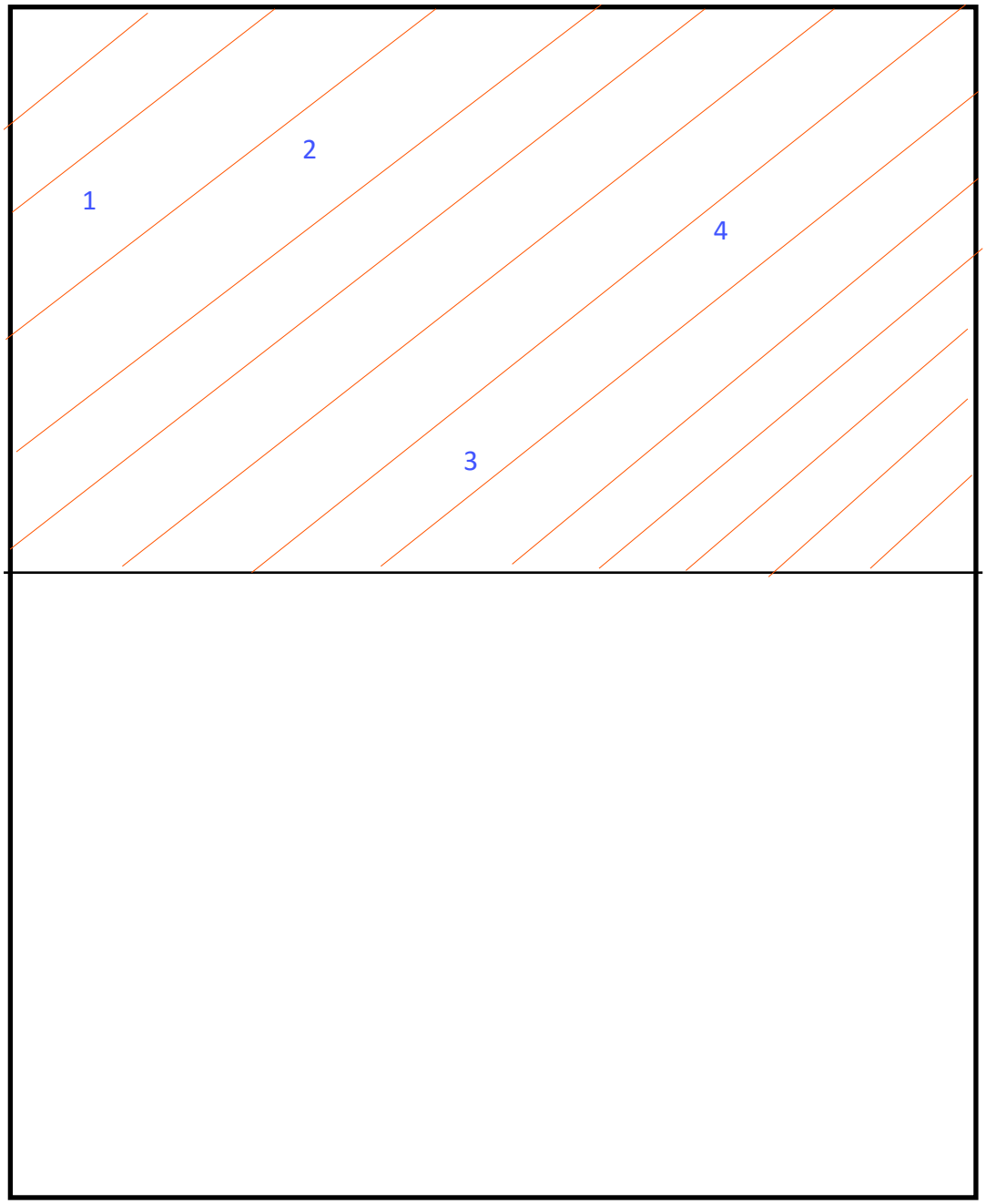
NC Asbestos Inspector # 12882
NC Asbestos Supervisor # 34329

Attachment I

410 Bonners Lane - (Concrete Pad)

LEGEND

Orange: Tile Area
Blue: Positive Asbestos Sample Location
Red: Negative Asbestos Sample Location



Bonners Lane

Attachment II

410 Bonners Lane – Asbestos Containing Materials.

Remaining floor tile on the right side of the empty concrete pad.

Attachment III

EMSL Analytical, Inc.

2500 Gateway Centre Blvd., Suite 600 Morrisville, NC 27560
Tel/Fax: (919) 465-3900 / (919) 465-3950
http://www.EMSL.com / raleighlab@emsl.com

EMSL Order: 291602721
Customer ID: EVAS42
Customer PO:
Project ID:

Attention: Sammy Lane
Enviro Assessments
10705 Hwy 55 W.
Dover, NC 28526

Phone: (252) 527-3052
Fax: (252) 527-3055
Received Date: 04/28/2016 10:00 AM
Analysis Date: 04/28/2016
Collected Date: 04/27/2016

Project: City of Greenville, Concrete Pad @ 410 Bonners Lane, Greenville, NC 27858

Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

			Non-Asbestos		Asbestos
Sample	**Description**	**Appearance**	**% Fibrous**	**% Non-Fibrous**	**% Type**
1-Floor Tile 291602721-0001	T/O Right Side - FT/Mastic	Green Fibrous Homogeneous		95% Non-fibrous (Other)	5% Chrysotile
1-Mastic 291602721-0001A	T/O Right Side - FT/Mastic	Black Fibrous Homogeneous	2% Cellulose	95% Non-fibrous (Other)	3% Chrysotile
2-Floor Tile 291602721-0002	T/O Right Side - FT/Mastic	Green Fibrous Homogeneous		97% Non-fibrous (Other)	3% Chrysotile
2-Mastic 291602721-0002A	T/O Right Side - FT/Mastic	Black Fibrous Homogeneous	3% Cellulose	95% Non-fibrous (Other)	2% Chrysotile
3-Floor Tile 291602721-0003	T/O Right Side - FT/Mastic	Red Fibrous Homogeneous		95% Non-fibrous (Other)	5% Chrysotile
3-Mastic 291602721-0003A	T/O Right Side - FT/Mastic	Black Fibrous Homogeneous	3% Cellulose	94% Non-fibrous (Other)	3% Chrysotile
4-Floor Tile 291602721-0004	T/O Right Side - FT/Mastic	Red Fibrous Homogeneous		97% Non-fibrous (Other)	3% Chrysotile
4-Mastic 291602721-0004A	T/O Right Side - FT/Mastic	Black Fibrous Homogeneous	2% Cellulose	95% Non-fibrous (Other)	3% Chrysotile

Analyst(s)
Billy Barnes (4)
Joshua Moorman (4)

Essie Spencer, Laboratory Manager
or Other Approved Signatory

Initial report from: 04/29/2016 09:37:54

OrderID: 291602721

Enviro Assessments
City of Greenville, Concrete Pad @ 410 Bonners Lane, Gr
4/28/2016 10:0 **TAT:** 24 Hour
PLM Bulk

Order ID: 291602721
No Samples: 4
Due: 04/29 10.00 AM
Fax: 252-527-3055

Enviro Assessments East, Inc. 10705 Hwy 55 West Dover, NC 28526 Contact: Sammy Lane PH# 252-560-3363 Fax#252-527-3055 Email: **eae200@embarqmail.com** **labresults@eae-inc.com**	**LABORATORY TEST REQUEST** Laboratory Name: EMSL Analytical, Inc. Account Name: City of Greenville Survey Site: Concrete Pad 2 Address: 410 Bonners Lane Greenville, NC 27858

Sample Type: **Asbestos Bulk**	Analysis Type: **PLM**	Date Shipped: 4/27/16
Turn Around Time: **24 HR**	# of Samples: 4	Date Collected: 4/27/16

Special Instructions/Notes

Sample #	Sample type	Location	P/S
1	FT/Mastic	T/O Right Side	
2	"	"	
3	"	"	
4	"	"	
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			

CHAIN OF CUSTODY RECORD

DATE/TIME	CONDITION OF SAMPLE	SAMPLES RECEIVED BY:	SAMPLES RELEASED BY:
4/27/16	**Double Bagged**	4/28/16	Jason Simpson

Asbestos Inspection Report for:

City of Greenville
Commercial Brick Building @
600, 602 Pitt Street
400 Bonners Lane
Greenville, NC 27858

Prepared For:
City of Greenville
1500 Beatty Street – Greenville, NC 27858

Prepared By:
Enviro Assessments East, Inc.
10705 Hwy 55 West – Dover, NC 28526
(NC Asbestos Inspector: Jason T. Simpson, # 12882)

Enviro Assessments East, Inc.

Asbestos-Lead-Mold Inspections & Abatement

10705 Hwy 55 West
Dover, NC 28526
Phone (252) 527-3052
FAX (252) 527-3055
Email Josh@eae-inc.com
www.eae-inc.com

Inspection # - ASB16-0429-01

Friday, April 29, 2016

Mr. Devin Thompson
Building and Grounds Supervisor
City of Greenville
1500 Beatty Street
Greenville, NC 27834

Reference: Asbestos Inspection Report
600, 602 Pitt Street: 400 Bonners Lane – 3 spaces, Corner Building
Greenville, NC 27858

Dear Mr. Thompson,

Enviro Assessments East, Inc. (EAE, Inc.) has completed the Asbestos Survey of the Property located at the building at Pitt Street and Bonners Lane in Greenville, NC. This building contains 400 Bonners Lane, 600, and 602 Pitt Street commercial spaces. We are pleased to provide you with this report, and if there are any questions please let us know.

Description of Services

An Asbestos Survey was performed on April 27th, 2016 by NC Licensed inspector Jason T. Simpson (NC Inspector # 12882). The inspection was conducted in general accordance with the U.S. Environmental Protection Agency requirements and in General accordance with the North Carolina Health Hazards Control Unit. This inspection was performed in preparation for the demolition of the commercial building located on site.

Inspection Process

EAE, Inc. began the survey by determining homogeneous areas within each structure. Those areas are defined as having suspect materials that are alike based upon location, material type, color, texture, and time period of installation. Representative bulk samples were collected of each homogeneous area of each structure. These areas included the exterior and roof portions of the building, as well as the three individual commercial spaces in the building. Each area of the structure in which asbestos containing materials (ACM) were discovered are listed out separately in tables below.

As required a minimum of 2 samples were taken of each material. These account for a total of 38 Bulk samples taken for analysis and 6 additional layers separated by the lab for a total of 44 Samples. All samples were double bagged and sent along with a chain of Custody (Attached) to a National Voluntary Laboratory Accreditation Program (NVLAP) approved laboratory for analysis. The samples were analyzed using Polarized Light Microscopy (PLM).

Results and Recommendations

Of the 44 total samples analyzed, 13 were found to contain asbestos. It is required that these materials be properly abated prior to disturbance by renovation activities or demolition. Please see the table below for a description of materials found to contain asbestos.

Roof / Exterior Areas Positive Sample Results

Sample #	Material Type	Location	% Asbestos	Quantity
3,4	Cool Seal / Tar	On Roof Penetrations and Chimney	2-3% Chrysotile	Approx. 10 Penetrations and 2 Chimneys.
5,6	Sealant	On Parapet Cap Seams & Cracks	3-5% Chrysotile	Approx. 40 SF
12	Skim / Cool Seal	On Brick Parapet Walls	5% Chrysotile	Approx. 450 SF

400 Bonners Lane Positive Sample Results

Sample #	Material Type	Location	% Asbestos	Quantity
25,26	Floor Tile Mastic	Throughout Space – Under Carpet and 12" Floor Tile.	3-5% Chrysotile	Approx. 700 SF

600 Pitt Street Positive Sample Results

Sample #	Material Type	Location	% Asbestos	Quantity
33,34	Floor Tile Mastic	Throughout Front and Rear Area – Under 12" Floor Tile.	3-5% Chrysotile	Approx. 380 SF
35,36	Floor Tile & Mastic	Throughout Rear Area – 9" Tile.	2-5% Chrysotile	Approx. 40 SF

- **All square footages area approximate and should be verified by the contractor before bidding.**
- ***Note: The following materials analyzed at less than 1%:***

  Roof / Exterior:
  Tar and Cool Seal on rolled tin roof.
  Black sealant used for patching around penetrations and on rolled tin roof.

  Space 400 Bonners Lane:
  12" Floor Tile underneath carpet throughout.

  Space 600 Pitt Street:
  12" Floor Tile throughout the front and rear areas of the space.

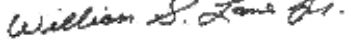
- **Although the EPA does not recognize materials with less than 1% asbestos as (ACM), OSHA recognizes any amount of asbestos within a material. OSHA has regulations in place as it pertains to worker health and safety during the disturbance of said materials.**

Limitations

To the best of my knowledge, no other asbestos containing materials were found that were sampled in this survey. Before a building is to be renovated of demolished, all asbestos material that will be disturbed should be removed by a North Carolina State Licensed Asbestos Contractor using only licensed workers and supervisors.

If during demolition or remodeling any other suspect asbestos material is discovered, stop work immediately and test those materials for asbestos.

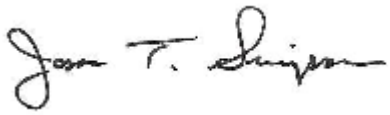
Sincerely,



William S. Lane Jr., President
Enviro Assessments East, Inc.

NC Asbestos Inspection # 12021
NC Asbestos Supervisor # 33514
NC General Contracting # 60742
NC Lead Firm # FPB-0292
NC RRP # RRP-0943
NC Lead Supervisor # 130279
VA & SC License upon Request

Sincerely,



Jason T. Simpson, Estimator/PM
Enviro Assessments East, Inc.

NC Asbestos Inspector # 12882
NC Asbestos Supervisor # 34329

Attachment I

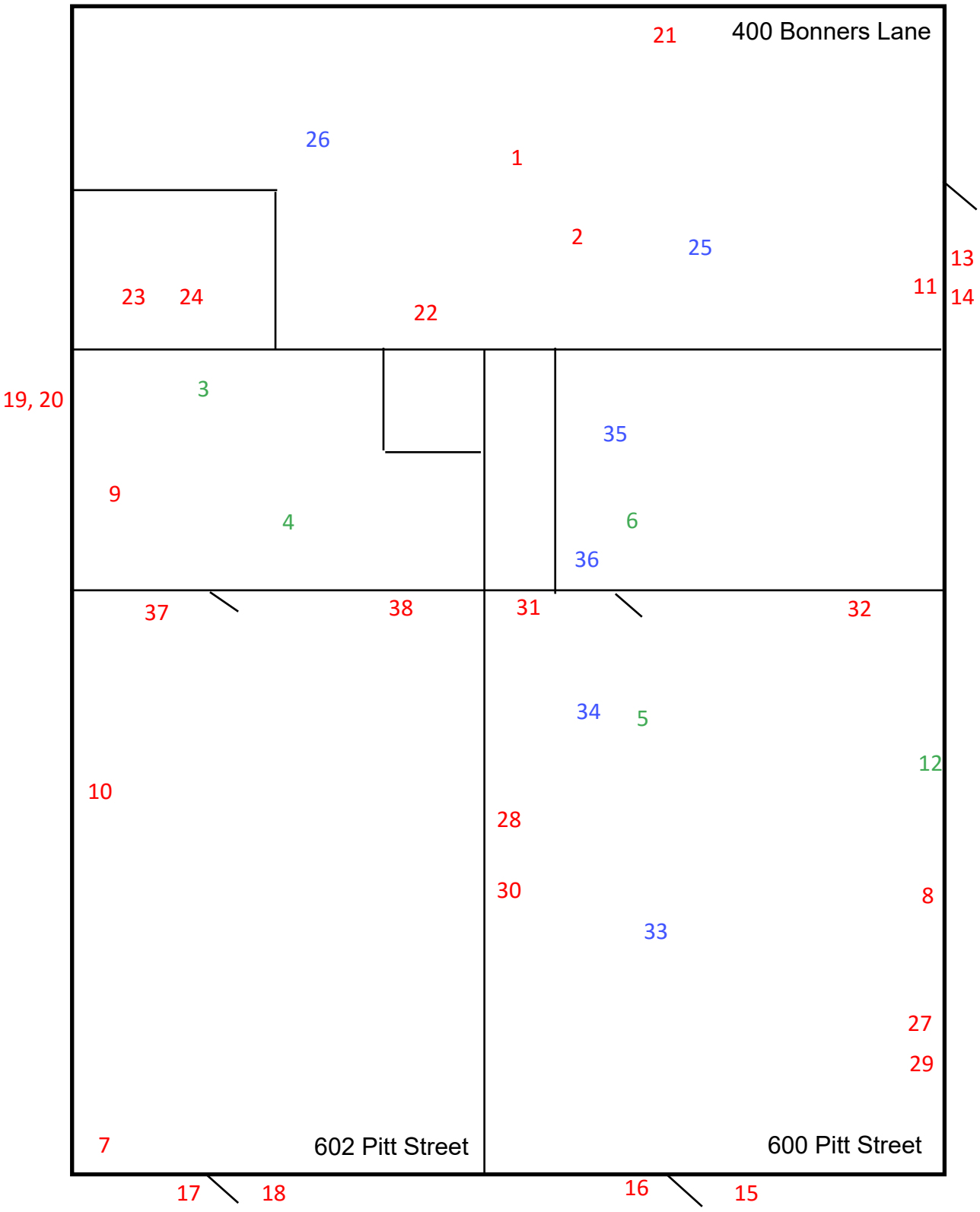
LEGEND

Green - Positive Roof/Exterior Samples

Red - Negative Roof/Exterior Samples

Blue - Positive Interior Asbestos Sample Locations

Black - Negative Interior Asbestos Sample Locations



Bonners Lane

Pitt Street

Attachment II

600 Pitt Street – Roof and Exterior Area Asbestos Containing Materials.

Cool Seal / Tar on Penetrations and Chimneys

Sealant on Parapet Wall Seams and Cracks.

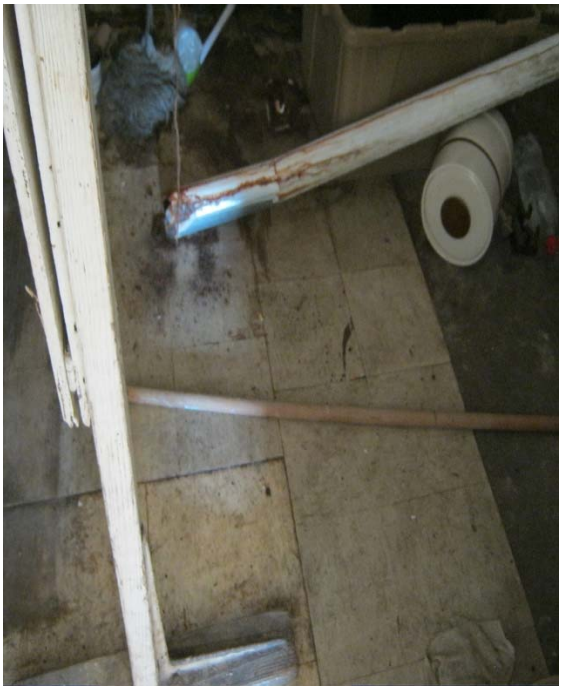
Skim / Cool Seal on Brick Parapet Walls.

400 Bonners Lane Interior Space – Asbestos Containing Materials

Floor Tile Mastic underneath 12” floor tile and carpet throughout the space.

600 Pitt Street Interior Space – Asbestos Containing Materials

Floor tile mastic under 12” tile throughout.



9” Floor tile and mastic in rear area.

Attachment III

EMSL Analytical, Inc.

2500 Gateway Centre Blvd., Suite 600 Morrisville, NC 27560
Tel/Fax: (919) 465-3900 / (919) 465-3950
http://www.EMSL.com / raleighlab@emsl.com

EMSL Order: 291602719
Customer ID: EVAS42
Customer PO:
Project ID:

Attention: Sammy Lane
Enviro Assessments
10705 Hwy 55 W.
Dover, NC 28526

Phone: (252) 527-3052
Fax: (252) 527-3055
Received Date: 04/28/2016 10:00 AM
Analysis Date: 04/28/2016
Collected Date: 04/27/2016

Project: City of Greenville, Building @ 600 Pitt Street, Greenville, NC 27858

Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

			Non-Asbestos		Asbestos
Sample	**Description**	**Appearance**	**% Fibrous**	**% Non-Fibrous**	**% Type**
1 *291602719-0001*	Exterior, On Rolled Tin Roof - Cool Seal/Tar	Black/Silver Fibrous Homogeneous	2% Wollastonite	98% Non-fibrous (Other)	<1% Chrysotile
2 *291602719-0002*	Exterior, On Rolled Tin Roof - Cool Seal/Tar	Black/Silver Fibrous Homogeneous	<1% Cellulose	100% Non-fibrous (Other)	<1% Chrysotile
3 *291602719-0003*	Exterior, On Roof Penetrations - Cool Seal/Tar	Black/Silver Fibrous Homogeneous	2% Wollastonite	96% Non-fibrous (Other)	2% Chrysotile
4 *291602719-0004*	Exterior, On Roof Penetrations - Cool Seal/Tar	Black/Silver Fibrous Homogeneous		97% Non-fibrous (Other)	3% Chrysotile
5 *291602719-0005*	Exterior, On Parapet Cap Seams - Sealant	Black/Silver Fibrous Homogeneous		97% Non-fibrous (Other)	3% Chrysotile
6 *291602719-0006*	Exterior, On Parapet Cap Seams - Sealant	Black/Silver Fibrous Homogeneous	2% Cellulose	93% Non-fibrous (Other)	5% Chrysotile
7 *291602719-0007*	Exterior, Around Penetrations, Parapet Wall/Cap - Sealant (Patch)	White/Silver Fibrous Homogeneous	2% Cellulose	98% Non-fibrous (Other)	None Detected
8 *291602719-0008*	Exterior, Around Penetrations, Parapet Wall/Cap - Sealant (Patch)	White/Silver Fibrous Homogeneous	<1% Cellulose	100% Non-fibrous (Other)	None Detected
9 *291602719-0009*	Exterior, Around Penetrations & on Tin Roof - Sealant (Patch)	Black/Silver Fibrous Homogeneous	5% Cellulose	95% Non-fibrous (Other)	<1% Chrysotile
10 *291602719-0010*	Exterior, Around Penetrations & on Tin Roof - Sealant (Patch)	Black/Silver Fibrous Homogeneous	<1% Cellulose	100% Non-fibrous (Other)	<1% Chrysotile
11 *291602719-0011*	Exterior, On Brick Parapet Walls - Skim/Cool Seal	Silver Fibrous Homogeneous	3% Cellulose 2% Glass	95% Non-fibrous (Other)	<1% Chrysotile
12 *291602719-0012*	Exterior, On Brick Parapet Walls - Skim/Cool Seal	Black/Silver Fibrous Homogeneous		95% Non-fibrous (Other)	5% Chrysotile
13 *291602719-0013*	Exterior, Windows/Door, Bonners Lane Space - Caulk (Exterior)	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
14 *291602719-0014*	Exterior, Windows/Door, Bonners Lane Space - Caulk (Exterior)	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected

Report amended: 04/29/2016 09:46:25 Replaces initial report from: 04/29/2016 08:59:35 Reason Code: Data Entry-Change to Location

EMSL Analytical, Inc.
2500 Gateway Centre Blvd., Suite 600 Morrisville, NC 27560
Tel/Fax: (919) 465-3900 / (919) 465-3950
http://www.EMSL.com / raleighlab@emsl.com

EMSL Order: 291602719
Customer ID: EVAS42
Customer PO:
Project ID:

Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

			Non-Asbestos		Asbestos
Sample	**Description**	**Appearance**	**% Fibrous**	**% Non-Fibrous**	**% Type**
15 *291602719-0015*	Exterior, Windows/Door, 600 Pitt St. Space - Caulk (Exterior)	White Fibrous Homogeneous	10% Wollastonite	90% Non-fibrous (Other)	None Detected
16 *291602719-0016*	Exterior, Windows/Door, 600 Pitt St. Space - Caulk (Exterior)	White Fibrous Homogeneous	2% Wollastonite	98% Non-fibrous (Other)	None Detected
17 *291602719-0017*	Exterior, Windows/Door, 602 Pitt St. Space - Caulk (Exterior)	White Fibrous Homogeneous	10% Wollastonite	90% Non-fibrous (Other)	None Detected
18 *291602719-0018*	Exterior, Windows/Door, 602 Pitt St. Space - Caulk (Exterior)	White Fibrous Homogeneous	5% Wollastonite	95% Non-fibrous (Other)	None Detected
19 *291602719-0019*	Exterior, Exhaust Fan Door, 602 Pitt St. Space - Caulk (Exterior)	Tan/White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
20 *291602719-0020*	Exterior, Exhaust Fan Door, 602 Pitt St. Space - Caulk (Exterior)	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
21 *291602719-0021* *This is a composite result of sheetrock, and joint compound.*	400 Bonners Lane, T/O - SR/JC Composite	Gray/White Fibrous Homogeneous	5% Cellulose 2% Glass	93% Non-fibrous (Other)	None Detected
22 *291602719-0022* *This is a composite result of sheetrock, and joint compound.*	400 Bonners Lane, T/O - SR/JC Composite	Gray/White Fibrous Homogeneous	10% Cellulose 3% Glass	87% Non-fibrous (Other)	None Detected
23 *291602719-0023*	400 Bonners Lane, Bath, Top Layer - Vinyl Floor	Gray/White Fibrous Homogeneous	25% Cellulose	75% Non-fibrous (Other)	None Detected
24 *291602719-0024*	400 Bonners Lane, Bath, Top Layer - Vinyl Floor	Gray/White Fibrous Homogeneous	20% Cellulose 10% Glass	70% Non-fibrous (Other)	None Detected
25-Floor Tile *291602719-0025*	400 Bonners Lane, T/O Under Carpet, Bath-Bottom Layer - FT/Mastic	Gray/White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
25-Mastic *291602719-0025A*	400 Bonners Lane, T/O Under Carpet, Bath-Bottom Layer - FT/Mastic	Black Fibrous Homogeneous		97% Non-fibrous (Other)	3% Chrysotile
26-Floor Tile *291602719-0026*	400 Bonners Lane, T/O Under Carpet, Bath-Bottom Layer - FT/Mastic	Beige Fibrous Homogeneous		100% Non-fibrous (Other)	<1% Chrysotile
26-Mastic *291602719-0026A*	400 Bonners Lane, T/O Under Carpet, Bath-Bottom Layer - FT/Mastic	Black Fibrous Homogeneous	2% Cellulose	93% Non-fibrous (Other)	5% Chrysotile
27 *291602719-0027*	600 Pitt St., T/O Space 600 & 602 (Perimeter Walls) - Skim Coat (Plaster)	White Non-Fibrous Homogeneous	<1% Cellulose	100% Non-fibrous (Other)	None Detected

Report amended: 04/29/2016 09:46:25 Replaces initial report from: 04/29/2016 08:59:35 Reason Code: Data Entry-Change to Location

EMSL Analytical, Inc.
2500 Gateway Centre Blvd., Suite 600 Morrisville, NC 27560
Tel/Fax: (919) 465-3900 / (919) 465-3950
http://www.EMSL.com / raleighlab@emsl.com

EMSL Order: 291602719
Customer ID: EVAS42
Customer PO:
Project ID:

Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

			Non-Asbestos		Asbestos
Sample	**Description**	**Appearance**	**% Fibrous**	**% Non-Fibrous**	**% Type**
28 *291602719-0028*	600 Pitt St., T/O Space 600 & 602 (Perimeter Walls) - Skim Coat (Plaster)	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
29 *291602719-0029*	600 Pitt St., T/O Space 600 & 602 (Perimeter Walls) - Base Coat (Plaster)	Gray/Tan Fibrous Homogeneous	2% Glass	98% Non-fibrous (Other)	None Detected
30 *291602719-0030*	600 Pitt St., T/O Space 600 & 602 (Perimeter Walls) - Base Coat (Plaster)	Brown Fibrous Homogeneous	<1% Cellulose	100% Non-fibrous (Other)	None Detected
31 *291602719-0031* *This is a composite result of sheetrock, and joint compound.*	600 Pitt St., T/O - SR/JC, Composite	Brown/Gray/White Fibrous Homogeneous	15% Cellulose	85% Non-fibrous (Other)	None Detected
32 *291602719-0032* *This is a composite result of sheetrock, and joint compound.*	600 Pitt St., T/O - SR/JC, Composite	White Fibrous Homogeneous	10% Cellulose 2% Glass	88% Non-fibrous (Other)	None Detected
33-Floor Tile *291602719-0033*	600 Pitt St., Main Area - FT/Mastic	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
33-Mastic *291602719-0033A*	600 Pitt St., Main Area - FT/Mastic	Black Fibrous Homogeneous		97% Non-fibrous (Other)	3% Chrysotile
34-Floor Tile *291602719-0034*	600 Pitt St., Main Area - FT/Mastic	Beige Fibrous Homogeneous		100% Non-fibrous (Other)	<1% Chrysotile
34-Mastic *291602719-0034A*	600 Pitt St., Main Area - FT/Mastic	Black Fibrous Homogeneous		95% Non-fibrous (Other)	5% Chrysotile
35-Floor Tile *291602719-0035*	600 Pitt St., Rear Area - FT/Mastic	Tan Fibrous Homogeneous		98% Non-fibrous (Other)	2% Chrysotile
35-Mastic *291602719-0035A*	600 Pitt St., Rear Area - FT/Mastic	Black Fibrous Homogeneous		95% Non-fibrous (Other)	5% Chrysotile
36-Floor Tile *291602719-0036*	600 Pitt St., Rear Area - FT/Mastic	Beige Fibrous Homogeneous		95% Non-fibrous (Other)	5% Chrysotile
36-Mastic *291602719-0036A*	600 Pitt St., Rear Area - FT/Mastic	Black Fibrous Homogeneous	2% Cellulose	93% Non-fibrous (Other)	5% Chrysotile
37 *291602719-0037* *This is a composite result of sheetrock, and joint compound.*	602 Pitt St., T/O - SR/JC Composite	Brown/Gray/White Fibrous Homogeneous	10% Cellulose 5% Glass	85% Non-fibrous (Other)	None Detected
38 *291602719-0038* *This is a composite result of sheetrock, and joint compound.*	602 Pitt St., T/O - SR/JC Composite	Brown/White Fibrous Homogeneous	15% Cellulose 2% Glass	83% Non-fibrous (Other)	None Detected

Report amended: 04/29/2016 09:46:25 Replaces initial report from: 04/29/2016 08:59:35 Reason Code: Data Entry-Change to Location

EMSL Analytical, Inc.

2500 Gateway Centre Blvd., Suite 600 Morrisville, NC 27560
Tel/Fax: (919) 465-3900 / (919) 465-3950
http://www.EMSL.com / raleighlab@emsl.com

EMSL Order:	291602719
Customer ID:	EVAS42
Customer PO:	
Project ID:	

Analyst(s)

Billy Barnes (22)
Joshua Moorman (22)

Essie Spencer, Laboratory Manager
or Other Approved Signatory

Report amended: 04/29/2016 09:46:25 Replaces initial report from: 04/29/2016 08:59:35 Reason Code: Data Entry-Change to Location

OrderID: 291602719 nts
City of Greenville, Building @ 600 Pitt Street, Greenville,
4/28/2016 10:0 TAT: 24 Hour
PLM Bulk

Order ID: 291602719
No Samples: 38
Due: 04/29 10:00 AM
Fax: 252-527-3055

Enviro Assessments East, Inc.
10705 Hwy 55 West
Dover, NC 28526
Contact: Sammy Lane
PH# 252-560-3363 Fax#252-527-3055
Email: **eae200@embarqmail.com**
labresults@eae-inc.com

LABORATORY TEST REQUEST
Laboratory Name: EMSL Analytical, Inc.
Account Name: City of Greenville
Survey Site: Building 20
Address: 600 Pitt Street
Greenville, NC 27858

Sample Type: **Asbestos Bulk**	Analysis Type: **PLM**	Date Shipped: 4/27/16
Turn Around Time: **24 HR**	# of Samples: 38	Date Collected: 4/27/16

Special Instructions/Notes

Sample #	Sample type	Location	P/S
1	Cool Seal / Tar	On Rolled Tin Roof	
2	" " "	" " " "	
3	" " "	On Roof Penetrations	
4	" " "	" " "	
5	Sealant	On Parapet Cap Seams	
6	"	" " " "	
7	" (Patch)	Around Penetrations, Parapet Wall / Cap.	
8	" "	" " " " "	
9	" "	Around Penetrations, + On Tin Roof	
10	" "	" " " " "	
11	Skim / Cool Seal	On Brick Parapet Walls	
12	" " "	" " " "	
13	Caulk (Exterior)	Windows / Door - Banners Lane Space	
14	" "	" " " " "	
15	" "	" " - 600 Pitt St. Space	
16	" "	" " " " " "	
17	" "	" " - 602 Pitt St. Space	
18	" "	" " " " " "	
19	" "	Exhaust Fan Door - " " " "	
20	" "	" " " " " "	
21	SR / JC > Composite	T/O	
22	" "	"	
23	Vinyl Floor > DO NOT TEST MASTIC	Bath Top Layer	
24	" "	" "	
25	FT / Mastic	T/O Under Carpet, Bath - Bottom Layer	
26	" "	" " " " " "	

CHAIN OF CUSTODY RECORD

DATE/TIME	CONDITION OF SAMPLE	SAMPLES RECEIVED BY:	SAMPLES RELEASED BY:
4/27/16	**Double Bagged**	4/28/16 10:0	

OrderID: 291602719

Enviro Assessments
City of Greenville, Building @ 600 Pitt Street, Greenville,
4/28/2016 10:0 TAT: 24 Hour
PLM Bulk

Order ID: 291602719
No Samples: 38
Due: 04/29 10:00 AM
Fax: 252-527-3055

Enviro Assessments East, Inc.
10705 Hwy 55 West
Dover, NC 28526
Contact: Sammy Lane
PH# 252-560-3363 Fax#252-527-3055
Email: **eae200@embarqmail.com**
labresults@eae-inc.com

LABORATORY TEST REQUEST
Laboratory Name: EMSL Analytical, Inc.
Account Name: City of Greenville
Survey Site: Building 2
Address: 600 Pitt Street
Greenville, NC 27858

Sample Type: **Asbestos Bulk**	Analysis Type: **PLM**	Date Shipped: 4/27/16
Turn Around Time: **24 HR**	# of Samples: 38	Date Collected: 4/27/16

Special Instructions/Notes

Sample #	Sample type	Location	P/S
27	Skim Coat (plaster)	T/O Space 600 & 602 (Perimeter Walls)	
28	" "	" " " " " "	
29	Base Coat "	" " " " " "	
30	" "	" " " " " "	
31	SR/JC > Composite	T/O	
32	" "	"	
33	FT/Mastic	Main Area	
34	" "	" "	
35	" "	Rear Area	
36	" "	" "	
37	SR/JC > Composite	T/O	
38	" "	"	
39			
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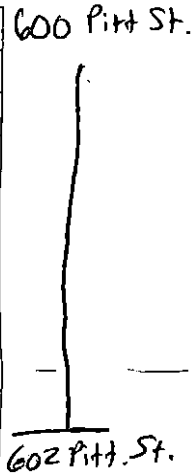
51			
52			



CHAIN OF CUSTODY RECORD

DATE/TIME	CONDITION OF SAMPLE	SAMPLES RECEIVED BY:	SAMPLES RELEASED BY:
4/27/16	**Double Bagged**	4/28/16 10:0	

Asbestos Inspection Report for:

City of Greenville
Former Daycare Building @
616 Pitt Street
Greenville, NC 27858

Prepared For:
City of Greenville
1500 Beatty Street – Greenville, NC 27858

Prepared By:
Enviro Assessments East, Inc.
10705 Hwy 55 West – Dover, NC 28526
(NC Asbestos Inspector: Jason T. Simpson, # 12882)

Enviro Assessments East, Inc.

Asbestos-Lead-Mold Inspections & Abatement

10705 Hwy 55 West
Dover, NC 28526
Phone (252) 527-3052
FAX (252) 527-3055
Email Josh@eae-inc.com
www.eae-inc.com

Inspection # - ASB16-0429-04

Friday, April 29, 2016

Mr. Devin Thompson
Building and Grounds Supervisor
City of Greenville
1500 Beatty Street
Greenville, NC 27834

Reference: Asbestos Inspection Report
616 Pitt Street – Former Daycare Building
Greenville, NC 27858

Dear Mr. Thompson,

Enviro Assessments East, Inc. (EAE, Inc.) has completed the Asbestos Survey of the Property located at 616 Pitt Street in Greenville, NC. We are pleased to provide you with this report, and if there are any questions please let us know.

Description of Services

An Asbestos Survey was performed on April 27th, 2016 by NC Licensed inspector Jason T. Simpson (NC Inspector # 12882). The inspection was conducted in general accordance with the U.S. Environmental Protection Agency requirements and in General accordance with the North Carolina Health Hazards Control Unit. This inspection was performed in preparation for the demolition of the former daycare building located on site.

Inspection Process

EAE, Inc. began the survey by determining homogeneous areas within each structure. Those areas are defined as having suspect materials that are alike based upon location, material type, color, texture, and time period of installation. Representative bulk samples were collected of each homogeneous area of each structure.

As a minimum, 2 samples were taken of each material. These account for a total of 26 Bulk samples taken for analysis and 4 additional layers separated by the lab for a total of 30 Samples. All samples were double bagged and sent along with a chain of Custody (Attached) to a National Voluntary Laboratory Accreditation Program (NVLAP) approved laboratory for analysis. The samples were analyzed using Polarized Light Microscopy (PLM).

Results and Recommendations

Of the 30 total samples analyzed, none were found to contain asbestos. If additional materials are uncovered during demolition or renovations those materials are to be presumed to contain asbestos until further sampling is performed.

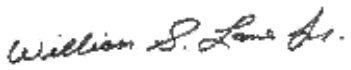
No Positive Results Found

Limitations

To the best of my knowledge, no other asbestos containing materials were found that were sampled in this survey. Before a building is to be renovated or demolished, all asbestos material that will be disturbed should be removed by a North Carolina State Licensed Asbestos Contractor using only licensed workers and supervisors.

If during demolition or remodeling any other suspect asbestos material is discovered, stop work immediately and presume or test those materials for asbestos.

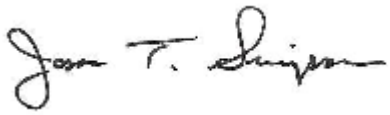
Sincerely,



William S. Lane Jr., President
Enviro Assessments East, Inc.

NC Asbestos Inspection # 12021
NC Asbestos Supervisor # 33514
NC General Contracting # 60742
NC Lead Firm # FPB-0292
NC RRP # RRP-0943
NC Lead Supervisor # 130279
VA & SC License upon Request

Sincerely,



Jason T. Simpson, Estimator/PM
Enviro Assessments East, Inc.

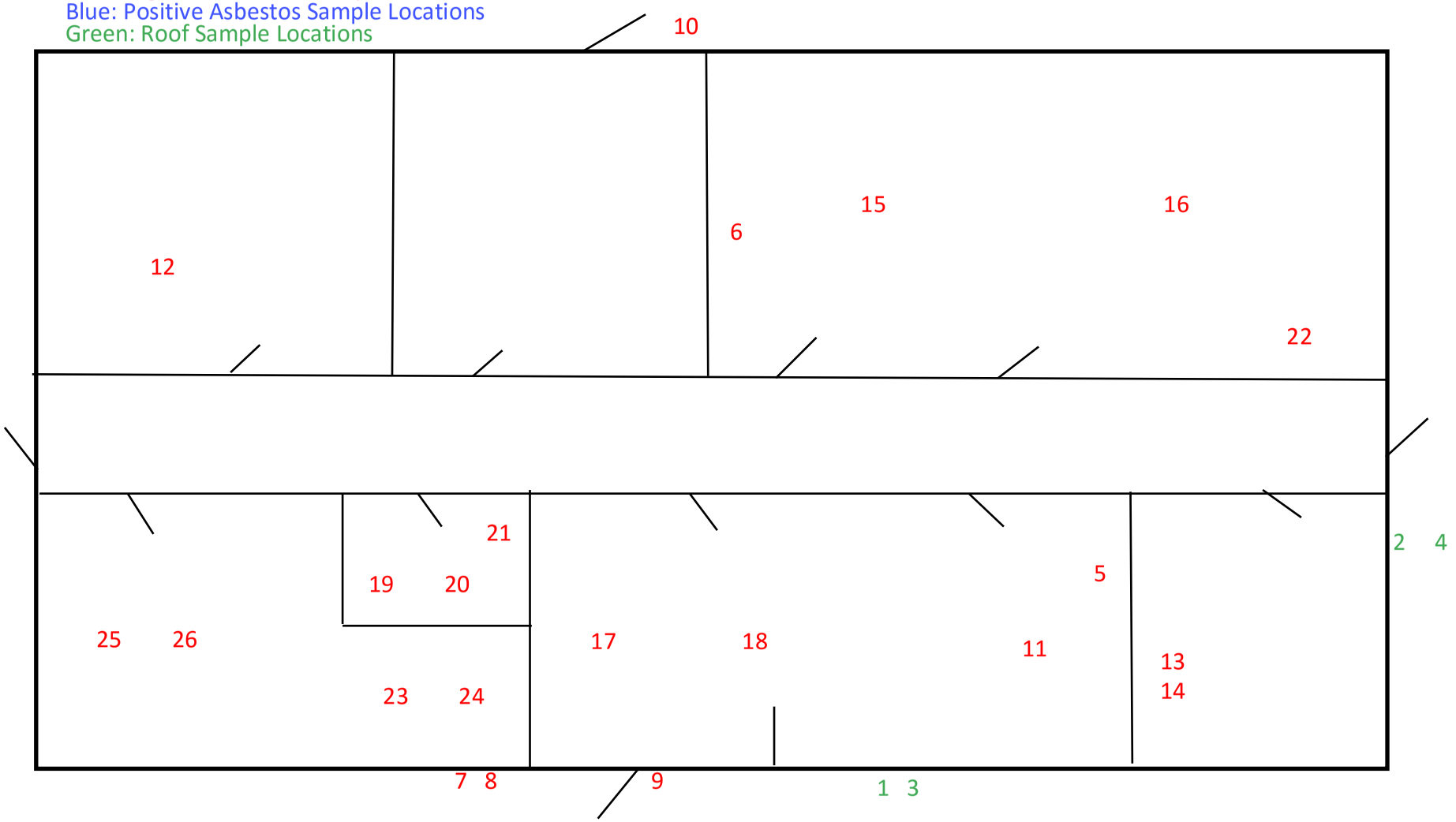
NC Asbestos Inspector # 12882
NC Asbestos Supervisor # 34329

Attachment I

616 Pitt Street

LEGEND

Red: Negative Asbestos Sample Locations
Blue: Positive Asbestos Sample Locations
Green: Roof Sample Locations



Pitt Street

Attachment II

EMSL Analytical, Inc.

2500 Gateway Centre Blvd., Suite 600 Morrisville, NC 27560
Tel/Fax: (919) 465-3900 / (919) 465-3950
http://www.EMSL.com / raleighlab@emsl.com

EMSL Order: 291602720
Customer ID: EVAS42
Customer PO:
Project ID:

Attention: Sammy Lane
Enviro Assessments
10705 Hwy 55 W.
Dover, NC 28526

Phone: (252) 527-3052
Fax: (252) 527-3055
Received Date: 04/28/2016 10:00 AM
Analysis Date: 04/28/2016
Collected Date: 04/27/2016

Project: City of Greenville, Former Daycare @ 616 Pitt St., Greenville, NC 27858

Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

			Non-Asbestos		Asbestos
Sample	**Description**	**Appearance**	**% Fibrous**	**% Non-Fibrous**	**% Type**
1 *291602720-0001*	Roof - Shingle	Black Fibrous Homogeneous	20% Glass	80% Non-fibrous (Other)	None Detected
2 *291602720-0002*	Roof - Shingle	Black Fibrous Homogeneous	20% Glass	80% Non-fibrous (Other)	None Detected
3 *291602720-0003*	Roof - Felt	Black Fibrous Homogeneous	70% Cellulose	30% Non-fibrous (Other)	None Detected
4 *291602720-0004*	Roof - Felt	Black Fibrous Homogeneous	65% Cellulose	35% Non-fibrous (Other)	None Detected
5 *291602720-0005* *This is a composite result of sheetrock, and jt. compound.*	T/O - SR/JC, Composite	White Fibrous Homogeneous	8% Cellulose 3% Glass	89% Non-fibrous (Other)	None Detected
6 *291602720-0006* *This is a composite result of sheetrock, and joint compound.*	T/O - SR/JC, Composite	White Fibrous Homogeneous	10% Cellulose 5% Glass	85% Non-fibrous (Other)	None Detected
7 *291602720-0007*	Windows - Caulk (Exterior)	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
8 *291602720-0008*	Windows - Caulk (Exterior)	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
9 *291602720-0009*	Doors - Caulk (Exterior)	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
10 *291602720-0010*	Doors - Caulk (Exterior)	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
11 *291602720-0011*	Under Carpet T/O - Glue	Tan/Yellow Fibrous Homogeneous	3% Cellulose	97% Non-fibrous (Other)	None Detected
12 *291602720-0012*	Under Carpet T/O - Glue	Tan/Yellow Fibrous Homogeneous	2% Cellulose	98% Non-fibrous (Other)	None Detected
13 *291602720-0013*	Utility Room - FT	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
14 *291602720-0014*	Utility Room - FT	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
15 *291602720-0015*	Right Rear Classroom - FT	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected

Initial report from: 04/29/2016 10:25:20

EMSL Analytical, Inc.
2500 Gateway Centre Blvd., Suite 600 Morrisville, NC 27560
Tel/Fax: (919) 465-3900 / (919) 465-3950
http://www.EMSL.com / raleighlab@emsl.com

EMSL Order: 291602720
Customer ID: EVAS42
Customer PO:
Project ID:

Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

			Non-Asbestos		Asbestos
Sample	**Description**	**Appearance**	**% Fibrous**	**% Non-Fibrous**	**% Type**
16 *291602720-0016*	Right Rear Classroom - FT	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
17-Floor Tile *291602720-0017*	Front Entrance Area - Vinyl Floor/Mastic	Brown Fibrous Homogeneous	<1% Cellulose	100% Non-fibrous (Other)	None Detected
17-Mastic *291602720-0017A*	Front Entrance Area - Vinyl Floor/Mastic	Yellow Fibrous Homogeneous	2% Cellulose	98% Non-fibrous (Other)	None Detected
18-Floor Tile *291602720-0018*	Front Entrance Area - Vinyl Floor/Mastic	Brown/Black Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
18-Mastic *291602720-0018A*	Front Entrance Area - Vinyl Floor/Mastic	Tan Fibrous Homogeneous	2% Cellulose	98% Non-fibrous (Other)	None Detected
19-Floor Tile *291602720-0019*	Women's Restroom - FT/Mastic	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
19-Mastic *291602720-0019A*	Women's Restroom - FT/Mastic	Tan/Yellow Fibrous Homogeneous	2% Cellulose	98% Non-fibrous (Other)	None Detected
20-Floor Tile *291602720-0020*	Women's Restroom - FT/Mastic	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
20-Mastic *291602720-0020A*	Women's Restroom - FT/Mastic	Tan Fibrous Homogeneous	3% Cellulose	97% Non-fibrous (Other)	None Detected
21 *291602720-0021*	Under Subfloor, T/O - Felt	Black Fibrous Homogeneous	70% Cellulose	30% Non-fibrous (Other)	None Detected
22 *291602720-0022*	Under Subfloor, T/O - Felt	Black Fibrous Homogeneous	65% Cellulose	35% Non-fibrous (Other)	None Detected
23 *291602720-0023*	Men's Restroom, Rear Area - FT/Mastic	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
24 *291602720-0024*	Men's Restroom, Rear Area - FT/Mastic	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
25 *291602720-0025*	Mean's Restroom, Main Area - FT/Mastic	Gray Fibrous Homogeneous	5% Synthetic	95% Non-fibrous (Other)	None Detected
26 *291602720-0026*	Mean's Restroom, Main Area - FT/Mastic	Gray Fibrous Homogeneous	2% Synthetic	98% Non-fibrous (Other)	None Detected

Initial report from: 04/29/2016 10:25:20

EMSL Analytical, Inc.
2500 Gateway Centre Blvd., Suite 600 Morrisville, NC 27560
Tel/Fax: (919) 465-3900 / (919) 465-3950
http://www.EMSL.com / raleighlab@emsl.com

EMSL Order:	291602720
Customer ID:	EVAS42
Customer PO:	
Project ID:	

Analyst(s)

Billy Barnes (15)
Joshua Moorman (15)

Essie Spencer, Laboratory Manager
or Other Approved Signatory

Initial report from: 04/29/2016 10:25:20

OrderID: 291602720

Enviro Assessments
City of Greenville, Former Daycare @ 616 Pitt St., Greenvi
4/28/2016 10:0 **TAT:** 24 Hour
PLM Bulk

Order ID: 291602720
No Samples: 26
Due: 04/29 10:00 AM
Fax: 252-527-3055

Enviro Assessments East, Inc.
10705 Hwy 55 West
Dover, NC 28526
Contact: Sammy Lane
PH# 252-560-3363 Fax#252-527-3055
Email: **eae200@embarqmail.com**
labresults@eae-inc.com

LABORATORY TEST REQUEST
Laboratory Name: EMSL Analytical, Inc.
Account Name: City of Greenville
Survey Site: Former Daycare @
Address: 616 Pitt Street
Greenville, NC 27858

Sample Type: **Asbestos Bulk**	Analysis Type: **PLM**	Date Shipped: 4/27/16
Turn Around Time: **24 HR**	# of Samples: 26	Date Collected: 4/27/16

Special Instructions/Notes

Sample #	Sample type	Location	P/S
1	Shingle	Roof	
2	"	"	
3	felt	"	
4	"	"	
5	SR/JC > Composite	T/O	
6	" "	"	
7	Caulk (Exterior)	Windows	
8	" "	"	
9	" "	Doors	
10	" "	"	
11	Glue	Under Carpet - T/O	
12	"	" " "	
13	FT	Utility Room	
14	"	" "	
15	"	Right, Rear Classroom	
16	"	" " "	
17	Vinyl floor /mastic	Front Entrance Area	
18	" " "	" " "	
19	FT/mastic	Women's Restroom	
20	" "	" "	
21	felt	Under Subfloor - T/O	
22	"	" " "	
23	FT/mastic > DO NOT TEST MASTIC	Men's Restroom - Rear Area	
24	" "	" " " "	
25	" "	" " Main Area	
26	" "	" " " "	

CHAIN OF CUSTODY RECORD

DATE/TIME	CONDITION OF SAMPLE	SAMPLES RECEIVED BY:	SAMPLES RELEASED BY:
4/27/16	**Double Bagged**	4/28/16 10m	Joan Snipes

Asbestos Inspection Report for:

City of Greenville
Former Church Building @
618 Pitt Street
Greenville, NC 27858

Prepared For:
City of Greenville
1500 Beatty Street – Greenville, NC 27858

Prepared By:
Enviro Assessments East, Inc.
10705 Hwy 55 West – Dover, NC 28526
(NC Asbestos Inspector: Jason T. Simpson, # 12882)

Enviro Assessments East, Inc.

Asbestos-Lead-Mold Inspections & Abatement

10705 Hwy 55 West
Dover, NC 28526
Phone (252) 527-3052
FAX (252) 527-3055
Email Josh@eae-inc.com
www.eae-inc.com

Inspection # - ASB16-0429-03

Friday, April 29, 2016

Mr. Devin Thompson
Building and Grounds Supervisor
City of Greenville
1500 Beatty Street
Greenville, NC 27834

Reference: Asbestos Inspection Report
618 Pitt Street – Former Church Building.
Greenville, NC 27858

Dear Mr. Thompson,

Enviro Assessments East, Inc. (EAE, Inc.) has completed the Asbestos Survey of the Property located at 618 Pitt Street in Greenville, NC. We are pleased to provide you with this report, and if there are any questions please let us know.

Description of Services

An Asbestos Survey was performed on April 27th, 2016 by NC Licensed inspector Jason T. Simpson (NC Inspector # 12882). The inspection was conducted in general accordance with the U.S. Environmental Protection Agency requirements and in General accordance with the North Carolina Health Hazards Control Unit. This inspection was performed in preparation for the demolition of the two story, former church building located on site.

Inspection Process

EAE, Inc. began the survey by determining homogeneous areas within each structure. Those areas are defined as having suspect materials that are alike based upon location, material type, color, texture, and time period of installation. Representative bulk samples were collected of each homogeneous area of each structure.

As required a minimum of 2 samples were taken of each material. These account for a total of 48 Bulk samples taken for analysis and 12 additional layers separated by the lab for a total of 60 Samples. Due to positive stop instructions placed on the chain of custody, only 59 of the 60 samples were actually analyzed. All samples were double bagged and sent along with a chain of Custody (Attached) to a National Voluntary Laboratory Accreditation Program (NVLAP) approved laboratory for analysis. The samples were analyzed using Polarized Light Microscopy (PLM).

Results and Recommendations

Of the 59 total samples analyzed, 1 was found to contain asbestos. It is required that these materials be properly abated prior to disturbance by renovation activities or demolition. Please see the table below for a description of materials found to contain asbestos.

Sample #	Material Type	Location	% Asbestos	Quantity
23	Vinyl Flooring	Foyer, Side Entrance	20% Chrysotile	Approx. 20 SF

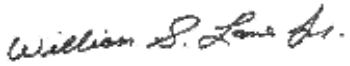
- **All square footages area approximate and should be verified by the contractor before bidding.**

Limitations

To the best of my knowledge, no other asbestos containing materials were found that were sampled in this survey. Before a building is to be renovated of demolished, all asbestos material that will be disturbed should be removed by a North Carolina State Licensed Asbestos Contractor using only licensed workers and supervisors.

If during demolition or remodeling any other suspect asbestos material is discovered, stop work immediately and test those materials for asbestos.

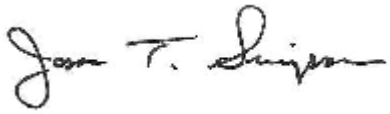
Sincerely,



William S. Lane Jr., President
Enviro Assessments East, Inc.

NC Asbestos Inspection # 12021
NC Asbestos Supervisor # 33514
NC General Contracting # 60742
NC Lead Firm # FPB-0292
NC RRP # RRP-0943
NC Lead Supervisor # 130279
VA & SC License upon Request

Sincerely,



Jason T. Simpson, Estimator/PM
Enviro Assessments East, Inc.

NC Asbestos Inspector # 12882
NC Asbestos Supervisor # 34329

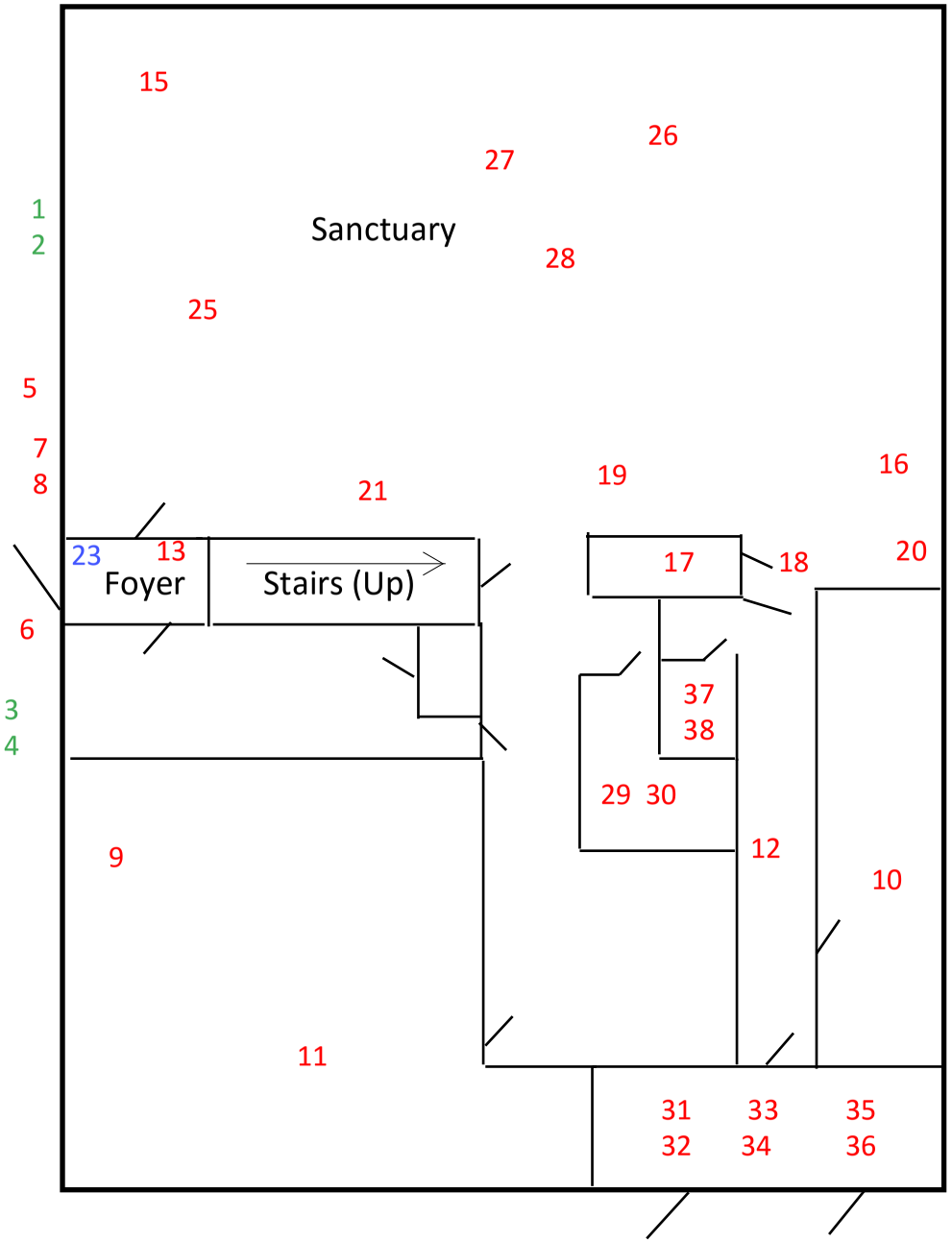
Attachment I

LEGEND

Green: Roof Sample Locations
Red: Negative Asbestos Sample Locations
Blue: Positive Asbestos Sample Locations

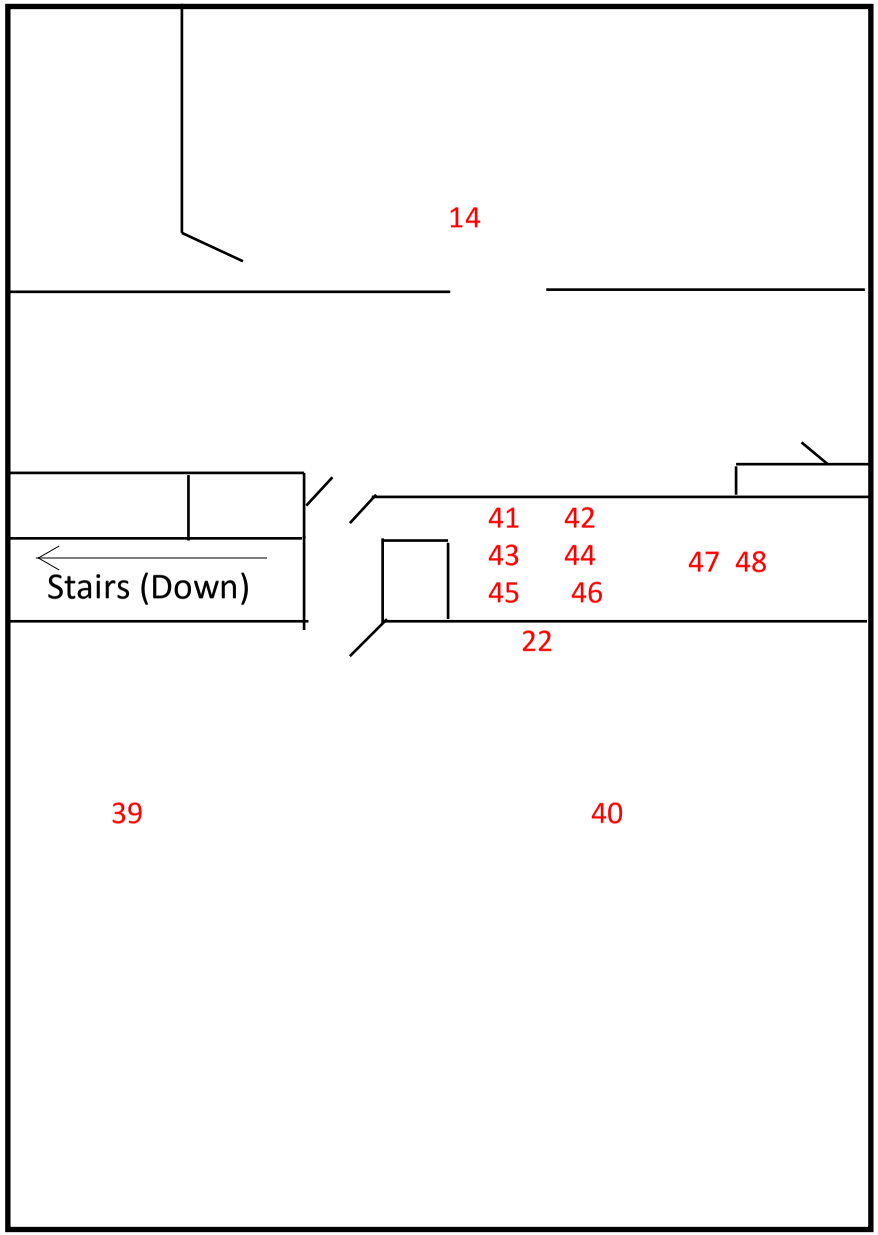
1st Floor Map

618 Pitt Street



Pitt Street

2nd Floor Map



Pitt Street

Attachment II

618 Pitt Street – Asbestos Containing Materials

Vinyl flooring located in the side entry foyer of the church building.

Attachment III

EMSL Analytical, Inc.

2500 Gateway Centre Blvd., Suite 600 Morrisville, NC 27560
Tel/Fax: (919) 465-3900 / (919) 465-3950
http://www.EMSL.com / raleighlab@emsl.com

EMSL Order: 291602722
Customer ID: EVAS42
Customer PO:
Project ID:

Attention: Sammy Lane
Enviro Assessments
10705 Hwy 55 W.
Dover, NC 28526

Phone: (252) 527-3052
Fax: (252) 527-3055
Received Date: 04/28/2016 10:00 AM
Analysis Date: 04/28/2016
Collected Date: 04/27/2016

Project: City of Greenville, Former Church @ 618 Pitt Street, Greenville, NC 27858

Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

			Non-Asbestos		Asbestos
Sample	**Description**	**Appearance**	**% Fibrous**	**% Non-Fibrous**	**% Type**
1 *291602722-0001*	Roof - Shingle	Black Fibrous Homogeneous	20% Glass	80% Non-fibrous (Other)	None Detected
2 *291602722-0002*	Roof - Shingle	Black Fibrous Homogeneous	15% Glass	85% Non-fibrous (Other)	None Detected
3 *291602722-0003*	Roof - Felt	Black Fibrous Homogeneous	70% Cellulose	30% Non-fibrous (Other)	None Detected
4 *291602722-0004*	Roof - Felt	Black Fibrous Homogeneous	65% Cellulose	35% Non-fibrous (Other)	None Detected
5 *291602722-0005*	Windows & Doors - Caulk (Exterior)	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
6 *291602722-0006*	Windows & Doors - Caulk (Exterior)	Gray/White/Blue Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
7 *291602722-0007*	Windows - Glazing	Tan Fibrous Homogeneous	<1% Cellulose	100% Non-fibrous (Other)	None Detected
8 *291602722-0008*	Windows - Glazing	Gray/Tan Fibrous Homogeneous	2% Cellulose	98% Non-fibrous (Other)	None Detected
9 *291602722-0009*	T/O 1st Floor - Ceiling Tile (Main)	White/Beige Fibrous Homogeneous	40% Cellulose 30% Min. Wool	15% Perlite 15% Non-fibrous (Other)	None Detected
10 *291602722-0010*	T/O 1st Floor - Ceiling Tile (Main)	Brown/White Fibrous Homogeneous	30% Cellulose 40% Min. Wool	15% Perlite 15% Non-fibrous (Other)	None Detected
11 *291602722-0011*	T/O 1st Floor - Ceiling Tile (Replacement)	White/Beige Fibrous Homogeneous	40% Cellulose 40% Min. Wool	15% Perlite 5% Non-fibrous (Other)	None Detected
12 *291602722-0012*	T/O 1st Floor - Ceiling Tile (Replacement)	Brown/White Fibrous Homogeneous	30% Cellulose 40% Min. Wool	15% Perlite 15% Non-fibrous (Other)	None Detected
13 *291602722-0013*	T/O Foyer & 2nd Fl Ceilings - Surfacing Material	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
14 *291602722-0014*	T/O Foyer & 2nd Fl Ceilings - Surfacing Material	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
15 *291602722-0015*	T/O Sanctuary Ceiling - Surfacing Material	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
16 *291602722-0016*	T/O Sanctuary Ceiling - Surfacing Material	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected

Initial Report From: 04/28/2016 19:00:00

EMSL Analytical, Inc.
2500 Gateway Centre Blvd., Suite 600 Morrisville, NC 27560
Tel/Fax: (919) 465-3900 / (919) 465-3950
http://www.EMSL.com / raleighlab@emsl.com

EMSL Order: 291602722
Customer ID: EVAS42
Customer PO:
Project ID:

Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

			Non-Asbestos		Asbestos
Sample	**Description**	**Appearance**	**% Fibrous**	**% Non-Fibrous**	**% Type**
17 *291602722-0017*	Storage Area Ceiling Adj to Sanctuary - Surfacing Material	Tan/White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
18 *291602722-0018*	Storage Area Ceiling Adj to Sanctuary - Surfacing Material	Tan/White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
19 *291602722-0019*	Rear Section of Sanctuary, Bathroom Area on 2nd Fl - Wall Texture	Brown/White Fibrous Homogeneous	3% Cellulose	97% Non-fibrous (Other)	None Detected
20 *291602722-0020*	Rear Section of Sanctuary, Bathroom Area on 2nd Fl - Wall Texture	White Non-Fibrous Homogeneous	<1% Cellulose	100% Non-fibrous (Other)	None Detected
21 *291602722-0021* *This is a composite result of sheetrock, and jt. compound.*	T/O - SR/JC Composite	White Fibrous Homogeneous	10% Cellulose 5% Glass	85% Non-fibrous (Other)	None Detected
22 *291602722-0022* *This is a composite result of sheetrock, and jt. compound.*	T/O - SR/JC Composite	Brown/Gray/White Fibrous Homogeneous	10% Cellulose 5% Glass	85% Non-fibrous (Other)	None Detected
23 *291602722-0023*	Foyer - Vinyl Floor	Brown Fibrous Homogeneous	40% Cellulose	40% Non-fibrous (Other)	20% Chrysotile
24 *291602722-0024*	Foyer - Vinyl Floor				Positive Stop (Not Analyzed)
25 *291602722-0025*	T/O 1st Floor - Carpet Glue	Gray/Tan Fibrous Homogeneous	2% Cellulose	98% Non-fibrous (Other)	None Detected
26 *291602722-0026*	T/O 1st Floor - Carpet Glue	Gray/Tan Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
27-Vinyl Floor *291602722-0027*	Sanctuary Under Carpet - Vinyl Floor/Glue	Brown Fibrous Homogeneous	<1% Cellulose	100% Non-fibrous (Other)	None Detected
27-Glue *291602722-0027A*	Sanctuary Under Carpet - Vinyl Floor/Glue	Yellow Fibrous Homogeneous	2% Cellulose	98% Non-fibrous (Other)	None Detected
28-Vinyl Floor *291602722-0028*	Sanctuary Under Carpet - Vinyl Floor/Glue	Brown Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
28-Glue *291602722-0028A*	Sanctuary Under Carpet - Vinyl Floor/Glue	Yellow Fibrous Homogeneous	3% Cellulose	97% Non-fibrous (Other)	None Detected
29-Floor Tile *291602722-0029*	Women's Restroom 1st Floor - FT/Mastic	Green Fibrous Homogeneous	2% Cellulose	98% Non-fibrous (Other)	None Detected
29-Mastic *291602722-0029A*	Women's Restroom 1st Floor - FT/Mastic	Brown/Tan Fibrous Homogeneous	2% Cellulose	98% Non-fibrous (Other)	None Detected
30-Floor Tile *291602722-0030*	Women's Restroom 1st Floor - FT/Mastic	Green Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
30-Mastic *291602722-0030A*	Women's Restroom 1st Floor - FT/Mastic	Tan Fibrous Homogeneous	2% Cellulose	98% Non-fibrous (Other)	None Detected

Initial Report From: 04/28/2016 19:00:00

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Tel/Fax: (919) 465-3900 / (919) 465-3950
http://www.EMSL.com / raleighlab@emsl.com

EMSL Order: 291602722
Customer ID: EVAS42
Customer PO:
Project ID:

Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

			Non-Asbestos		Asbestos
Sample	**Description**	**Appearance**	**% Fibrous**	**% Non-Fibrous**	**% Type**
31-Floor Tile *291602722-0031*	Pitt Street Entrance Foyer - FT/Mastic	Gray Fibrous Homogeneous	<1% Cellulose	100% Non-fibrous (Other)	None Detected
31-Mastic *291602722-0031A*	Pitt Street Entrance Foyer - FT/Mastic	Tan Fibrous Homogeneous	3% Cellulose	97% Non-fibrous (Other)	None Detected
32-Floor Tile *291602722-0032*	Pitt Street Entrance Foyer - FT/Mastic	Gray Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
32-Mastic *291602722-0032A*	Pitt Street Entrance Foyer - FT/Mastic	Tan Fibrous Homogeneous	2% Cellulose <1% Glass	98% Non-fibrous (Other)	None Detected
33-Floor Tile *291602722-0033*	Pitt Street Entrance Foyer - FT/Mastic	Gray Fibrous Homogeneous	<1% Cellulose	100% Non-fibrous (Other)	None Detected
33-Mastic *291602722-0033A*	Pitt Street Entrance Foyer - FT/Mastic	Tan Fibrous Homogeneous	2% Cellulose	98% Non-fibrous (Other)	None Detected
34-Floor Tile *291602722-0034*	Pitt Street Entrance Foyer - FT/Mastic	Gray Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
34-Mastic *291602722-0034A*	Pitt Street Entrance Foyer - FT/Mastic	Tan Fibrous Homogeneous	2% Cellulose	98% Non-fibrous (Other)	None Detected
35-Floor Tile *291602722-0035*	Pitt Street Entrance Foyer - FT/Mastic	Blue Fibrous Homogeneous	<1% Cellulose	100% Non-fibrous (Other)	None Detected
35-Mastic *291602722-0035A*	Pitt Street Entrance Foyer - FT/Mastic	Brown/Tan Fibrous Homogeneous	3% Cellulose	97% Non-fibrous (Other)	None Detected
36-Floor Tile *291602722-0036*	Pitt Street Entrance Foyer - FT/Mastic	Blue Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
36-Mastic *291602722-0036A*	Pitt Street Entrance Foyer - FT/Mastic	Brown/Tan Fibrous Homogeneous	2% Cellulose	98% Non-fibrous (Other)	None Detected
37-Floor Tile *291602722-0037*	Men's Restroom 1st Floor - FT/Mastic	White Fibrous Homogeneous	<1% Cellulose	100% Non-fibrous (Other)	None Detected
37-Mastic *291602722-0037A*	Men's Restroom 1st Floor - FT/Mastic	Tan Fibrous Homogeneous	2% Cellulose	98% Non-fibrous (Other)	None Detected
38-Floor Tile *291602722-0038*	Men's Restroom 1st Floor - FT/Mastic	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
38-Mastic *291602722-0038A*	Men's Restroom 1st Floor - FT/Mastic	Brown/Tan Fibrous Homogeneous	2% Cellulose <1% Glass	98% Non-fibrous (Other)	None Detected
39 *291602722-0039*	2nd Floor Right Side - Vinyl Floor	Gray/White Non-Fibrous Homogeneous	10% Glass	90% Non-fibrous (Other)	None Detected
40 *291602722-0040*	2nd Floor Right Side - Vinyl Floor	White Fibrous Homogeneous	2% Cellulose 10% Glass	88% Non-fibrous (Other)	None Detected
41 *291602722-0041*	Upstairs Bath - FT/Mastic	Peach Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected

Initial Report From: 04/28/2016 19:00:00

EMSL Analytical, Inc.
2500 Gateway Centre Blvd., Suite 600 Morrisville, NC 27560
Tel/Fax: (919) 465-3900 / (919) 465-3950
http://www.EMSL.com / raleighlab@emsl.com

EMSL Order: 291602722
Customer ID: EVAS42
Customer PO:
Project ID:

Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

			Non-Asbestos		Asbestos
Sample	**Description**	**Appearance**	**% Fibrous**	**% Non-Fibrous**	**% Type**
42 *291602722-0042*	Upstairs Bath - FT/Mastic	Peach Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
43 *291602722-0043*	Upstairs Bath - FT/Mastic	Blue Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
44 *291602722-0044*	Upstairs Bath - FT/Mastic	Gray/Blue Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
45 *291602722-0045*	Upstairs Bath - FT/Mastic	Brown Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
46 *291602722-0046*	Upstairs Bath - FT/Mastic	Brown Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
47 *291602722-0047*	Upstairs Bath - FT/Mastic	Blue Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
48 *291602722-0048*	Upstairs Bath - FT/Mastic	Blue Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected

Analyst(s)
Billy Barnes (31)
Joshua Moorman (28)

Essie Spencer, Laboratory Manager
or Other Approved Signatory

Initial Report From: 04/28/2016 19:00:00

OrderID: 291602722

Enviro Assessments
City of Greenville, Former Church @ 618 Pitt Street, Gree
4/28/2016 10.0 **TAT:** 24 Hour
PLM Bulk

Order ID: 291602722
No Samples: 48
Due: 04/29 10.00 AM
Fax: 252-527-3055

Enviro Assessments East, Inc.
10705 Hwy 55 West
Dover, NC 28526
Contact: Sammy Lane
PH# 252-560-3363 Fax#252-527-3055
Email: **eae200@embarqmail.com**
labresults@eae-inc.com

LABORATORY TEST REQUEST
Laboratory Name: EMSL Analytical, Inc.
Account Name: City of Greenville
Survey Site: Former Church @
Address: 618 Pitt Street
Greenville, NC 27858

Sample Type: **Asbestos Bulk**	Analysis Type: **PLM**	Date Shipped: 4/27/16
Turn Around Time: **24 HR**	# of Samples: 48	Date Collected: 4/27/16

Special Instructions/Notes

Sample #	Sample type	Location	P/S
1	Shingle	Roof	
2	"	"	
3	felt	"	
4	"	"	
5	Caulk (Exterior)	Windows + Doors	
6	" "	" "	
7	Glazing	Windows	
8	"	"	
9	Ceiling Tile (Main)	T/O 1st Floor	
10	" " "	" " "	
11	" " (Replacement)	" " "	
12	" " "	" " "	
13	Surfacing Material	T/O Foyer + 2nd Floor Ceilings	
14	" "	" " " " "	
15	" "	T/O Sanctuary Ceiling	
16	" "	" " "	
17	" "	Storage Area Ceiling Adjacent to	
18	" "	Sanctuary.	
19	Wall Texture	Rear Section of Sanctuary, Bathroom	
20	" "	Area on 2nd Floor	
21	SR/JC > Composite	T/O	
22	" "	"	
23	Vinyl Floor > DO NOT TEST MASTIC	Foyer	
24	" "	"	
25	Carpet Glue	T/O 1st Floor	
26	" "	" " "	

CHAIN OF CUSTODY RECORD

DATE/TIME	CONDITION OF SAMPLE	SAMPLES RECEIVED BY:	SAMPLES RELEASED BY:
4/27/16	**Double Bagged**	4/28/16 10am	

Enviro Assessments
City of Greenville, Former Church @ 618 Pitt Street, Gree
4/28/2016 10:0
PLM
TAT: 24 Hour
Bulk

Order ID: 291602722
No Samples: 48
Due: 04/29 10:00 AM
Fax: 252-527-3055

Enviro Assessments East, Inc.
10705 Hwy 55 West
Dover, NC 28526
Contact: Sammy Lane
PH# 252-560-3363 Fax#252-527-3055
Email: **eae200@embarqmail.com**
labresults@eae-inc.com

LABORATORY TEST REQUEST
Laboratory Name: EMSL Analytical, Inc.
Account Name: City of Greenville
Survey Site: Former Church @
Address: 618 Pitt Street
Greenville, NC 27858

Sample Type: **Asbestos Bulk**	Analysis Type: **PLM**	Date Shipped: 4/27/16
Turn Around Time: **24 HR**	# of Samples: 48	Date Collected: 4/27/16

Special Instructions/Notes

Sample #	Sample type	Location	P/S
27	Vinyl floor / Glue	Sanctuary - Under Carpet	
28	" " "	" " "	
29	FT/mastic	Women's Restroom 1st Floor	
30	" "	" " " "	
31	" "	Pitt Street Entrance Foyer	
32	" "	" " " "	
33	" "	" " " "	
34	" "	" " " "	
35	" "	" " " "	
36	" "	" " " "	
37	" "	Men's Restroom 1st floor	
38	" "	" " " "	
39	Vinyl Floor } Do NOT TEST MASTIC	2nd Floor - Right Side	
40	" "	" " " "	
41	FT/mastic } DO NOT TEST MASTICS	Upstairs Bath	
42	" "	" "	
43	" "	" "	
44	" "	" "	
45	" "	" "	
46	" "	" "	
47	" "	" "	
48	" "	" "	
49			
50			
51			
52			

CHAIN OF CUSTODY RECORD

DATE/TIME	CONDITION OF SAMPLE	SAMPLES RECEIVED BY:	SAMPLES RELEASED BY:
4/27/16	**Double Bagged**	[signature] 4/28/16 10	[signature]

Part 1 General

1.1 Geotechnical Data

A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information, but are not a warranty of existing conditions. This Document and its attachments are not part of the Contract Documents.

B. A geotechnical investigation report for Project, obtained by Terracon Consultants Inc., dated July 16, 2015, is available for viewing as appended to this Document.

C. A coring thickness report for Poject is available for viewing as appended to this document.

D. Related Requirements:

1. Document 002113 "Instructions to Bidders" for the Bidder's responsibilities for examination of Project Site and existing conditions.

Part 2 Products

Not used.

Part 3 Execution

Not used.

END

Geotechnical Engineering Report

Proposed Greenville Transportation and Activity Center

S. Pitt Street and Clark Street

Greenville, North Carolina

July 16, 2015

Project No. 72155038

Prepared for:

ARK Consulting Group, PLLC
Greenville, North Carolina

Prepared by:

Terracon Consultants, Inc.
Winterville, North Carolina

July 16, 2015

Terracon

ARK Consulting Group, PLLC
3280 Charles Boulevard, Suite B
Greenville, North Carolina 27858

Attn: Mr. Scott T. Anderson, PE
Principal
P: 252-558-0888
E: scott@arkconsultinggroup.com

Re: Geotechnical Engineering Report
Proposed Greenville Transportation and Activity Center
S. Pitt Street and Clark Street
Greenville, NC
Terracon Project No. 72155035

Dear Mr. Anderson:

Terracon Consultants, Inc. (Terracon) has completed the geotechnical engineering services for the above referenced project. This study was performed in general accordance with our proposal P72150040 dated February 10, 2015.

This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations, floor slabs, and pavements for the proposed municipal transportation and activity center.

We appreciate the opportunity to be of service to you on this project. Materials testing services are provided by Terracon. We would be pleased to discuss these services with you. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,

Terracon Consultants, Inc.

Barney C. Hale

Andrew J. Gliniak, P.E.
Geotechnical Project Engineer
Registered NC 042183

Barney C. Hale, P.E.
Senior Geotechnical Engineer

Enclosures

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The following items represent a brief summary of the findings of our subsurface exploration and recommendations for the proposed retail facility to be located on S. Pitt Street and Clark Street in Greenville, North Carolina. A total of 8 borings were advanced to depths of about 5 to 50 feet below the existing ground surface.

- We understand that the portion of the site for the proposed stormwater BMP could not be accessed due to property ownership. Once access to this property is obtained, the seasonal high water table (SHWT) will be determined and infiltration testing will be performed. The SHWT and infiltration test results will be issued under a separate report.

- Based on the results of the borings, subsurface conditions on the project site can be generalized as a loose to medium dense sand and medium stiff to stiff clay underlain by medium dense sand. Fill was encountered in over half of the borings to depths of about 2.5 to 6 feet.

- Support of footings, floor slabs, and pavements on or above existing fill soils is discussed in this report. However, even with the recommended construction testing services, there is an inherent risk for the owner that compressible fill or unsuitable material within or buried by the fill will not be discovered. This risk of unforeseen conditions cannot be eliminated without completely removing the existing fill, but can be reduced by performing additional testing and evaluation during construction.

- A total of 3 buildings are located at the site. After demolition of the structures, the foundations and existing utilities should be completely removed in the proposed building and pavement areas. Excavations should be backfilled with engineered fill.

- Support of the proposed building on a shallow foundation system is recommended after vibratory compaction. The proposed building can be supported on a shallow foundation sized for a net allowable bearing pressure of 2,000 pounds per square foot.

- We recommend Terracon be retained to observe and test the foundation bearing materials as well as other construction materials at the site.

This summary should be used in conjunction with the entire report for design purposes. Details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein. The section titled **GENERAL COMMENTS** should be read for an understanding of report limitations.

GEOTECHNICAL ENGINEERING REPORT
PROPOSED GREENVILLE TRANSPORTATION AND ACTIVITY CENTER
S. PITT STREET AND CLARK STREET
GREENVILLE, NORTH CAROLINA

Terracon Project No. 72155038
July 16, 2015

1.0 INTRODUCTION

We have completed the geotechnical engineering report for the proposed retail facility to be located on S. Pitt Street and Clark Street in Greenville, North Carolina. A total of 8 borings were advanced to depths of about 5 to 50 feet below the existing ground surface. Logs of the borings along with a site location plan and a boring location plan are included in Appendix A of this report.

We understand that the portion of the site for the proposed stormwater BMP could not be accessed due to property ownership. Once access to this property is obtained, the seasonal high water table (SHWT) will be determined and infiltration testing will be performed. The SHWT and infiltration test results will be issued under a separate report.

The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Groundwater conditions
- Earthwork
- Pavements
- Floor slab design and construction
- Seismic considerations
- Foundation recommendation

2.0 PROJECT INFORMATION

2.1 Project Description

ITEM	DESCRIPTION
Site Location	See Appendix A, Exhibit A-1, Site Location Plan
Site layout	See Appendix A, Exhibit A-2, Boring Location Plan
Site GPS	Latitude: 35.6105° Longitude: -77.3774°

ITEM	DESCRIPTION
Structures	The project includes a two story building with a footprint of approximately 6,000 square feet and a total area of approximately 10,000 square feet. The project includes a canopy system that connects the building to bus parking areas. General parking areas are also planned for the project
Building Construction	Steel framed building with concrete slab on grade floors. Asphalt parking lots with concrete bus hard stands.
Maximum loads	Columns: 100 kips (assumed) Walls: 2 kips lf (assumed) Floor: 100 psf (assumed)
Finished floor elevation	Not provided.
Grading	Up to 2 feet of cut/fill will be required (assumed).

2.2 Site Location and Description

ITEM	DESCRIPTION
Location	The proposed location for the Greenville Transportation and Activity Center is between S. Pitt Street and Clark Street, at the intersection of Bonner's Lane in Greenville, NC.
Existing improvements	The area of the proposed transportation center is comprised of numerous small parcels of land that are a combination of developed and grassed, with isolated trees.
Current ground cover	Partially covered with structures and pavements, mostly grassed with some trees.
Existing topography	Relatively level.

3.0 SUBSURFACE CONDITIONS

3.1 Typical Profile

Based on the results of the boring, subsurface conditions on the project site can be generalized as shown on the following table:

Description	Approximate Depth to Bottom of Stratum (feet)	Material Encountered	Consistency/Density
Stratum 1	0.25 to 0.33	Topsoil	NA
Stratum 2A	2.5 to 6	Fill: Silty Sand (SM) Clayey Sand (SC) in Borings B-1, B-2, B-5, B-6, and B-7	Loose to Medium Dense
Stratum 2B	6 to 8	Silty Sand (SM), Lean Clay (CL), Poorly Graded Sand (SP), Clayey Sand (SC), Silty Clay (CL-ML)	Medium Stiff to Stiff/ Loose to Medium Dense
Stratum 3	43	Poorly Graded Sand (SP), Silty Sand (SM), Clayey Sand (SC)	Medium Dense
Stratum 4	Boring Terminated – 50	Clayey Sand	Loose to Medium Dense

Laboratory tests for water content, Atterberg limits, grain size, maximum dry density, and California Bearing Ratio (CBR) were conducted on selected soil samples. The test results are presented in the Appendix B of this report.

Conditions encountered at the boring locations are indicated on the boring logs. Stratification boundaries on the boring logs represent the approximate location of changes in soil types; in-situ, the transition between materials may be gradual. For a comprehensive description of the conditions encountered in the borings, refer to the boring logs in Appendix A of this report.

3.2 Groundwater

Mud rotary drilling techniques were used to advance the borings. The boreholes were observed while drilling for the presence and level of groundwater. Groundwater was observed at a depth of about 18 feet in the deepest boring. The moisture condition of the soil samples supports this groundwater level.

The groundwater level can change due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

3.3 Site Geology

The subject site is located in the Coastal Plain Physiographic Province. The Coastal Plain soils consist mainly of marine sediments that were deposited during successive periods of fluctuating sea level and moving shoreline. The soils include sands, silts, and clays with irregular deposits of shells, which are typical of those lain down in a shallow sloping sea bottom. Recent alluvial sands, silts, and clays are typically present near rivers and creeks.

According USGS Mineral Resources On-Line Spatial Data based off of the 1998 digital equivalent of the official State Geology Map and 1985 Geologic Map of North Carolina, the site is mapped within the Yorktown Formation and Duplin Formation, Undivided

4.0 RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION

4.1 Geotechnical Considerations

The borings encountered a medium dense layer of sand below a surface layer of loose ot medium dense sand and medium stiff to stiff clay. Over half of the borings encountered fill to depths of 2.5 to 6 feet. Footings, floor slabs, and pavements could be supported on or above existing fill soils. However, even with the recommended construction testing services, there is an inherent risk for the owner that compressible fill or unsuitable material within or buried by the fill will not be discovered. This risk of unforeseen conditions cannot be eliminated without completely removing the existing fill, but can be reduced by performing additional testing and evaluation such as proofrolling, test pits, and foundation observations.

A total of 3 buildings are present at the site. After demolition of the structures, the foundations and existing utilities should be completely removed in building and pavement areas. Disturbed soils from the excavations should be undercut. Excavations should then be backfilled with engineered fill.

After demolition and site stripping, the exposed subgrade soils in the building footprints should be densified in-place using a medium weight vibratory roller. The purpose of the vibratory rolling is to improve the exposed subgrade soils prior to placing fill. The exposed subgrade soils should then evaluated by a representative of Terracon to evaluate its stability and suitability relative to supporting new fill under the floor slabs or pavements. Stabilization measures and undercutting may be required prior to placing fill.

The building foundations bearing on the design subgrade could be designed as a shallow foundation system with a net allowable bearing pressure of 2,000 pounds per square foot.

A more complete discussion of these points and additional information is included in the following sections.

4.2 Earthwork

Site preparation should begin with the complete removal and demolition of the existing residence, existing foundations, and surface vegetation within the proposed building and pavement areas. Based on site observations during the drilling process, topsoil should be stripped to a depth of approximately 3 to 4 inches. A Terracon representative should field verify the stripping depth during construction. Topsoil may be reused in areas of the site to be landscaped. Topsoil should not be used as structural fill or backfill.

After stripping, the exposed subgrade soils in the building and parking lot footprints should be densified in place using a medium weight vibratory roller. The purpose of the vibratory rolling is to improve the exposed subgrade soils prior to placing fill. The roller should make at least 6 passes across the site, with the second set of 3 passes perpendicular to the first set of 3 passes. If water is brought to the surface by the vibratory rolling, the operation should be discontinued until the water subsides. Vibratory rolling should be completed during dry weather.

After the vibratory rolling, pore pressures should be allowed to dissipate for a minimum of eighteen hours. After the waiting period, proofrolling should be performed on the exposed subgrade soils in areas to receive fill or at the subgrade elevation in cut areas with a fully loaded, tandem-axle dump truck or similar rubber-tired construction equipment. Proofrolling is recommended as a means of detecting areas of soft or unstable subgrade soils. The proofrolling should be performed during a period of dry weather to avoid degrading an otherwise suitable subgrade. The proofrolling operations should be observed by a representative of the geotechnical engineer. Subgrade soils that exhibit excessive rutting or deflection during proofrolling should be overexcavated as directed by the representative and replaced with properly compacted fill.

Engineered fill should meet the following material property requirements:

Fill Type [1,]	USCS	Acceptable Location for Placement
Imported Soil	SM, SC, SP	All locations and elevations.
On-site Soils	SM, SC, SP, CL, CL-ML	All Locations and elevations.

1. Controlled, compacted fill should consist of approved materials that are free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to the geotechnical engineer for evaluation.

4.2.1 Compaction Requirements

We recommend that the fill be placed as recommended in the following table.

ITEM	DESCRIPTION
Fill Lift Thickness	9-inches or less in loose thickness (4" to 6" lifts when hand-operated equipment is used).
Compaction Requirements [1]	Compact to a minimum of 95% of the materials standard Proctor maximum dry density (ASTM D 698). It is not necessary to achieve 95% compaction during vibratory rolling of subgrade.
Moisture Content – Structural Fill	Within the range of -2% to +2% of optimum moisture content as determined by the standard Proctor test at the time of placement and compaction.

1. Engineered fill should be tested for moisture content and compaction during placement. If in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the tests should be reworked and retested as required until the specified moisture and compaction requirements are achieved.

4.2.2 Grading and Drainage

During construction, grades should be sloped to promote runoff away from the construction area. Final surrounding grades should be sloped away from the structures on all sides to prevent ponding of water. If gutters / downspouts do not discharge directly onto pavement, they should not discharge directly adjacent to the building. This can be accomplished through the use of splash-blocks, downspout extensions, and flexible pipes that are designed to attach to the end of the downspout. Flexible pipe should only be used if it is daylighted in such a manner that it gravity-drains collected water. Splash-blocks should also be considered below hose bibs and water spigots.

4.2.3 Construction Considerations

Performing earthwork operations during warmer periods of the year (May through October) will reduce the potential for problems associated with unstable subgrades. Site drying conditions are typically enhanced when it is warm. The moisture sensitivity of the on-site soils does not preclude performing earthwork at other times of the year, but does lead to an increased potential for having to perform overexcavation and replacement or some other form of remedial work.

The site should be graded to prevent ponding of surface water on the prepared subgrades or in excavations. If the subgrade should become frozen, desiccated, saturated, or disturbed, the affected material should be removed or these materials should be scarified, moisture conditioned, and recompacted.

As a minimum, all temporary excavations should be sloped or braced as required by Occupational Safety and Health Administration (OSHA) regulations to provide stability and safe

working conditions. Temporary excavations will most likely be required during grading operations. The grading contractor, by his contract, is usually responsible for designing and constructing stable, temporary excavations and should shore, slope or bench the sides of the excavations as required, to maintain stability of both the excavation sides and bottom. All excavations should comply with applicable local, state and federal safety regulations, including the current OSHA Excavation and Trench Safety Standards.

The geotechnical engineer should be retained during the construction phase of the project to observe earthwork and to perform necessary tests and observations during subgrade preparation; vibratory rolling, proofrolling; placement and compaction of controlled compacted fills; and backfilling of excavations.

4.3 Foundation Recommendations

4.3.1 Shallow Foundations

The building can be supported by a shallow foundation system after site preparation including the removal of existing foundations and vibratory rolling of the building footprint. The shallow foundations can consist of either isolated column and wall footings or thickened portions of a monolithic slab.

Design recommendations for a shallow foundation system are presented in the following table and paragraphs.

DESCRIPTION	VALUE
Maximum Net allowable bearing pressure [1, 2]	2,000 psf
The required embedment below lowest adjacent finished grade for frost protection and protective embedment [3]	12 inches
Minimum embedment depth	24 inches
Minimum width for continuous wall footings	16 inches for strip footings 12 inches for thickened edge
Minimum width for isolated column footings	24 inches
Approximate total settlement [4]	Up to 1 inch
Estimated differential settlement [4]	Up to 1/2 inch along 40 feet of wall
Ultimate coefficient of sliding friction	0.35

1. The recommended net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation.
2. The maximum net allowable bearing pressure may be increased by 1/3 for temporary wind loads.
3. For frost protection and to reduce effects of seasonal moisture variations in subgrade soils. For perimeter footings and footings beneath unheated areas.
4. The actual magnitude of settlement that will occur beneath the foundations will depend upon the variations within the subsurface soil profile, the structural loading conditions and the quality of the foundation excavation. The estimated total and differential settlements listed assume that the foundation-related earthwork and the foundation design are completed in accordance with our recommendations.

4.3.2 Construction Considerations

The foundation bearing materials should be evaluated at the time of the foundation excavation. This is an essential part of the construction process. A representative of the geotechnical engineer should use a combination of hand auger borings and dynamic cone penetrometer (DCP) testing to determine the suitability of the bearing materials for the design bearing pressure. DCP testing should be performed to a depth of 3 to 5 feet below the bottom of footing excavation. Excessively soft, loose or wet bearing soils should be overexcavated to a depth recommended by the geotechnical engineer. The footings could then bear directly on these soils at the lower level or the excavated soils could be replaced with compacted soil fill or washed, crushed stone (NCDOT No. 57) wrapped in a geotextile fabric (Mirafi 140 N or equivalent).

The base of all foundation excavations should be free of water and loose soil prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Should the soils at bearing level become excessively disturbed or saturated, the affected soil should be removed prior to placing concrete.

4.4 Seismic Considerations

Code Used	Seismic Parameters[1]
2012 North Carolina Building Code	Seismic Site Class D Ss = 0.159 S_1 = 0.065 S_{ms} = 0.255 S_{m1} = 0.157 S_{DS} = 0.170 S_{D1} = 0.105

1) Seismic parameters are based off of the 2009 International building code (IBC) referenced in the 2012 NC Building Code.

Based on our experience with the geology of the area, it is our opinion that the subsurface characteristics reflect those of Site Class D as described in the 2012 North Carolina State Building Code. Liquefaction of sand is not expected based on the relatively low level of ground motions projected for a seismic event.

4.5 Floor Slabs

4.5.1 Design Recommendations

ITEM	DESCRIPTION
Floor slab support	Approved existing soils or new engineered fill
Modulus of subgrade reaction	100 pounds per square inch per inch (psi/in) for point loading conditions
Base Course/Capillary Break Layer	4 inches of washed crushed stone (No. 57)

Saw-cut control joints should be placed in the slab to help control the location and extent of cracking. For additional recommendations, refer to the ACI Design Manual.

The use of a vapor retarder should be considered beneath concrete slabs on grade that will be covered with wood, tile, carpet or other moisture sensitive or impervious coverings. The slab designer should refer to ACI 302 and/or ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder.

4.5.2 Construction Considerations

On most project sites, the site grading is generally accomplished early in the construction phase. However as construction proceeds, the subgrade may be disturbed due to utility excavations, construction traffic, desiccation, rainfall, etc. If such disturbance occurs, the floor slab subgrade may not be suitable for placement of the stone sub base and concrete and corrective action will be required.

We recommend the area underlying the structure footprint be rough graded and evaluated for stability prior to the placement of the sub-base layer. Particular attention should be paid to high traffic areas that were rutted and disturbed by construction activities and to areas where backfilled trenches are located. Areas where unsuitable conditions are located should be repaired by removing and replacing the affected material with properly compacted fill. Floor slab subgrade areas should be moisture conditioned and properly compacted to the recommendations in this report immediately prior to placement of the aggregate base course and concrete.

4.6 Pavements

The pavement subgrade should be thoroughly vibratory compacted and proofrolled as outlined in section **4.2 Earthwork** of this report. Soft or loose soils delineated by the proofrolling operations should be undercut and backfilled as recommended by the geotechnical engineer. The use of a geosynthetic fabric and additional crushed stone is also a potential option for subgrade improvement. Upon completion of any necessary remediation, the subgrade should be adequate for support of the pavement sections recommended below.

Pavement thickness design is dependent upon the following:

- Anticipated traffic conditions during the life of the pavement.
- Subgrade and paving material characteristics.
- Climatic conditions of the region.

We have assumed that traffic loads at the site will be produced primarily by busses in the heavy duty areas and by passenger cars for the light duty areas. Two pavement section alternatives have been provided. The light-duty pavement sections are for car parking areas only. Heavy-duty pavement sections should be used for areas with bus traffic, concentrated car traffic (drive lanes / entrance drives), and garbage/delivery truck traffic areas.

Recommended pavement sections are listed in the following table. For areas subject to concentrated and repetitive loading conditions, i.e. dumpster pads and ingress/egress aprons, or in areas where vehicles will turn at low speeds, we recommend using a Portland cement concrete pavement with a thickness of at least 7 inches underlain by at least 4 inches of crushed stone. For dumpster pads, the concrete pavement area should be large enough to support the container and tipping axle of the refuse truck.

Recommended Pavement Sections			
Pavement Type	**Material**	**Layer Thickness (inches)**	
		Light Duty	**Heavy Duty**
Rigid	Portland Cement Concrete (4,000 psi)	5	7
	Crushed Aggregate Base Course (NCDOT CABC Type 1 or Type 2)	4	4
Flexible (Superpave)	Asphalt Surface (NCDOT S-9.5A)	3[1]	1.5
	Asphalt Binder (NCDOT I-19.0B)	--	2.5
	Crushed Aggregate Base Course (NCDOT CABC Type 1 or Type 2)	6	8

1. Placed in two 1.5 inch lifts

The placement of a partial pavement thickness for use during construction is not suggested without a detailed pavement analysis incorporating construction traffic. In addition, we should be contacted to confirm the traffic assumptions outlined above. If the actual traffic varies from the assumptions outlined above, modification of the pavement section thickness will be required.

Recommendations for pavement construction presented depend upon compliance with recommended material specifications. To assess compliance, observation and testing should be performed under the direction of the geotechnical engineer.

Asphalt concrete and aggregate base course materials should conform to the North Carolina Department of Transportation (NCDOT) “Standard Specifications for Roads and Structures”. Concrete pavement materials should conform to ACI 330.1 “Specifications for Unreinforced Parking Lots”. Concrete pavement should be air-entrained and have a minimum compressive strength of 4,000 psi after 28 days of laboratory curing per ASTM C-31. ACI 330R-01 recommendations should be followed concerning control and expansion joints, as well as other concrete pavement practices.

The performance of all pavements can be enhanced by minimizing excess moisture which can reach the subgrade soils. The following recommendations should be considered a minimum:

- Site grading at a minimum 2 percent grade away from the pavements.
- Subgrade and pavement surface with a minimum 1/4 inch per foot slope to promote proper surface drainage.
- Installation of joint sealant to seal cracks immediately.

Preventative maintenance should be planned and provided for through an ongoing pavement management program to enhance future pavement performance. Preventative maintenance activities are intended to slow the rate of pavement deterioration and to preserve the pavement investment. Preventative maintenance, which consists of both localized maintenance (e.g. crack and joint sealing and patching) and global maintenance (e.g. surface sealing), is usually the first priority when implementing a planned pavement maintenance program and provides the highest return on investment for pavements.

5.0 GENERAL COMMENTS

Terracon should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide observation and testing services during grading, excavation, foundation construction and other earth-related construction phases of the project.

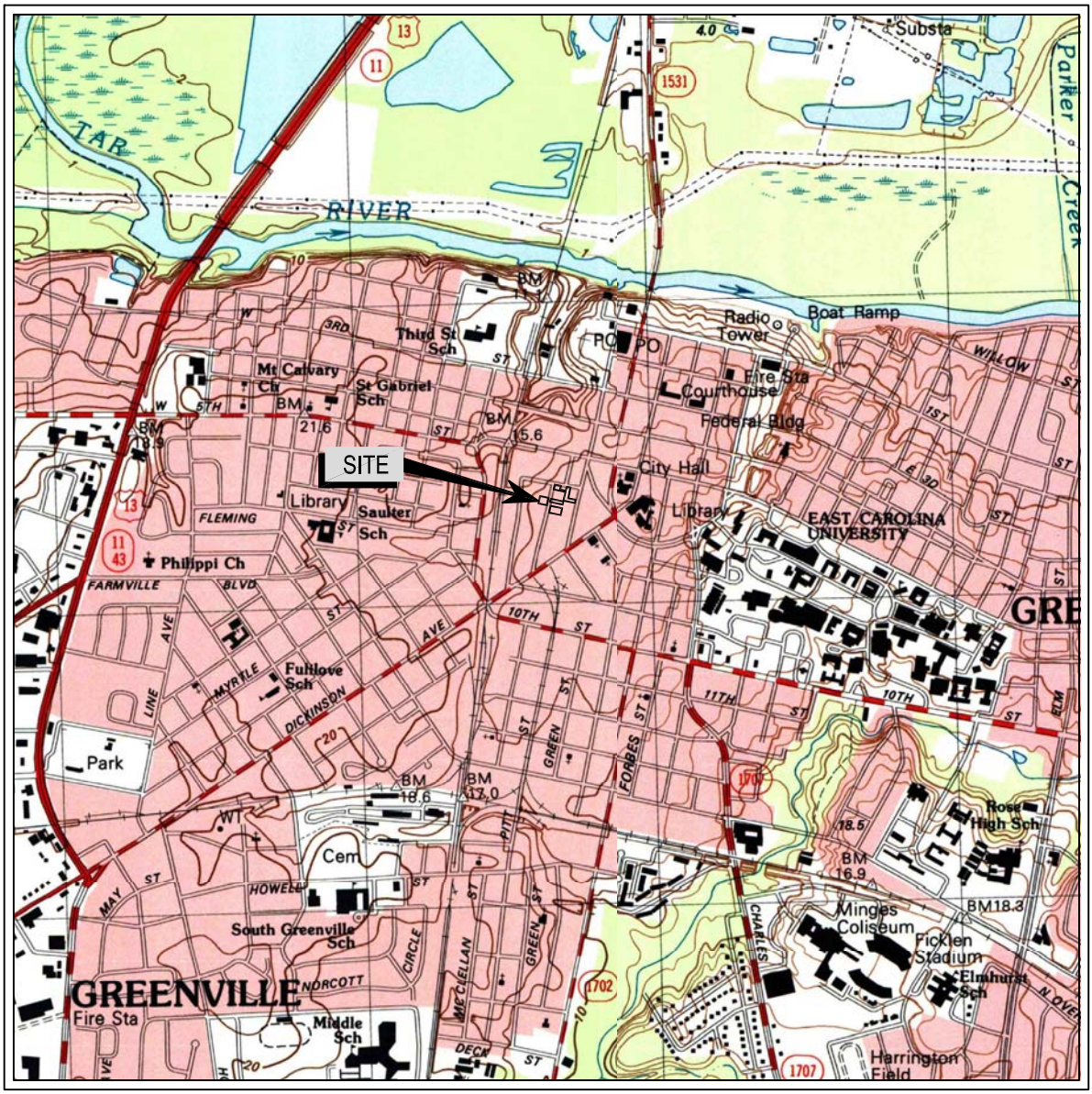
The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

APPENDIX A
FIELD EXPLORATION

UNITED STATES – DEPARTMENT OF THE INTERIOR – GEOLOGICAL SURVEY



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1 .5 0 KILOMETERS 1 2

1000 0 METERS 1000 2000

1 .5 0 1

MILES

1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10 000

FEET

CONTOUR INTERVAL 2 FEET

NATIONAL GEODETIC VERTICAL DATUM OF 1929

N

QUADRANGLE

*GREENVILLE SOUTHWEST, NC & GREENVILLE SOUTHEAST, NC

1998

7.5 MINUTE SERIES (TOPOGRAPHIC)

*INDICATES WHICH MAP SITE IS LOCATED ON

Project Mngr:	AJG
Drawn By:	DWD
Checked By:	AJG/MRF
Approved By:	CB
Project No.	72155038
Scale:	AS SHOWN
File No.	GEO72155038-1
Date:	JULY 2015

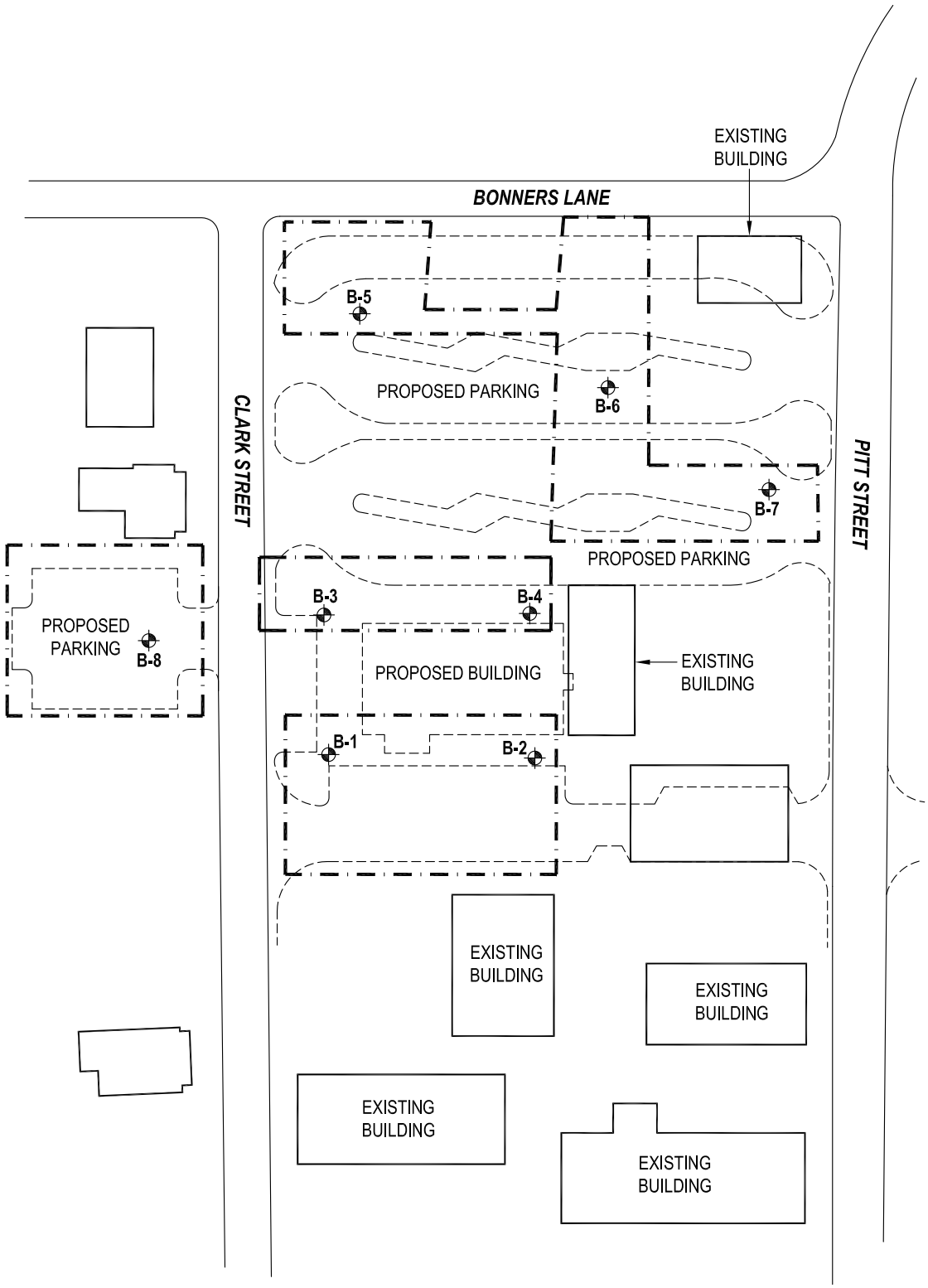
Terracon
Consulting Engineers and Scientists
314 Beacon Drive Winterville, NC 28590
(252) 353-1600 (252) 353-0002

SITE LOCATION PLAN

GEOTECHNICAL ENGINEERING REPORT
GREENVILLE TRANSPORTATION CENTER
CLARK STREET & BONNERS LANE
GREENVILLE, NC

EXHIBIT

A-1



LEGEND

SITE

APPROXIMATE BORING LOCATION

THIS DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Mngr:	AJG
Drawn By:	DWD
Checked By:	AJG/MRF
Approved By:	BCH
Project No.	72155038
Scale:	AS SHOWN
File No.	GEO72155038-2
Date:	JULY 2015

Terracon
Consulting Engineers and Scientists
314 Beacon Drive Winterville, NC 28590
(252) 353-1600 (252) 353-0002

BORING LOCATION PLAN

GEOTECHNICAL ENGINEERING REPORT
GREENVILLE TRANSPORTATION CENTER
CLARK STREET & BONNERS LANE
GREENVILLE, NC

EXHIBIT

A-2

Field Exploration Description

The boring locations were marked by a surveyor provided by Ark Consulting Group, PLLC. GPS locations of the borings were recorded by referencing existing site features on aerial photography. The locations of the borings should be considered accurate only to the degree implied by the means and methods used to define them.

The soil test borings were performed by a trailer-mounted power drilling rig utilizing mud rotary drilling procedures to advance the boreholes. The drilling tools were removed from the borehole and representative soil samples were obtained at 2.5 to 5 foot intervals using split-barrel sampling procedures. In the split barrel sampling procedure, the number of blows required to advance a standard 2 inch O.D. split barrel sampler the last 12 inches of the typical total 18 inch penetration by means of a 140 pound safety hammer with a free fall of 30 inches, is the standard penetration resistance value (SPT-N). This value is used to estimate the in-situ relative density of cohesionless soils and consistency of cohesive soils. Soil samples were taken at 2.5 foot intervals above a depth of 10 feet and at 5 foot intervals below 10 feet.

An automatic SPT hammer was used to advance the split-barrel sampler in the borings performed on this site. A greater efficiency is typically achieved with the automatic hammer compared to the conventional safety hammer operated with a cathead and rope. Published correlations between the SPT values and soil properties are based on the lower efficiency cathead and rope method. This higher efficiency affects the standard penetration resistance blow count (N) value by increasing the penetration per hammer blow over what would be obtained using the cathead and rope method. The effect of the automatic hammer's efficiency has been considered in the interpretation and analysis of the subsurface information for this report.

The samples were tagged for identification, sealed to reduce moisture loss, and taken to our laboratory for further examination, testing, and classification. Information provided on the boring logs attached to this report includes soil descriptions, consistency evaluations, boring depths, sampling intervals, and groundwater conditions.

A field log of each boring was prepared by the drill crew. These logs included visual classifications of the materials encountered during drilling as well as the driller’s interpretation of the subsurface conditions between samples. Final boring logs included with this report represent the engineer's interpretation of the field logs and include modifications based on laboratory observation and tests of the samples. Additional information provided on the boring logs attached to this report includes soil descriptions, consistency evaluations, boring depths, sampling intervals, and groundwater conditions.

BORING LOG NO. B-1

PROJECT: Proposed Greenville Transportation and Activity Center

CLIENT: ARK Consulting Group PLLC
Greenville, NC

SITE: S Pitt St and Clark St
Greenville, NC

LOCATION See Exhibit A-2

Latitude: 35.610219° Longitude: -77.377521°

DEPTH	GRAPHIC LOG	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SAMPLE	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.3									
	Grass/Topsoil/Rootmat								
	FILL - SILTY SAND (SM), trace gravel and organics, dark brownish gray, very loose			X	2-2-1 N=3	1			
3.0									
	POORLY GRADED SAND (SP), trace gravel, light tannish brown and orange, loose to medium dense			X	2-2-3 N=5	2			
		5							
				X	4-4-5 N=9	3			
				X	5-6-8 N=14	4			
		10							
			▨						
				X	8-8-9 N=17	5			
		15							
				X	9-11-17 N=28	6			
20.0		20							
	Boring Terminated at 20 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud Rotary

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

▨ *Dry cave*

Terracon
314 Beacon Drive
Winterville, North Carolina

Boring Started: 6/24/2015 Boring Completed: 6/24/2015

Drill Rig: 45D-14 Driller: Carolina Drilling, Inc.

Project No.: 72155038 Exhibit: A-4

BORING LOG NO. B-2

PROJECT: Proposed Greenville Transportation and Activity Center

CLIENT: ARK Consulting Group PLLC
Greenville, NC

SITE: S Pitt St and Clark St
Greenville, NC

LOCATION See Exhibit A-2

Latitude: 35.610056° Longitude: -77.377274°

DEPTH	GRAPHIC LOG		DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SAMPLE	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.3		**Grass/Topsoil/Rootmat**								
		FILL - SILTY SAND (SM), with gravel, black, loose			X	3-3-3 N=6	1			
3.0		**FILL - CLAYEY SAND (SC)**, trace wood and gravel, light tan and orange, loose			X	2-3-5 N=8	2			
6.0		**SILTY CLAY (SM)**, with gravel, orange and light tan, medium dense	5		X	3-5-7 N=12	3			
8.0		**POORLY GRADED SAND (SP)**, with gravel, light tan and orange, medium dense			X	6-6-6 N=12	4			
			10	▽						
					X	5-7-8 N=15	5			
			15							
					X	6-8-10 N=18	6			
20.0		***Boring Terminated at 20 Feet***	20							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud Rotary

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

▽ *Dry cave*

Terracon
314 Beacon Drive
Winterville, North Carolina

Boring Started: 6/24/2015 | Boring Completed: 6/24/2015

Drill Rig: 45D-14 | Driller: Carolina Drilling, Inc.

Project No.: 72155038 | Exhibit: A-5

BORING LOG NO. B-3

PROJECT: Proposed Greenville Transportation and Activity Center

CLIENT: ARK Consulting Group PLLC
Greenville, NC

SITE: S Pitt St and Clark St
Greenville, NC

LOCATION See Exhibit A-2

Latitude: 35.610362° Longitude: -77.377189°

DEPTH	GRAPHIC LOG		DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SAMPLE	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.3		**Grass/Topsoil/Rootmat**								
		SILTY SAND (SM), light tannish gray, loose			X	2-2-3 N=5	1	4		
3.0										
		LEAN CLAY WITH SAND (CL), gray and orange, stiff			X	2-3-5 N=8	2	16		
6.0			5							
		SILTY SAND (SM), trace gravel, tannish gray and orange to orange brown, medium dense to dense			X	3-5-7 N=12	3	13		
					X	3-6-8 N=14	4	12	NP	14
			10							
					X	4-8-11 N=19	5	18		
			15	▽						
					X	32-15-17 N=32	6	15		
			20							
23.0		**CLAYEY SAND (SC)**, dark gray, medium dense			X	9-13-12 N=25	7	35		
			25							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud Rotary

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *While Drilling*

Terracon
314 Beacon Drive
Winterville, North Carolina

Boring Started: 6/24/2015 Boring Completed: 6/24/2015

Drill Rig: 45D-14 Driller: Carolina Drilling, Inc.

Project No.: 72155038 Exhibit: A-6

BORING LOG NO. B-3

PROJECT: Proposed Greenville Transportation and Activity Center

CLIENT: ARK Consulting Group PLLC
Greenville, NC

SITE: S Pitt St and Clark St
Greenville, NC

LOCATION See Exhibit A-2

Latitude: 35.610362° Longitude: -77.377189°

DEPTH	GRAPHIC LOG		DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SAMPLE	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		CLAYEY SAND (SC), dark gray, medium dense *(continued)*								
28.0		**SILTY SAND (SM)**, trace mica, dark gray and light gray, medium dense			X	4-6-8 N=14	8	25		
			30							
					X	5-8-7 N=15	9	25		
			35							
					X	4-4-7 N=11	10	17		
43.0		**CLAYEY SAND (SC)**, dark gray to black, loose to medium dense	40							
					X	3-3-3 N=6	11	28		
			45							
50.0					X	5-10-7 N=17	12	24		
		Boring Terminated at 50 Feet	50							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud Rotary

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

While Drilling

Terracon
314 Beacon Drive
Winterville, North Carolina

Boring Started: 6/24/2015 Boring Completed: 6/24/2015

Drill Rig: 45D-14 Driller: Carolina Drilling, Inc.

Project No.: 72155038 Exhibit: A-6

BORING LOG NO. B-4

PROJECT: Proposed Greenville Transportation and Activity Center

CLIENT: ARK Consulting Group PLLC
Greenville, NC

SITE: S Pitt St and Clark St
Greenville, NC

LOCATION See Exhibit A-2

Latitude: 35.6104° Longitude: -77.377472°

DEPTH	GRAPHIC LOG		DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SAMPLE	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.3		**Grass/Topsoil/Rootmat**								
		SILTY SAND (SM), light tannish gray, medium dense			X	6-7-7 N=14	1			
3.0		**SANDY LEAN CLAY (CL)**, gray, red and orange, medium stiff			X	2-5-5 N=10	2			
6.0		**SILTY SAND (SM)**, light tan and orange, loose to medium dense	5		X	3-3-4 N=7	3			
					X	4-7-11 N=18	4			
13.0		**POORLY GRADED SAND (SP)**, orange and light tan, medium dense	10	▨	X	5-7-8 N=15	5			
			15		X	6-6-9 N=15	6			
20.0		***Boring Terminated at 20 Feet***	20							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud Rotary

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

▨ *Dry cave*

Terracon
314 Beacon Drive
Winterville, North Carolina

Boring Started: 6/24/2015 Boring Completed: 6/24/2015

Drill Rig: 45D-14 Driller: Carolina Drilling, Inc.

Project No.: 72155038 Exhibit: A-7

BORING LOG NO. B-5

PROJECT: Proposed Greenville Transportation and Activity Center

CLIENT: ARK Consulting Group PLLC
Greenville, NC

SITE: S Pitt St and Clark St
Greenville, NC

LOCATION See Exhibit A-2

Latitude: 35.610742° Longitude: -77.377307°

GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SAMPLE	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	0.3 **Grass/Topsoil/Rootmat**								
	FILL - SILTY SAND (SM), with brick fragments, dark brownish gray, medium dense			X	12-9-7 N=16	1			
	3.0 **SANDY LEAN CLAY (CL)**, gray and orange, medium stiff			X	3-2-3 N=5	2			
	5.0 ***Boring Terminated at 5 Feet***	5							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud Rotary

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
314 Beacon Drive
Winterville, North Carolina

Boring Started: 6/24/2015 Boring Completed: 6/24/2015

Drill Rig: 45D-14 Driller: Carolina Drilling, Inc.

Project No.: 72155038 Exhibit: A-8

BORING LOG NO. B-6

PROJECT: Proposed Greenville Transportation and Activity Center

CLIENT: ARK Consulting Group PLLC
Greenville, NC

SITE: S Pitt St and Clark St
Greenville, NC

LOCATION See Exhibit A-2

Latitude: 35.610599° Longitude: -77.376971°

GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SAMPLE	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	0.3 **Grass/Topsoil/Rootmat**								
	FILL - SILTY SAND (SM), with glass and brick fragments, dark brownish gray, loose			X	5-2-2 N=4	1			
	2.5 **SANDY SILTY CLAY (CL-ML)**, light gray, loose								
		5		X	3-3-3 N=6	2			
	6.0 ***Boring Terminated at 6 Feet***								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud Rotary

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
314 Beacon Drive
Winterville, North Carolina

Boring Started: 6/24/2015 Boring Completed: 6/24/2015

Drill Rig: 45D-14 Driller: Carolina Drilling, Inc.

Project No.: 72155038 Exhibit: A-9

BORING LOG NO. B-7

PROJECT: Proposed Greenville Transportation and Activity Center

CLIENT: ARK Consulting Group PLLC
Greenville, NC

SITE: S Pitt St and Clark St
Greenville, NC

LOCATION See Exhibit A-2

Latitude: 35.610401° Longitude: -77.376712°

GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SAMPLE	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	0.3 **Grass/Topsoil/Rootmat**								
	FILL - SILTY SAND (SM), trace gravel and glass debris, dark brownish gray and orange, loose			X	5-4-5 N=9	1			
	3.0 **CLAYEY SAND (SC)**, light gray and orange, loose								
	5.0			X	2-3-2 N=5	2			
	Boring Terminated at 5 Feet	5							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud Rotary

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
314 Beacon Drive
Winterville, North Carolina

Boring Started: 6/24/2015 Boring Completed: 6/24/2015

Drill Rig: 45D-14 Driller: Carolina Drilling, Inc.

Project No.: 72155038 Exhibit: A-10

BORING LOG NO. B-8

PROJECT: Proposed Greenville Transportation and Activity Center

CLIENT: ARK Consulting Group PLLC
Greenville, NC

SITE: S Pitt St and Clark St
Greenville, NC

LOCATION See Exhibit A-2

Latitude: 35.610434° Longitude: -77.377793°

GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SAMPLE	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	0.3 **Grass/Topsoil/Rootmat**								
	CLAYEY SAND (SC), orange, loose			X	5-3-2 N=5	1			
	3.0 **SANDY LEAN CLAY (CL)**, gray and orange, stiff			X	5-4-5 N=9	2			
	5.0 ***Boring Terminated at 5 Feet***	5							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud Rotary

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
314 Beacon Drive
Winterville, North Carolina

Boring Started: 6/24/2015 Boring Completed: 6/24/2015

Drill Rig: 45D-14 Driller: Carolina Drilling, Inc.

Project No.: 72155038 Exhibit: A-11

APPENDIX B
LABORATORY TESTING

Laboratory Test Description

Descriptive classifications of the soils indicated on the boring logs are in accordance with the enclosed General Notes and the Unified Soil Classification System. Also shown are estimated Unified Soil Classification Symbols. A brief description of this classification system is attached to this report. Soils laboratory testing was performed under the direction of a geotechnical engineer and included visual classification, moisture content, grain size analysis, Atterberg limits, optimum dry density, and California Bearing Ratio (CBR) testing as appropriate. The results of the laboratory testing are shown on the borings logs, Appendix B, and the following tables.

Atterberg Limits / Gradation

Boring Number	Sample Depth (feet)	Liquid Limit (%)	Plasticity Index (%)	#200 Wash (%)	Natural Moisture (%)
B-3	8.5 – 10	NP	NP	14	12
B-6	2.5 – 6	17	4	55	---

Moisture-Density Relationship (Proctor) / CBR

Boring Number	Sample Depth (feet)	Maximum Dry Density	Optimum Moisture Content	CBR
B-6	2.5 – 6	115	12	8

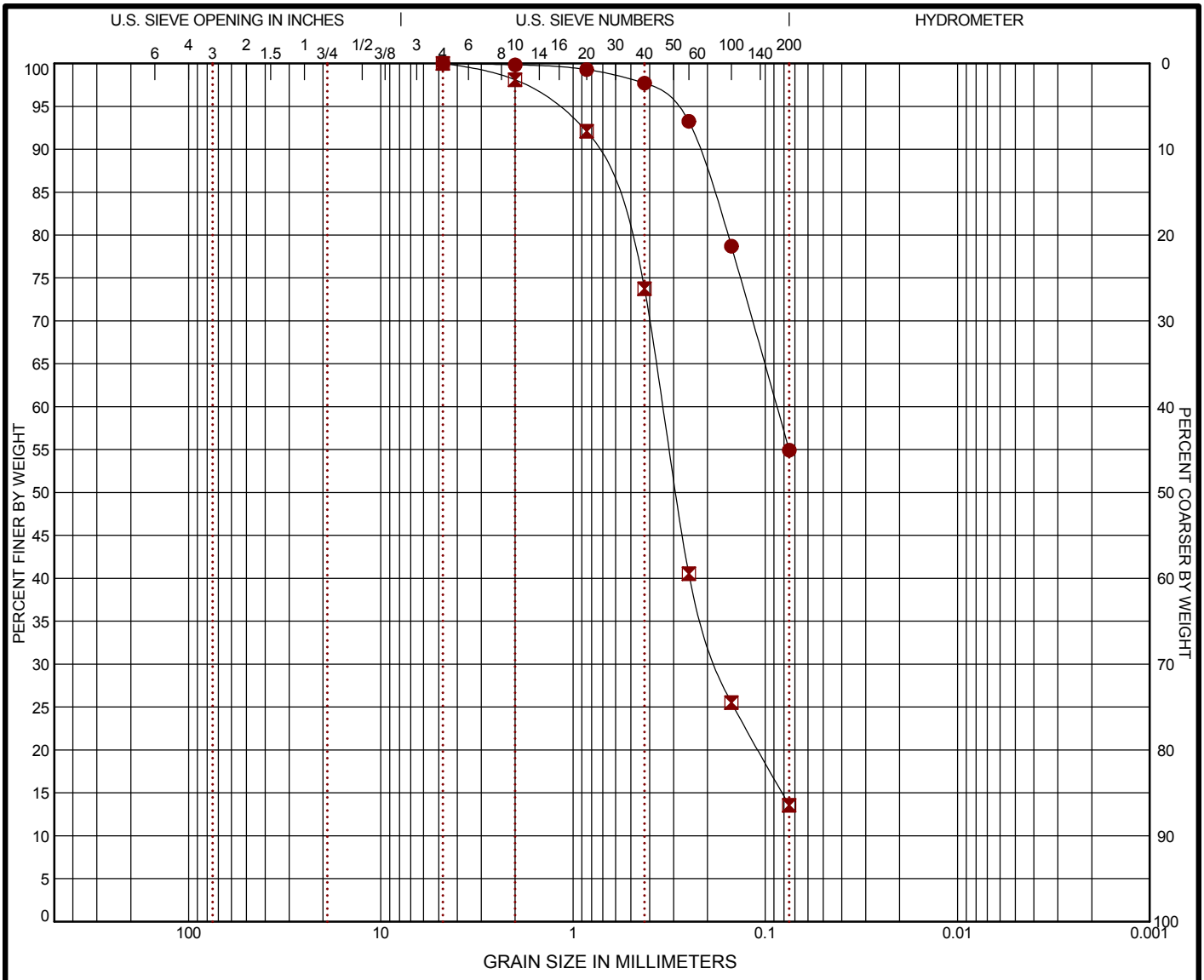
The laboratory test methods are described in the ASTM Standards listed below:

ASTM D2216 Standard Test Method of Determination of Water Content of Soil and Rock by Mass
ASTM D2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D2488 Standard Practice of Description and Identification of Soils (Visual Manual Method)
ASTM D422 Standard Test Method for Particle Size Analysis of Soils
ASTM D1140 Standard Test Methods for Determining the Amount of Material Finer than No. 200 Sieve in Soils by Washing
ASTM D4318 Standard Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils
ASTM D698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort
ASTM D1883 Standard Test Method for California Bearing Ration (CBR) of Laboratory-Compacted Soils

Procedural standards noted above are for reference to methodology in general. In some cases variations to methods are applied as a result of local practice or professional judgment.

GRAIN SIZE DISTRIBUTION

ASTM D422



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	**BS-6**	**2.5 - 6**	**0.0**	**0.0**	**45.1**		**54.9**		**CL-ML**
⊠	**B-3**	**8.5 - 10**	**0.0**	**0.0**	**86.4**		**13.6**		**SM**

	GRAIN SIZE		
	●	⊠	
D_{60}	**0.087**	**0.341**	
D_{30}		**0.175**	
D_{10}			
	COEFFICIENTS		
C_C			
C_U			

SIEVE (size)	PERCENT FINER ●	PERCENT FINER ⊠	
1 1/2"			
1"			
3/4"			
1/2"			
3/8"			
#4	**100.0**	**100.0**	
#10	**99.83**	**98.09**	
#20	**99.28**	**92.09**	
#40	**97.7**	**73.75**	
#60	**93.25**	**40.54**	
#100	**78.7**	**25.52**	
#200	**54.93**	**13.56**	

SOIL DESCRIPTION

● DARK GRAY, LIGHT GRAY & ORANGE SANDY SILTY CLAY

⊠ TANNISH GRAY & ORANGE SILTY SAND

REMARKS

● Proposed soil subgrade for pavement section

⊠

PROJECT: Proposed Greenville Transportation and Activity Center

SITE: S Pitt St and Clark St Greenville, NC

Terracon

314 Beacon Drive
Winterville, North Carolina

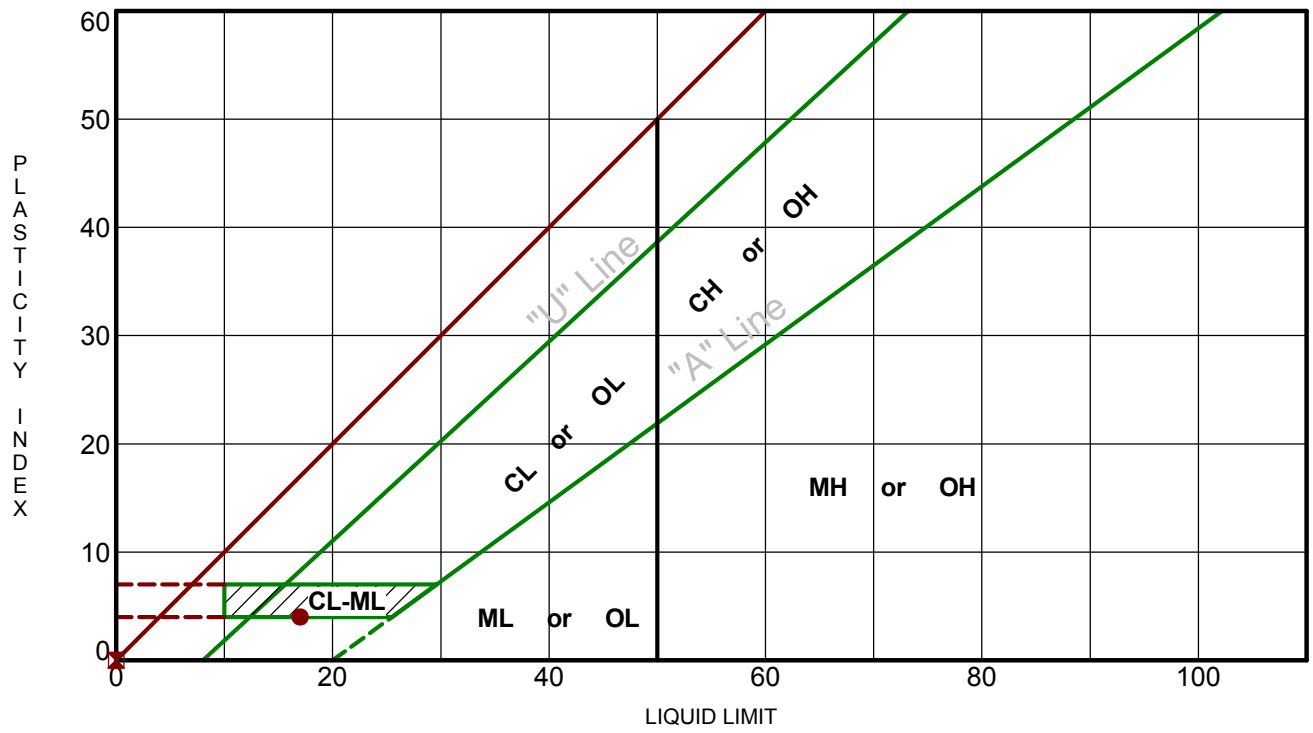
PROJECT NUMBER: 72155038

CLIENT: ARK Consulting Group PLLC Greenville, NC

EXHIBIT: B-2

ATTERBERG LIMITS RESULTS

ASTM D4318



Boring ID	Depth	LL	PL	PI	Fines	USCS	Description
● BS-6	2.5 - 6	17	13	4	55	CL-ML	DARK GRAY, LIGHT GRAY & ORANGE SANDY SILTY CLAY
⊠ B-3	8.5 - 10	NP	NP	NP	14	SM	TANNISH GRAY & ORANGE SILTY SAND

PROJECT: Proposed Greenville Transportation and Activity Center

SITE: S Pitt St and Clark St Greenville, NC

Terracon
314 Beacon Drive
Winterville, North Carolina

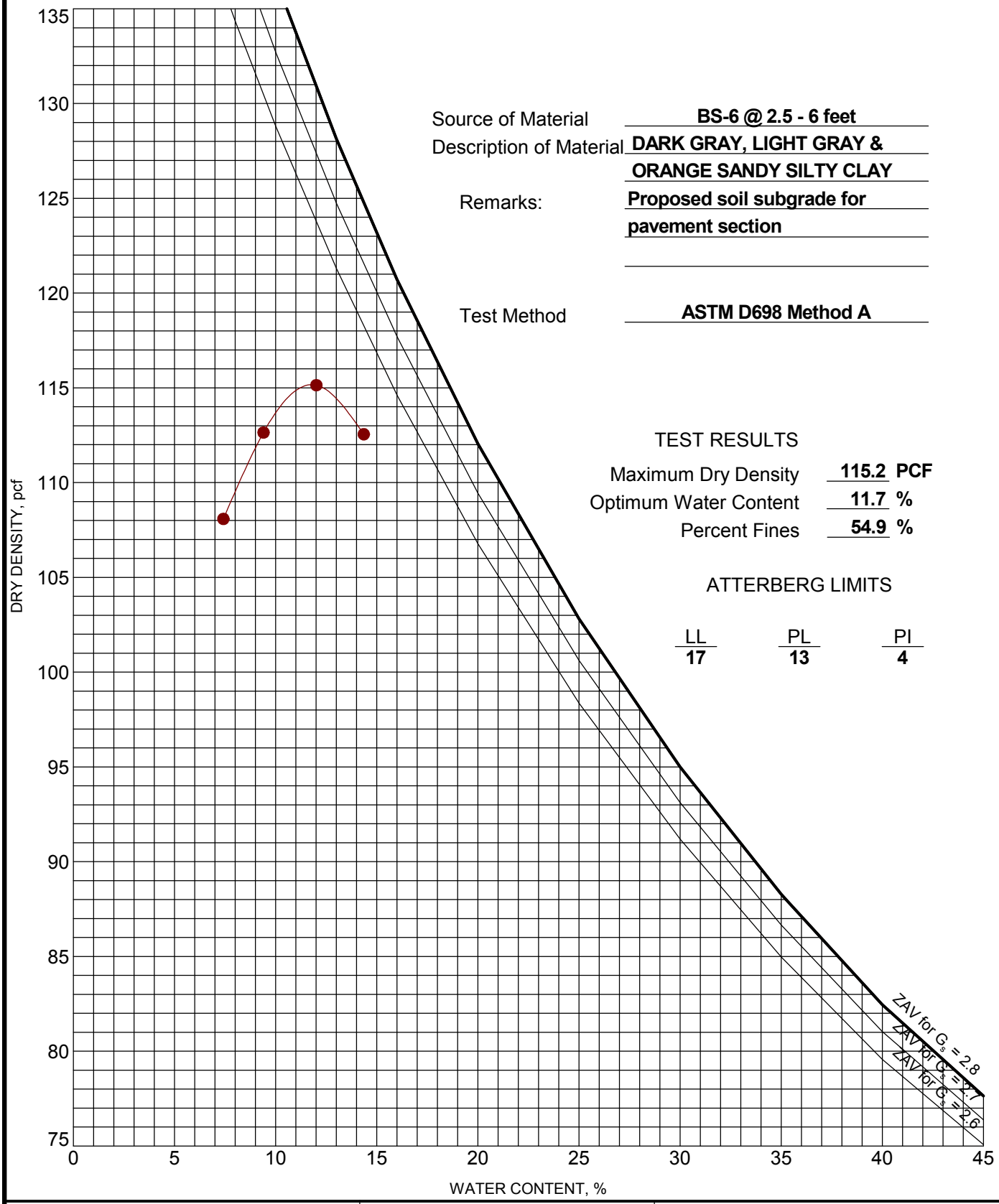
PROJECT NUMBER: 72155038

CLIENT: ARK Consulting Group PLLC Greenville, NC

EXHIBIT: B-3

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material: **BS-6 @ 2.5 - 6 feet**

Description of Material: **DARK GRAY, LIGHT GRAY & ORANGE SANDY SILTY CLAY**

Remarks: **Proposed soil subgrade for pavement section**

Test Method: **ASTM D698 Method A**

TEST RESULTS

Maximum Dry Density	**115.2**	**PCF**
Optimum Water Content	**11.7**	**%**
Percent Fines	**54.9**	**%**

ATTERBERG LIMITS

LL	PL	PI
17	**13**	**4**

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. COMPACTION - V2 72155038 PROPOSED GREENVILLE TRANSPORTATION AND ACTIVITY CENTER; GREENVILLE, NC.GPJ LOGS.GPJ 7/16/15

PROJECT: Proposed Greenville Transportation and Activity Center

SITE: S Pitt St and Clark St Greenville, NC

Terracon

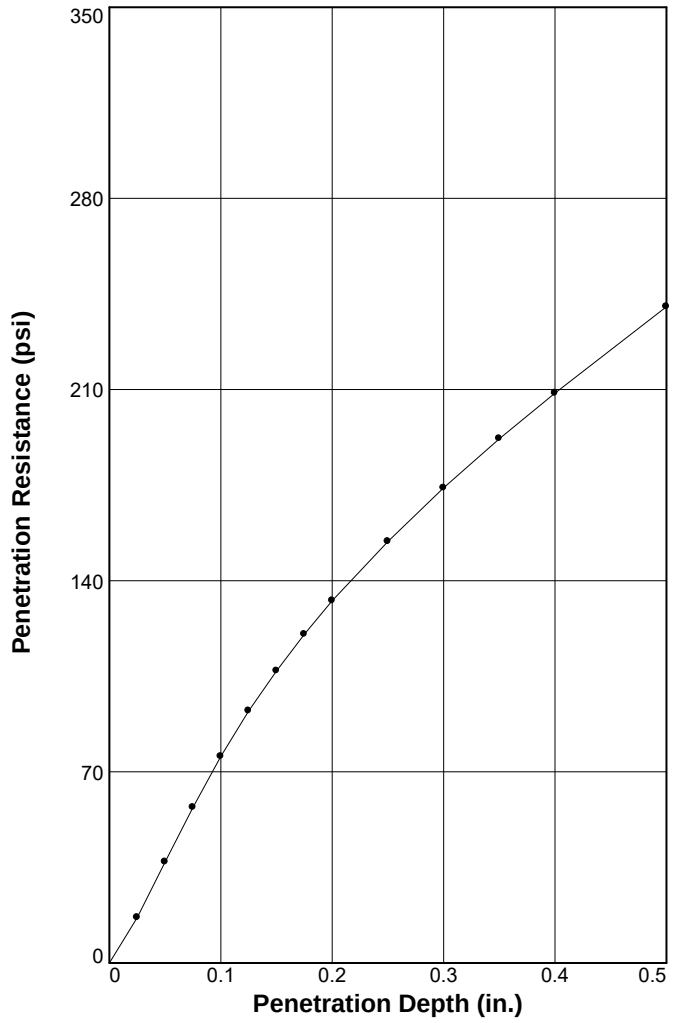
314 Beacon Drive
Winterville, North Carolina

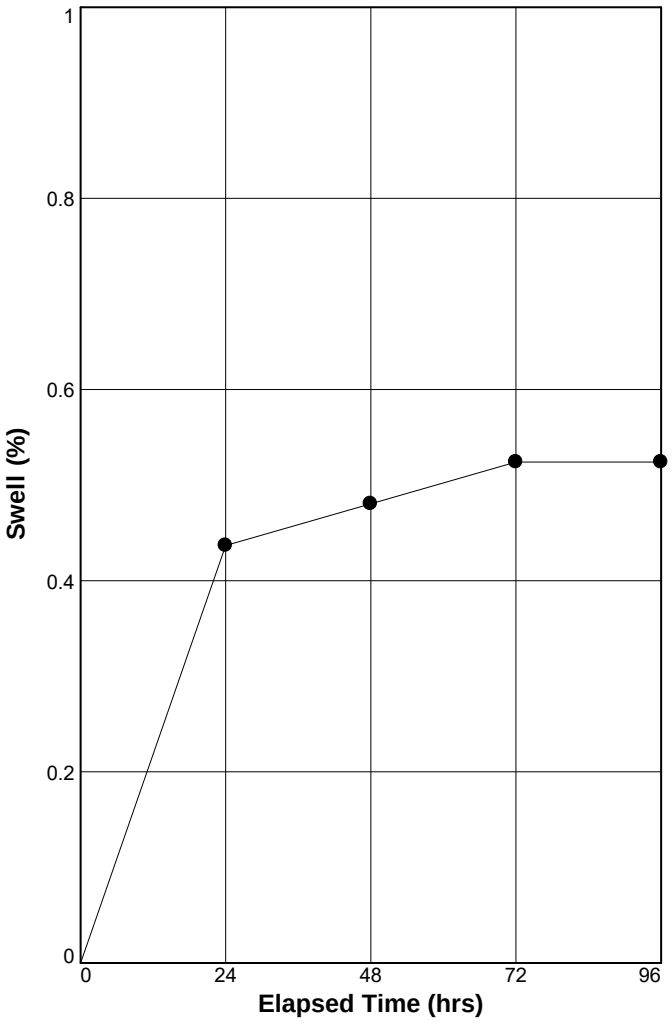
PROJECT NUMBER: 72155038

CLIENT: ARK Consulting Group PLLC Greenville, NC

EXHIBIT: B-4

BEARING RATIO TEST REPORT
ASTM D 1883-07





	Molded			Soaked			CBR (%)		Linearity Correction (in.)	Surcharge (lbs.)	Max. Swell (%)
	Density (pcf)	Percent of Max. Dens.	Moisture (%)	Density (pcf)	Percent of Max. Dens.	Moisture (%)	0.10 in.	0.20 in.			
1 ○	110.8	96.2	11.0	110.2	95.7	14.1	7.7	8.9	0.002	10	0.5
2 △											
3 □											

Material Description	USCS	Max. Dens. (pcf)	Optimum Moisture (%)	LL	PI
DARK GRAY, LIGHT GRAY & ORANGE SANDY SILTY CLAY	CL-ML	115.2	11.8	17	4

Project No: 72155038

Project: Proposed Greenville Transportation and Activity Center

Location: Bulk sample from B-6

Sample Number: 1

Date: 6-24-2015

Test Description/Remarks:

ASTM D1883; SOAKED

PROPOSED SOIL SUBGRADE FOR PAVEMENT SECTION

BEARING RATIO TEST REPORT

Terracon Consultants, Inc.

Exhibit B-5

APPENDIX C

SUPPORTING DOCUMENTS

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING


Auger


Split Spoon


Shelby Tube


Macro Core


Ring Sampler


Rock Core


Grab Sample


No Recovery

WATER LEVEL


Water Initially Encountered


Water Level After a Specified Period of Time


Water Level After a Specified Period of Time

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

FIELD TESTS

(HP)	Hand Penetrometer
(T)	Torvane
(b/f)	Standard Penetration Test (blows per foot)
(PID)	Photo-Ionization Detector
(OVA)	Organic Vapor Analyzer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance Includes gravels, sands and silts.			CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance			
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Ring Sampler Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength, Qu, psf**	**Standard Penetration or N-Value Blows/Ft.**	**Ring Sampler Blows/Ft.**
Very Loose	0 - 3	0 - 6	Very Soft	less than 500	0 - 1	< 3
Loose	4 - 9	7 - 18	Soft	500 to 1,000	2 - 4	3 - 4
Medium Dense	10 - 29	19 - 58	Medium-Stiff	1,000 to 2,000	4 - 8	5 - 9
Dense	30 - 50	59 - 98	Stiff	2,000 to 4,000	8 - 15	10 - 18
Very Dense	> 50	≥ 99	Very Stiff	4,000 to 8,000	15 - 30	19 - 42
			Hard	> 8,000	> 30	> 42

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 - 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300 mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm
Silt or Clay	Passing #200 sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 - 12
Modifier	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification	
					Group Symbol	Group Name [B]
Coarse Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]		GW	Well-graded gravel [F]
			$Cu < 4$ and/or $1 > Cc > 3$ [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F,G,H]
			Fines classify as CL or CH		GC	Clayey gravel [F,G,H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]		SW	Well-graded sand [I]
			$Cu < 6$ and/or $1 > Cc > 3$ [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G,H,I]
			Fines classify as CL or CH		SC	Clayey sand [G,H,I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A" line [J]		CL	Lean clay [K,L,M]
			PI < 4 or plots below "A" line [J]		ML	Silt [K,L,M]
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay [K,L,M,N]
			Liquid limit - not dried			Organic silt [K,L,M,O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line		CH	Fat clay [K,L,M]
			PI plots below "A" line		MH	Elastic Silt [K,L,M]
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay [K,L,M,P]
			Liquid limit - not dried			Organic silt [K,L,M,Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

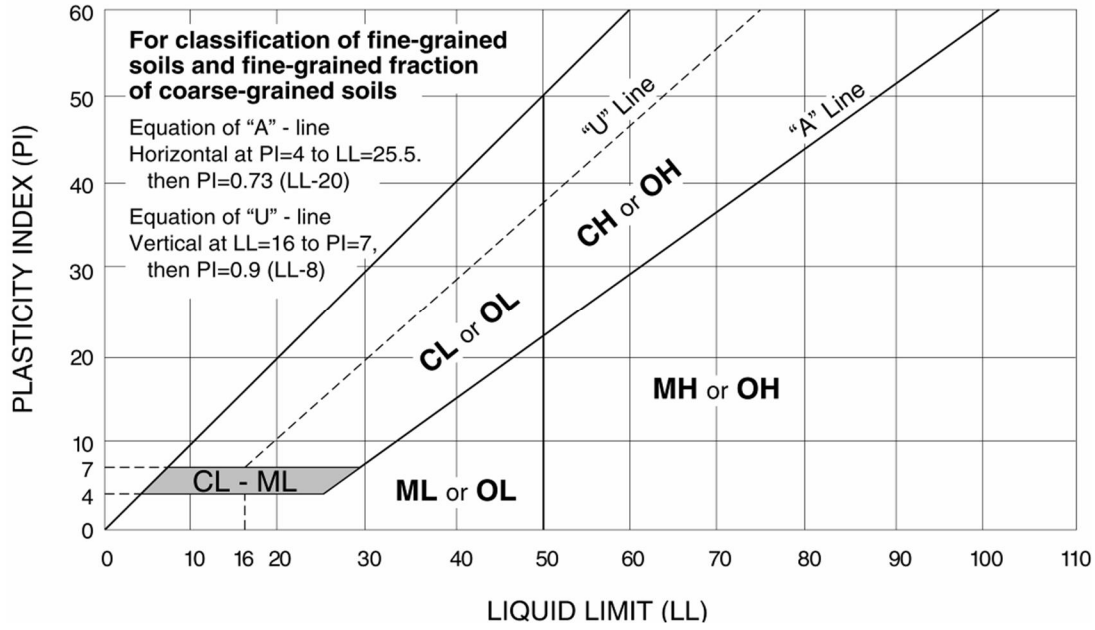
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



Terracon

Exhibit C-2

Report Number: 72155038
Service Date: 8/13/2015
Report Date: 8/14/2015

Client

ARK Consulting Group PLLC
3280 Charles Boulevard
Suite B
Greenville, NC 27858

Project

Proposed Greenville Transportation Center
S. Pitt and Clark Street
Greenville, NC

Project Number: 72155038

SERVICES REQUESTED BY: Mr. Scott Anderson, representing ARK Consulting

TERRACON PERSONNEL: Mike Stout, Joe Franklin, Adam Mohn

Representatives of Terracon Consultants, Inc. were on site today to obtain drilled cores from Pitt Street, Bonners Lane and Clark Street. Locations are indicated on the attached location diagram.

Core Numbers	1st Course (inches)	2nd Course (inches)	3rd Course (inches)	4th Course (inches)	Total Asphalt (inches)	Stone (inches)
1	8 Concrete*					
2	¾	1 ¾			2 ½	0
3	2				2	0
4	1 ¾				1 ¾	0
5	1 1/8	1 1/8	1 ¼		3 ½	0
6	1 ½	1			2 ½	0
7	1 ¾	1 ¼	3	3 ½	9 ½	12
8	1	1	6” Concrete		2	0
9	1	3			4	12 ½
10	1 ½	1	6” Concrete		2 ½	0

COMMENTS:
Traffic control was utilized during coring.

*Location 1 was paved with concrete. The concrete was not able to be cored to a depth greater than 8 inches. The core was not able to be extracted to measure underlying stone thickness.

Core locations were patched upon completion.

Feel free to contact our office with any questions. Thank you for choosing us for your testing needs.

Sincerely,

G. Lucas Fenton, PE
Project Manager

20' 0 10' 20'

SCALE 1 inch = 20 ft

To: Owner: City Of Greenville

Name of Project: Greenville Transportation Activity Center

Location of Project: 600 South Pitt Street, Greenville, NC 27834

From: _____

Gentlemen:

A. In response to your invitation for Bids in Project Manual dated May 10, 2016, undersigned, having carefully examined Contract Documents, and having visited Project Site and examined all conditions affecting Work, proposes to do all of such Work, including furnishing of all necessary labor, machinery, equipment, materials, supplies, transportation, bonds and incidentals as required by Contract Documents for sum of:

1. $ _____ (Price in Words).
2. $ _____ (Figures).

B. Base proposal includes sum of $ _____ for furnishing a Performance Bond, and a Labor and Material Payment Bond.

	Alternates:	**Add**	**Deduct**
1.	Alternate No. 1:	$ _____	$ _____.
2.	Alternate No. 2:	$ _____	$ _____.
3.	Alternate No. 3:	$ _____	$ _____.
4.	Alternate No. 4:	$ _____	$ _____.
5.	Alternate No. 5:	$ _____	$ _____.
6.	Alternate No. 6:	$ _____	$ _____.

C. Contractor shall have included in Total Lump Sum Bid amount listed above all allowances as hereafter specified.

D. Length of time required to complete this Work is _____ calendar days in accordance with Construction Schedule included with Bidding Documents.

E. In accordance with Division 01, a complete detailed Construction Schedule containing all requested information will be submitted within 15 calendar days after Award of Contract.

F. Receipt of Addenda, Number _____ through _____ inclusive, is hereby acknowledged and value for Work therein is included in amount of this Bid.

_____

(Name of Firm)

_____

(Business Address)

_____

_____

(Signature of Responsible Official)

_____

(Title)

_____

(State of Incorporation)

_____

(Names of Partners)

_____

_____

Notary Seal

Part 1 General

1.1 Bid Form Supplement

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

1.2 Bid Bond Form

A. AIA Document A310, "Bid Bond," is the recommended form for a bid bond. A bid bond acceptable to Owner, or other bid security as described in the Instructions to Bidders, is required to be attached to the Bid Form as a supplement.

B. Copies of AIA standard forms may be obtained from The American Institute of Architects; www.aia.org/contractdocs/purchase/index.htm; email: docspurchases@aia.org; (800) 942-7732.

Part 2 Products

Not used.

Part 3 Execution

Not used.

Section 004325 Substitution Request Form (During Procurement)

Part 1 General

1.1 Definitions

A. Procurement Substitution Requests: Requests for changes in products, materials, equipment, and methods of construction from those indicated in the Procurement and Contracting Documents, submitted prior to receipt of bids.

B. Substitution Requests: Requests for changes in products, materials, equipment, and methods of construction from those indicated in the Contract Documents, submitted following Contract award. See Section 012513 "Product Substitution Procedures" for conditions under which Substitution requests will be considered following Contract award.

1.2 Quality Assurance

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

1.3 Procurement Substitutions

A. Procurement Substitutions, General: By submitting a bid, the Bidder represents that its bid is based on materials and equipment described in the Procurement and Contracting Documents, including Addenda. Bidders are encouraged to request approval of qualifying substitute materials and equipment when the Specifications Sections list materials and equipment by product or manufacturer name.

B. Procurement Substitution Requests will be received and considered by Owner when the following conditions are satisfied, as determined by Architect; otherwise requests will be returned without action:

1. Extensive revisions to the Contract Documents are not required.
2. Proposed changes are in keeping with the general intent of the Contract Documents, including the level of quality of the Work represented by the requirements therein.
3. The request is fully documented and properly submitted.

1.4 Submittals

A. Procurement Substitution Request: Submit to Architect. Procurement Substitution Request must be made in writing by prime contract Bidder only in compliance with the following requirements:

1. Requests for substitution of materials and equipment will be considered if received no later than ten (10) days prior to date of bid opening.

2. Submittal Format: Submit one digital color pdf copy of each written Procurement Substitution Request, using CSI Substitution Request Form 1.5C.

   a. Identify the product or the fabrication or installation method to be replaced in each request. Include related Specifications Sections and drawing numbers.
   b. Provide complete documentation on both the product specified and the proposed substitute, including the following information as appropriate:

      1) Point-by-point comparison of specified and proposed substitute product data, fabrication drawings, and installation procedures.

      2) Copies of current, independent third-party test data of salient product or system characteristics.

      3) Samples where applicable or when requested by Architect.

      4) Detailed comparison of significant qualities of the proposed substitute with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.

      5) Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.

      6) Research reports, where applicable, evidencing compliance with building code in effect for Project, from ICC-ES.

      7) 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, which will become necessary to accommodate the proposed substitute.

   c. Provide certification by manufacturer that the substitute proposed is equal to or superior to that required by the Procurement and Contracting Documents, and that its in-place performance will be equal to or superior to the product or equipment specified in the application indicated.
   d. Bidder, in submitting the Procurement Substitution Request, waives the right to additional payment or an extension of Contract Time because of the failure of the substitute to perform as represented in the Procurement Substitution Request.

B. Architect's Action:

1. Architect may request additional information or documentation necessary for evaluation of the Procurement Substitution Request. Architect will notify all bidders of acceptance of the proposed substitute by means of an Addendum to the Procurement and Contracting Documents.

2. Architect's approval of a substitute during bidding does not relieve Contractor of the responsibility to submit required shop drawings and to comply with all other requirements of the Contract Documents.

Part 2 Products

Not used.

Part 3 Execution

Not used.

END

Part 1 General

1.1 Basic Information

A. The form of Agreement between Owner and Contractor shall be as provided herein.

Part 2 Products

Not used.

Part 3 Execution

Not used.

END

NORTH CAROLINA
PITT COUNTY

CONTRACT FOR CONSTRUCTION/REPAIR

THIS CONTRACT is entered into by and between , hereinafter referred to as the "Contractor", and the City of Greenville, a North Carolina municipal corporation, hereinafter referred to as the "City" for the project entitled:

And for the Contract Amount of: (in written word and numerals).

WITNESSETH:

WHEREAS, the City desires to procure a contractor to perform services; and

WHEREAS, the City has completed necessary steps for retention of construction/repair services under State law and applicable City policies; and

WHEREAS, the City has agreed to engage the Contractor, and the Contractor has agreed to contract with the City, for performance of services as described, and according to the further terms and conditions, set forth herein.

NOW THEREFORE, in consideration of sums to be paid to the Contractor, and other good and valuable consideration, the Contractor and City do contract and agree as follows:

1. Description of Work

The Contractor, at his (its) own proper cost and expense and with skill and diligence, shall furnish all labor, tools, materials and equipment and do all things necessary for the proper construction and completion ready for use of the following improvements:

In strict accordance with and as shown in the specifications, schedules, drawings and other documents set forth herein or incorporated by reference as follows:

In case of conflict between this Contract and any incorporated attachments or references, the terms of this Contract shall prevail.

The Contractor shall further perform in accordance with the directions (not inconsistent therewith) given from time to time during the construction by the Project Engineer or such other official, employee, or other agent of the City as the City may designate.

2. General Obligations of the Contractor

The Contractor will accept the prices specified in this Contract in full compensation and satisfaction for the performance of this Contract and as consideration of this Contract. The Contractor shall be responsible for all loss and damages of every kind and nature which may arise out of or an account of the performance of the work required by this Contract, and for all risks of every description connected with the said work; and the Contractor shall be responsible for well and faithfully completing the whole work according to all applicable plans and specifications and the terms and conditions of this Contract.

3. Time of Commencement and Completion

a. The entire work required by this Contract shall be completed by the Contractor not later than 365 days after the date of Notice-to-Proceed. Contractor shall be subject to liquidated damages in the amount of $1,000 per day should the Contract fail to be completed within the time stated above.

b. The City and the Contractor recognize that the City will suffer financial loss if the work under this Contract is not completed within the time specified in section 3(a). They also recognize the delays, expense, and difficulty to both the City and the Contractor involved in proving or contesting the amounts of those losses. Instead of requiring proof of those amounts, it is agreed that Contractor shall be liable for and shall pay the City in the amount of $1,000 per day as liquidated damages, and not as a penalty, for each day after the time specified in section 3(a) until the entire work required by this Contract is completed. The amounts stated as liquidated damages are agreed to be reasonable estimates of the City's losses and expenses for delays, including inspections, architectural and engineering services, and administrative costs. City may collect liquidated damages by retaining moneys otherwise due Contractor in the amount of such damages, and by other legal means.

4. Workmanship and Quality of Services/Warranties

All work under this Contract shall be done and performed to the satisfaction of the Project Engineer of the City of Greenville, or of such other official, employee, or agent of the City of Greenville as may be designated by the City, and such official, employee or agent designated by the City shall in all cases of dispute determine the quantity, quality, acceptability and fitness of the work and materials and of several portions thereof which are to be paid for under this Contract and shall decide and determine all questions which may arise as to the measurements, lines, levels and dimensions of the work and all questions respecting the true construction, interpretation or meaning of the plans and specifications. In case of dispute between the Contractor and the said official, employee, or agent of the City, the decision and determination of the latter shall be taken, and shall be final and conclusive.

The Contractor, in executing this Contract, warrants that he will be responsible for the maintenance or correction of any work completed under this Contract that may become defective due to faulty workmanship or materials for a period of one (1) year after final acceptance of the work performed.

It is understood and agreed by the parties hereto that work done under this Contract shall be subject to all ordinances of the City of Greenville relating to work done in the public streets or other public property of the City.

5. Compensation

In consideration of the performance of this Contract and the full completion of the work required of the Contractor by the terms and conditions of this Contract, the City agrees to pay to the Contractor the contract amount based on the following: Partial payments will be made to the Contractor by the City NET thirty (30) days after presentation of a true and accurate payment application to the City as certified by the Project Engineer or agent of the City of Greenville. **All invoices must include the following Purchase Order Number_____.** Final estimate of the amount due to the Contractor will be made within thirty (30) days after the certified completion and final acceptance of all the work required by the Contract less retainage per Section 6. Payment to the Contractor by the City of the amounts so determined to be due, in accordance with this Contract, shall relieve the City from all claims for work done and materials and equipment furnished under this Contract.

It is further mutually agreed between the parties that no estimate or partial payment made under this Contract shall be conclusive evidence of the performance of this Contract, either wholly or in part, and that no such payment shall be construed to be an acceptance of defective work or improper materials.

6. Retainage

To ensure proper performance of the Contract, the City may retain five percent (5%) of the amount of each approved partial or periodic payment application until the project work is fifty percent (50%) complete, provided that the Contractor continues to perform satisfactorily and any non-conforming work identified in writing prior to that date has been corrected by the Contractor and accepted by the City's designated Construction Manager.

If the City determines the Contractor's performance is unsatisfactory, the City may reinstate retainage in the amount of five percent (5%) for each subsequent partial or periodic payment application until the Contractor's performance becomes satisfactory. The project shall be deemed fifty percent (50%) complete when the contractor's gross project invoices, excluding the value of materials stored off-site, equal or exceed fifty percent (50%) of the value of the contract, except the value of materials stored on-site shall not exceed twenty percent (20%) of the contractor's gross project invoices for the purpose of determining whether the project is fifty percent (50%) complete. Following fifty percent (50%) completion of the project, the City may also withhold additional retainage from any subsequent periodic payment, not to exceed five percent (5%), in order to allow the City to retain two and one-half percent (2 ½%) total retainage through the completion of the project.

Within sixty (60) days after the submission of a pay request, the City with written consent of the surety shall release to the Contractor all retainage on payments held by the City if (1) the City receives a certificate of substantial completion from the architect, engineer, or designer in charge of the project; or (2) the City receives beneficial occupancy or use of the project. However, the City may retain sufficient funds to secure completion of the project or corrections on any work. If the City retains funds, the amount retained shall not exceed two and one-half (2 ½) times the estimated value of the work to be completed or corrected. Any reduction in the amount of the retainage on payments shall be with the consent of the contractor's surety.

Retainer provisions contained in Contractor's subcontracts may not exceed the terms and conditions for retainage provided herein. Contractors are further required to satisfy the retainage provisions of N.C.G.S. 143-134.1(b2) with regard to subcontracts for early finishing trades (structural steel, piling, caisson, and demolition) and to coordinate the release of retainage for such trades from the retainage held by the City from the Contractor pursuant to statute. Nothing shall prevent the City from withholding payment to the Contractor in addition to the amounts identified herein for unsatisfactory job progress, defective construction not remedied, disputed work, or third-party claims filed against the City or reasonable evidence that a third-party claim will be filed.

7. Notices

All notices, requests for payment, or other communications arising hereunder shall be sent to the following:

City of Greenville
Attn: Ken Jackson
Telephone: (252) 329-4522
1500 Beatty Street
Greenville, NC 27834

Contractor

8. Non-discrimination

In consideration of the signing of this Contract, the parties hereto for themselves, their agents, officials, employees and servants agree not to discriminate in any manner on the basis of race, color, creed, national origin, sex, age, handicap, or sexual orientation with reference to the subject matter of this Contract, no matter how remote.

9. Disadvantaged Business Enterprise Program

It is the policy of the City of Greenville to provide disadvantaged businesses equal opportunity for participation in all aspects of the City's contract procurement programs. Refer to Section 006239 for additional information.

10. Assignment

This Contract may not be assigned without the express written consent of the City.

11. Applicable Law

All matters relating to this Contract shall be governed by the laws of the State of North Carolina, without regard to its choice of law provisions, and venue for any action relating to this Contract shall be Pitt County Civil Superior Court.

12. Insurance

Contractor agrees to purchase at its own expense insurance coverages to satisfy the following minimum requirements. A certificate reflecting the following minimum coverages shall accompany this Contract:

Workers' Compensation Insurance:
Limits:

Workers Compensation: Statutory for the State of North Carolina
Employers Liability: Bodily Injury by Accident $1,000,000 each accident
Bodily Injury by Disease $1,000,000 policy limit
Bodily Injury by Disease $1,000,000 each employee

Commercial General Liability:
Limits:

Each Occurrence:	$1,000,000
Personal and Advertising Injury	$1,000,000
General Aggregate Limit	$2,000,000
Products and Completed Operations Aggregate	$2,000,000

The aggregate limit must apply per project. The form of coverage must be the ISO CG 00 01 policy as approved by the State of North Carolina Department of Insurance. If a form of coverage other than the CG 00 01 is used it must be approved by the City of Greenville. Any endorsed exclusions or limitations from the standard policy must be clearly stated in writing and attached to the Certificate of Insurance. Completed Operations coverage must be maintained for the period of the applicable statute of limitations.

The City of Greenville must be added as an Additional Insured to the Commercial General Liability policy.

Commercial Automobile Liability:
Limits:

$1,000,000 combined single limit.

The City of Greenville must be added as an Additional Insured on the Commercial Auto Liability policy.

Additional Insured – Contractor agrees to endorse the City as an Additional insured on the Commercial General Liability, Auto Liability and Umbrella Liability if being used to meet the standard of the General Liability and Automobile Liability. The Additional Insured shall read **'City of Greenville is named additional insured as their interest may appear'.**

The Certificate Holder address should read:

City of Greenville
200 West Fifth Street
Greenville, NC 27835-7207

Builders Risk Coverage:

Limit:

Minimum limit in the amount of total bid price.

The Builder Risk policy must be endorsed to increase the limit of insurance for all change orders.

Policy Form:

Builder Risk coverage must be on a direct physical loss basis and contain no exclusion for theft, collapse or damage to foundations or underground structures, pipes or conduits.

Named Insured:

The Named Insured shall be the City of Greenville, the Contractor and all sub-contractors with a contractual assumption of responsibility for damage to the project.

All insurance companies must be admitted to do business in North Carolina and be acceptable to the City of Greenville. If the insurance company(s) is a permitted surplus lines insurer, the insurance company name, and NAIC number must be submitted to the Greenville Risk Manager for approval before commencing work. Contractor shall be required to provide the City no less than thirty (30) days notice of cancellation, or any material change, to any insurance coverage required by this Contract.

A Certificate of Insurance (COI) must be issued by an authorized representative of the insurance carrier(s). Certificates of Insurance must have the Insurance Company name and NAIC number clearly identified. The acceptance of or the review of Certificates of Insurance by the City of Greenville does not relieve Contractor of any requirements in the contract to provide specific insurance coverage required by the contract, nor does the

acceptance of or review of Certificates of Insurance covenant all insurance requirements have been met.

13. Surety Bonds

The Contractor shall furnish and attach hereto a Performance Bond and a Payment Bond each in the penal sum of the full Contract amount covering the faithful performance of the Contract and the payment of all obligations arising hereunder, in such form and content as the City may prescribe and with surety approved by the City. Should any surety upon the bond for the performance of this Contract become unacceptable to the City, the Contractor must promptly furnish additional security as may be required from time to time by the City to protect the interests of the City and of persons, firms and corporations supplying labor or materials in the performance of the work contemplated by the Contract.

14. Indemnity

Except to the extent caused by the sole negligence or willful misconduct of the City, the Contractor shall indemnify and hold and save the City, its officers, agents and employees, harmless from liability of any kind, including all claims, costs (including defense) 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 this Contract, and from any and all claims, costs (including defense) and losses accruing or resulting to any person, firm, or corporation that may be injured or damaged by the Contractor's negligence in the performance of this Contract. This representation and warranty shall survive the termination or expiration of this Contract.

The Contractor shall indemnify and hold and save the City, its officers, agents and employees, harmless from liability of any kind, including claims, costs (including defense) and expenses, on account of any copyrighted material, patented or unpatented invention, articles, device or appliance manufactured or used in the performance of this Contract.

15. Force Majeure

Except as otherwise provided in any environmental laws, rules, regulations or ordinances applicable to the parties and the services performed under this Contract, 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 by an act of war, hostile foreign actions, nuclear explosion, earthquake, hurricane, tornado, or other catastrophic natural event or act of God. Either party to the Contract must take reasonable measures and implement reasonable protections when a weather event otherwise defined as a force majeure event is forecast to be eligible to be excused from the performance otherwise required under this Contract by this provision.

16. Advertising

The Contractor shall not use the existence of this Contract, or the name of the City of Greenville, as part of any advertising without prior written approval of the City.

17. Termination

If the Contractor fails to perform the work described herein by the time allowances provided in Section 3, or fails to provide adequate staff and resources required to properly execute said work in a workmanlike and safe manner, the City can declare the Contractor in Default. If the Contractor fails to complete the work in the provided project duration as stated in item 3 of this document, or fails to meet periodic schedules describing work sequence, or fails to comply with all appropriate local, federal, or state laws, rules and regulations the City may, without prejudice to any other right or remedy and after giving the Contractor and his surety a maximum of seven (7) days from delivery of a written notice, declare the Contract in default, take possession of the project and of all equipment, tools, materials thereon owned by the Contractor and call upon the surety or appropriate legal recourse to finish the work by whatever method deemed expedient.

18. Laws/Safety Standards

The Contractor shall comply with all laws, ordinances, codes, rules, regulations, safety standards and licensing requirements that are applicable to the conduct of its business, including those of Federal, State, and local agencies having jurisdiction and/or authority.

All manufactured items and/or fabricated assemblies subject to operation under pressure, operation by connection to an electric source, or operation involving a connection to a manufactured, natural, or LP gas source shall be constructed and approved in a manner acceptable to the appropriate state inspector which customarily requires the label or re-examination listing or identification marking of the appropriate safety standard organization, such as the American Society of Mechanical Electrical Engineers for pressure vessels; the Underwriters' Laboratories and/or National Electrical Manufacturers' Association for electrically operated assemblies; or the American Gas Association for gas operated assemblies, where such approvals of listings have been established for the type(s) of devices offered and furnished. Further, all items furnished by the Contractor shall meet all requirements of the Occupational Safety and Health Act (OSHA), and state and federal requirements relating to clean air and water pollution.

Contractor must comply with *North Carolina Occupational Safety and Health Standards for General Industry, 29CFR 1910.* In addition, Contractor shall comply with all applicable occupational health and safety and environmental rules and regulations.

Contractor shall effectively manage their safety and health responsibilities including:

A. Accident Prevention

Prevent injuries and illnesses to their employees and others on or near their job site. Contractor managers and supervisors shall ensure personnel safety by strict adherence to established safety rules and procedures.

B. Environmental Protection

Protect the environment on, near, and around their work site by compliance with all applicable environmental regulations.

C. Employee Education and Training

Provide education and training to all contractors employees before they are exposed to potential workplace or other hazards as required by specific OSHA Standards.

19. Applicability of North Carolina Public Records Law

Notwithstanding any other provisions of this Contract, this Contract and all materials submitted to the City by the Contractor are subject to the public records laws of the State of North Carolina and it is the responsibility of the Contractor to properly designate materials that may be protected from disclosure as trade secrets under North Carolina law as such and in the form required by law prior to the submission of such materials to the City. Contractor understands and agrees that the City may take any and all actions necessary to comply with federal, state, and local laws and/or judicial orders and such actions will not constitute a breach of the terms of this Contract. To the extent that any other provisions of this Contract conflict with this paragraph, the provisions of this section shall control.

20. Miscellaneous

The Contractor shall be responsible for the proper custody and care of any property furnished or purchased by the City for use in connection with the performance of this Contract, and will reimburse the City for the replacement value of its loss or damage. The Contractor shall keep the job sites and surrounding area reasonably free from rubbish at all times and shall remove debris from the site from time to time or when directed to do so by the City. Before final inspection and acceptance of the project, the Contractor shall thoroughly clean the job sites, and completely prepare the project and site for use by the City.

The Contractor shall be considered to be an Independent Contractor and as such shall be wholly responsible for the work to be performed and for the supervision of its employees. Nothing herein is intended or will be construed to establish any agency, partnership, or joint venture. Contractor represents that it has, or will secure at its own expense, all personnel required in performing the services under this Contract. Such employees shall not be employees of or have any individual contractual relationship with the City.

This Contract may be amended only by written agreement of the parties executed by their authorized representatives.

21. Right of Audit and Examination of Records

1 The City of Greenville may conduct an audit of Contractor’s financial, performance and compliance records maintained in connection with the operations and services performed under this Contract. Such audits may be performed by a City's representative or an outside representative engaged by City. The City or its designee may conduct such audits or inspections throughout the term of this Contract and for a period of three years after final payment or longer if required by law.

2 In the event of such an audit, the City, or its designated representative, shall have the right to, without limitation, review and copy records; interview all current or former employees; and conduct verifications such as counting employees at the Construction Site, witnessing the distribution of payroll,

verifying information and amounts through interviews and written confirmations with Contractor employees, field and agency labor, subcontractors, and vendors.

3 Contractor's, subcontractors' and sub-subcontractors' "records" shall upon reasonable notice be open to inspection and subject to audit and/or reproduction during normal business working hours. Contractor's "records" as referred to in this contract shall include any and all information, materials and data of every kind and character in hard copy and digital format, including without limitation, records; books; papers; documents; subscriptions; recordings; agreements; purchase orders; leases; contracts; commitments; arrangements; notes; daily diaries; superintendent reports; drawings; receipts; vouchers; memoranda; payroll records, cancelled payroll checks, subcontract files, including but not limited to proposals of successful and unsuccessful bidders, bid recaps, and negotiation notes; original bid estimates; estimating work sheets; correspondence; change order files, including documentation covering negotiated settlements; backcharge logs and supporting documentation; invoices and related payment documentation; general ledger; information detailing cash and trade discounts earned; insurance rebates and dividends and any and all other agreements, sources of information and matters that may in City's judgment relate to any matters, rights, duties or obligations under or covered by any Contract Document to the extent necessary to adequately permit evaluation and verification of any or all of the following:

(a) Compliance with contract requirements for deliverables;
(b) Compliance with approved plans and specifications;
(c) Compliance with City's business ethics expectations;
(d) Compliance with contract provisions regarding the pricing of change orders;
(e) Accuracy of contractor representations regarding the pricing of invoices; and
(f) Accuracy of contractor representations related to claims submitted by the contractor or any of his payees.

4 Contractor shall require all payees (e.g. subcontractors, material suppliers, insurance carriers) to comply with the provisions of this article by including the requirements hereof in a written contract agreement between Contractor and payee. Contractor shall ensure that all payees have the same right to audit provisions contained in this contract.

5 City's authorized representative or designee shall have reasonable access to the Contractor's facilities, shall be allowed to interview all current or former employees to discuss matters pertinent to the performance of this contract and shall be provided adequate and appropriate work space in order to conduct audits in compliance with this article.

6 If an audit inspection or examination in accordance with this article discloses overpricing or overcharges by the Contractor or Contractor's payee to the City in excess of one percent (1%) of the total contract billings, the Contractor shall make adjustments to the applicable charges and the actual cost of the City's audit shall be reimbursed to the City by the Contractor. Any adjustments and/or payments which must be made as a result of any such audit or examination of records shall be made within ninety (90) days from presentation of City's findings to Contractor.

22. Federal Transit Administration (FTA) Terms and Conditions

The Federal Transit Administration (FTA) Terms and conditions shall apply to this contract (see Section 08100).

23. Incorporation of Documents/Complete Agreement

This Contract, and any documents incorporated below, represent the entire Contract between the parties and suspend all prior oral or written statements, agreements or Contracts.

Specifically incorporated into this Contract are the following attachments, or if not physically attached, are incorporated fully herein by reference:

- ☐ Advertisement for Bids
- ☐ Contractor's Proposal
- ☐ Procedure for N.C. Sales Tax Reporting
- ☐ Performance Bond (w/Power-of-Attorney)
- ☐ Payment Bond (w/Power-of-Attorney)
- ☐ Certificate of Insurance
- ☐ General Conditions
- ☐ Special or Supplemental Conditions
- ☐ Job Specifications
- ☐ Other (Describe) _____

24. E - Verify

Contractor shall comply with *E-Verify*, the federal E-Verify program operated by the United States Department of Homeland Security and other federal agencies, or any successor or equivalent program used to verify the work authorization of newly hired employees pursuant to federal law and as in accordance with N.C.G.S. §64-25 *et seq*. In addition, to the best of Contractor's knowledge, any subcontractor employed by Contractor as a part of this contract shall be in compliance with the requirements of E-Verify and N.C.G.S. §64-25 *et seq.*

In cases of conflict between this Contract and any of the above incorporated attachments or references, the terms of this Contract shall prevail.

The remainder of this page is left blank intentionally.

THIS CONTRACT is entered into this day of , 20 .
IN WITNESS WHEREOF, the Contractor has executed the foregoing with the signature(s) of its duly authorized officer(s), under seal, and the City has executed with the signature of its City Manager, attested by its (Assistant/Deputy) Clerk-Treasurer, with the official seal affixed, the day and year first above written.

CONTRACTOR:

By:

_____

_____
Printed Name/Title

(If corporate)
ATTEST:

By:_____

_____
Printed Name/Title
(Affix Seal)

CITY OF GREENVILLE

By:

_____
City Manager

APPROVED AS TO FORM:

By: _____
David A. Holec, City Attorney

PRE-AUDIT CERTIFICATION:

This instrument has been pre-audited in the manner required by the Local Government Budget and Fiscal Control Act

_____
Bernita W, Demery, Director of Financial Services

Account Number _____

Project Code (if applicable) _____

Part 1 General

1.1 Form Of Agreement And General Conditions

A. The following form of Owner/Contractor Agreement and form of the General Conditions shall be used for Project:

1. City of Greenville Contract for Construction/Repair
    a. The General Conditions for Project are AIA Document A201, "General Conditions of the Contract for Construction."
2. The General Conditions are incorporated by reference.
3. The Supplementary Conditions for Project are separately prepared and included in the Project Manual.
4. The Special Conditions for FTA terms and conditions included in the Project Manual.

1.2 Administrative Forms

A. Administrative Forms: Additional administrative forms are specified in Division 01 General Requirements.

B. Copies of AIA standard forms may be obtained from the American Institute of Architects; http://www.aia.org/contractdocs/purchase/index.htm; docspurchases@aia.org; (800) 942-7732.

C. Preconstruction Forms:

1. Form of Performance Bond and Labor and Material Bond: AIA Document A312, "Performance Bond and Payment Bond."
2. Form of Certificate of Insurance: AIA Document G715, "Supplemental Attachment for ACORD Certificate of Insurance 25-S."

D. Information and Modification Forms:

1. Form of Request for Proposal: AIA Document G709, "Work Changes Proposal Request."
2. Change Order Form: AIA Document G701, "Change Order."
3. Form of Architect's Memorandum for Minor Changes in the Work: AIA Document G707, "Architect's Supplemental Instructions."
4. Form of Change Directive: AIA Document G714, "Construction Change Directive."

E. Payment Forms:

1. Schedule of Values Form: AIA Document G703, "Continuation Sheet."
2. Payment Application: AIA Document G702/703, "Application and Certificate for Payment and Continuation Sheet."
3. Form of Contractor's Affidavit: AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
4. Form of Affidavit of Release of Liens: AIA Document G706A, "Contractor's Affidavit of Payment of Release of Liens."
5. Form of Consent of Surety: AIA Document G707, "Consent of Surety to Final Payment."

Part 2 Products

Not used.

Part 3 Execution

Not used.

END

Part 1 General

1.1 Basic Information

A. Furnish Performance Bond and Labor and Material Payment Bond using AIA Document A312. (Sample attached to this Section).

B. Amount of each bond shall be 100 percent of Contract amount.

Part 2 Products

Not used.

Part 3 Execution

Not used.

END

DRAFT

AIA® Document A312™ – 2010

Performance Bond

CONTRACTOR:
(Name, legal status and address)

« »« »
« »

SURETY:
(Name, legal status and principal place of business)

« »« »
« »

OWNER:
(Name, legal status and address)

« »« »
« »

CONSTRUCTION CONTRACT
Date: « »
Amount: $ « »
Description:
(Name and location)

«Draft»
« »

BOND
Date:
(Not earlier than Construction Contract Date)
« »
Amount: $ « »
Modifications to this Bond: « » None « » See Section 16

CONTRACTOR AS PRINCIPAL		SURETY	
Company:	*(Corporate Seal)*	Company:	*(Corporate Seal)*
Signature:		Signature:	
Name and Title:	« »« »	Name and Title:	« »« »

(Any additional signatures appear on the last page of this Performance Bond.)

(FOR INFORMATION ONLY — Name, address and telephone)

AGENT or BROKER:

« »
« »
« »

OWNER'S REPRESENTATIVE:
(Architect, Engineer or other party:)

« »
« »
« »
« »
« »
« »

ADDITIONS AND DELETIONS: The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

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

Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.

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§ 1 The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference.

§ 2 If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except when applicable to participate in a conference as provided in Section 3.

§ 3 If there is no Owner Default under the Construction Contract, the Surety's obligation under this Bond shall arise after

.1 the Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice shall indicate whether the Owner is requesting a conference among the Owner, Contractor and Surety to discuss the Contractor's performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner's notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Section 3.1 shall be held within ten (10) business days of the Surety's receipt of the Owner's notice. If the Owner, the Contractor and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement shall not waive the Owner's right, if any, subsequently to declare a Contractor Default;

.2 the Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and

.3 the Owner has agreed to pay the Balance of the Contract Price in accordance with the terms of the Construction Contract to the Surety or to a contractor selected to perform the Construction Contract.

§ 4 Failure on the part of the Owner to comply with the notice requirement in Section 3.1 shall not constitute a failure to comply with a condition precedent to the Surety's obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.

§ 5 When the Owner has satisfied the conditions of Section 3, the Surety shall promptly and at the Surety's expense take one of the following actions:

§ 5.1 Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract;

§ 5.2 Undertake to perform and complete the Construction Contract itself, through its agents or independent contractors;

§ 5.3 Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and a contractor selected with the Owner's concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Section 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or

§ 5.4 Waive its right to perform and complete, arrange for completion, or obtain a new contractor and with reasonable promptness under the circumstances:

.1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, make payment to the Owner; or

.2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.

§ 6 If the Surety does not proceed as provided in Section 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Section 5.4, and the Owner refuses the payment or the Surety has denied liability, in whole or in part, without further notice the Owner shall be entitled to enforce any remedy available to the Owner.

§ 7 If the Surety elects to act under Section 5.1, 5.2 or 5.3, then the responsibilities of the Surety to the Owner shall not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety shall not be greater than those of the Owner under the Construction Contract. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication, for

.1 the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;

.2 additional legal, design professional and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Section 5; and

.3 liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.

§ 8 If the Surety elects to act under Section 5.1, 5.3 or 5.4, the Surety's liability is limited to the amount of this Bond.

§ 9 The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators, successors and assigns.

§ 10 The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders and other obligations.

§ 11 Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and shall be instituted within two years after a declaration of Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this Paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

§ 12 Notice to the Surety, the Owner or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears.

§ 13 When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

§ 14 Definitions

§ 14.1 Balance of the Contract Price. The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made, including allowance to the Contractor of any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.

§ 14.2 Construction Contract. The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.

§ 14.3 Contractor Default. Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.

§ 14.4 Owner Default. Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

§ 14.5 Contract Documents. All the documents that comprise the agreement between the Owner and Contractor.

§ 15 If this Bond is issued for an agreement between a Contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

§ 16 Modifications to this bond are as follows:

« »

(Space is provided below for additional signatures of added parties, other than those appearing on the cover page.)

CONTRACTOR AS PRINCIPAL		SURETY	
Company:	*(Corporate Seal)*	Company:	*(Corporate Seal)*
Signature:		Signature:	
Name and Title:	« »« »	Name and Title:	« »« »
Address:	« »	Address:	« »

Disadvantaged Business Enterprise Program (Federal)

The purpose of this program is to carry out the U.S. Department of Transportation's policy of ensuring nondiscrimination in the award and administration of contracts financed in whole or in part with Federal funds. This provision is guided by 49 CFR Part 26.

Policy Statement

It is the policy of the Department of Transportation and the City of Greenville that Disadvantaged Business Enterprises, as defined in 49 CFR Part 26 shall have the maximum opportunity to participate in the performance of Contract financed in whole or in part with federal funds under this Agreement. Consequently, the DBE requirements of 49 CFR Part 26 apply to this Contract. The Contractor agrees to ensure that DBEs as defined in 49 CFR Part 26 have the maximum opportunity to participate in the whole or in part with federal funds provided under this Agreement. In this regard, the Contractor shall take all necessary and reasonable steps in accordance with the regulations to ensure that DBEs have the maximum opportunity to compete for and perform subcontracts. The Contractor shall not discriminate on the basis of race, color, national origin, religion, sex, age or physical handicap in the award and performance of subcontracts. The grantee or subgrantee shall promote the development and increase the participation of businesses owned and controlled by disadvantaged. DBE involvement in all phases of procurement activities is encouraged.

DBE Obligation

The Contractor and its subcontractors agree to ensure that disadvantaged businesses have the maximum opportunity to participate in the performance of contracts and subcontracts financed in whole or in part with federal funds provided under the Agreement. In that regard, all Contractors and subcontractors shall take all necessary and reasonable steps in accordance with 49 CFR Part 26 as amended, to ensure that minority business enterprises have the maximum opportunity to compete for and perform contracts.

Where the Contractor is found to have failed to exert sufficient reasonable and good faith efforts to involve DBEs in the work provided, the grantee or subgrantee may declare the contractor noncompliant and in breach of contract.

The Contractor will keep records and documents for a reasonable time following performance of this contract to indicate compliance with grantee or subgrantee DBE program. These records and documents will be made available at reasonable times and places for inspection by any authorized representative of grantee or subgrantee and will be submitted to grantee or subgrantee upon request.

DBE Goal

The following DBE goal for participation by Disadvantaged Business Enterprises is established for this contract:

Disadvantaged Business Enterprises **8.39%**

(A) *If the DBE goal is more than zero*, the Contractor shall exercise all necessary and reasonable steps to ensure that DBEs participate in at least the percent of the contract as set forth above as the DBE goal.

(B) *If the DBE goal is zero*, the Contractor shall make an effort to recruit and use DBEs during the performance of the contract. Any DBE participation obtained shall be reported to the Project Manager.

Directory of Transportation Firms (Directory)
Only firms identified in the NCDOT Directory as DBE certified shall be used to meet the DBE goal. The Directory can be found at the following link:
https://partner.ncdot.gov/VendorDirectory/default.html

The listing of an individual firm in the directory shall not be construed as an endorsement of the firm's capability to perform certain work.

Listing of DBE Subcontractors
At the time of bid, bidders shall submit all DBE participation that they anticipate to use during the life of the contract. Only those firms with current DBE certification at the time of bid will be acceptable for listing in the bidder's submittal of DBE participation. **Blank forms will not be deemed to represent zero participation**. Bids submitted that do not have DBE participation indicated on the appropriate form will not evaluated and will be considered non-responsive.

The Contractor shall indicate the following required information:

(A) *If the DBE goal is more than zero,*

(1) Bidders, at the time the proposal is submitted, shall submit a listing of DBE participation, including the names and addresses on *Listing of DBE SubContractors* contained elsewhere in the contract documents in order for the proposal to be considered responsive. Bidders shall indicate the total dollar value of the DBE participation for the contract.

(2) If bidders have no DBE participation, they shall indicate this on the *Listing of DBE SubContractors* by entering the word "None" or the number "0." This form shall be completed in its entirety.

(3) The bidder shall be responsible for ensuring that the DBE is certified at the time of bid by checking the Directory of Transportation Firms. If the firm is not certified at the time of bid, that DBE's participation will not count towards achieving the DBE goal.

(B) *If the DBE goal is zero,* bidders, at the time the proposal is submitted, shall enter the word "None"; or the number "0"; or if there is participation, add the value on the *Listing of DBE SubContractors* contained elsewhere in the contract documents.

DBE Prime Contractor
When a certified DBE firm proposes on a contract that contains a DBE goal, the DBE firm is responsible for meeting the goal or making good faith efforts to meet the goal, just like any other bidder. In most cases, a DBE bidder on a contract will meet the DBE goal by virtue of the work it performs on the

contract with its own forces. However, all the work that is performed by the DBE bidder and any other DBE subcontractors will count toward the DBE goal. The DBE bidder shall list itself along with any DBE subcontractors, if any, in order to receive credit toward the DBE goal. For example, if the DBE goal is 45% and the DBE bidder will only perform 40% of the contract work, the prime will list itself at 40%, and the additional 5% shall be obtained through additional DBE participation with DBE subcontractors or documented through a good faith effort.

Written Documentation – Letter of Intent
The bidder shall submit written documentation for each DBE that will be used to meet the DBE goal of the contract, indicating the bidder's commitment to use the DBE in the contract. This documentation shall be submitted on the form titled *Letter of Intent*. The documentation shall be received no later than 12:00 noon of the sixth calendar day following opening of bids, unless the sixth day falls on Saturday, Sunday or an official state holiday. In that situation, it is due in no later than 12:00 noon on the next official state business day.

If the bidder fails to submit the *Letter of Intent* from each committed DBE to be used toward the DBE goal, or if the form is incomplete (i.e. both signatures are not present), the DBE participation will not count toward meeting the DBE goal. If the lack of this participation drops the commitment below the DBE goal, the Contractor shall submit evidence of good faith efforts, completed in its entirety, no later than 12:00 noon on the eighth calendar day following opening of proposals, unless the eighth day falls on Saturday, Sunday or an official state holiday. In that situation, it is due no later than 12:00 noon on the next official state business day.

Bid of Good Faith Effort
If the bidder fails to meet or exceed the DBE goal, the apparent lowest responsive bidder shall submit documentation of adequate good faith efforts made to reach the DBE goal. One complete set shall be received no later than 12:00 noon of the sixth calendar day following opening of proposals, unless the sixth day falls on Saturday, Sunday or an official state holiday. In that situation, it is due no later than 12:00 noon on the next official state business day.

Note: Where the information submitted includes repetitious solicitation letters, it will be acceptable to submit a representative letter along with a distribution list of the firms that were solicited. Documentation of DBE quotations shall be a part of the good faith effort submittal. This documentation may include written subContractor quotations, telephone log notations of verbal quotations, or other types of quotation documentation.

Consideration of Good Faith Effort for Projects with DBE Goals More Than Zero
Adequate good faith efforts mean that the bidder took all necessary and reasonable steps to achieve the goal which, by their scope, intensity, and appropriateness, could reasonably be expected to obtain sufficient DBE participation. Adequate good faith efforts also mean that the bidder actively and aggressively sought DBE participation. Mere *pro forma* efforts are not considered good faith efforts. The City of Greenville will consider the quality, quantity, and intensity of the different kinds of efforts a bidder has made. Listed below are examples of the types of actions a bidder will take in making a good faith effort to meet the goal and are not intended to be exclusive or exhaustive, nor is it intended to be a mandatory checklist.

(A) Soliciting through all reasonable and available means (e.g. attendance at pre-proposal meetings, advertising and/or written notices through the use of the NCDOT Directory of Transportation

Firms) the interest of all certified DBEs who have the capability to perform the work of the contract. The bidder must solicit this interest within at least 10 days prior to proposal opening to allow the DBEs to respond to the solicitation. Solicitation shall provide the opportunity to DBEs within the Division and surrounding Divisions where the project is located. The bidder must determine with certainty if the DBEs are interested by taking appropriate steps to follow up initial solicitations.

(B) Selecting portions of the work to be performed by DBEs in order to increase the likelihood that the DBE goals will be achieved. This includes, where appropriate, breaking out contract work items into economically feasible units to facilitate DBE participation, even when the prime Contractor might otherwise prefer to perform these work items with its own forces.

(C) Providing interested DBEs with adequate information about the plans, specifications, and requirements of the contract in a timely manner to assist them in responding to a solicitation.

(D) Negotiating in good faith with interested DBEs. It is the bidder's responsibility to make a portion of the work available to DBE subcontractors and suppliers and to select those portions of the work or material needs consistent with the available DBE subcontractors and suppliers, so as to facilitate DBE participation. Evidence of such negotiation includes the names, addresses, and telephone numbers of DBEs that were considered; a description of the information provided regarding the plans and specifications for the work selected for subcontracting; and evidence as to why additional agreements could not be reached for DBEs to perform the work. A bidder using good business judgment would consider a number of factors in negotiating with subcontractors, including DBE subcontractors, and would take a firm's price and capabilities as well as contract goals into consideration. However, the fact that there may be some additional costs involved in finding and using DBEs is not in itself sufficient reason for a bidder's failure to meet the contract DBE goal, as long as such costs are reasonable. Also, the ability or desire of a prime Contractor to perform the work of a contract with its own organization does not relieve the bidder of the responsibility to make good faith efforts. Contractors are not, however, required to accept higher quotes from DBEs if the price difference is excessive or unreasonable.

(E) Not rejecting DBEs as being unqualified without sound reasons based on a thorough investigation of their capabilities. The bidder's standing within its industry, membership in specific groups, organizations, or associates and political or social affiliations (for example, union vs. non-union employee status) are not legitimate causes for the rejection or non-solicitation of proposals in the bidder's efforts to meet the project goal.

(F) Making efforts to assist interested DBEs in obtaining bonding, lines of credit, or insurance as required by the recipient or bidder.

(G) Making efforts to assist interested DBEs in obtaining necessary equipment, supplies, materials, or related assistance or services.

(H) Effectively using the services of available minority/women community organizations; minority/women Contractors' groups; Federal, State, and local minority/women business assistance offices; and other organizations as allowed on a case-by-case basis to provide assistance in the recruitment and placement of DBEs. Any other evidence that the bidder submits which shows that the bidder has made reasonable good faith efforts to meet the DBE goal.

In addition, The City of Greenville may take into account the following:

- Whether the bidder's documentation reflects a clear and realistic plan for achieving the DBE goal.
- The bidders' past performance in meeting the DBE goals.

- The performance of other bidders in meeting the DBE goal. For example, when the apparent successful bidder fails to meet the DBE goal, but others meet it, you may reasonably raise the question of whether, with additional reasonable efforts the apparent successful bidder could have met the goal. If the apparent successful bidder fails to meet the DBE goal, but meets or exceeds the average DBE participation obtained by other bidders, the City may view this, in conjunction with other factors, as evidence of the apparent successful bidder having made a good faith effort. If the City does not award the contract to the apparent lowest responsive bidder, the City reserves the right to award the contract to the next lowest responsive bidder that can satisfy to the City that the DBE goal can be met or that an adequate good faith effort has been made to meet the DBE goal.

Non-Good Faith Appeal
The City will notify the Contractor verbally and in writing of non-good faith. A Contractor may appeal a determination of non-good faith. If a Contractor wishes to appeal the determination made by the Committee, they shall provide written notification to the Assistant City Manager. The appeal shall be made within 2 business days of notification of the determination of non-good faith.

Counting DBE Participation Toward Meeting DBE Goal
(A) Participation

The total dollar value of the participation by a committed DBE will be counted toward the contract goal requirement. The total dollar value of participation by a committed DBE will be based upon the value of work actually performed by the DBE and the actual payments to DBE firms by the Contractor.

(B) Joint Checks

Prior notification of joint check use shall be required when counting DBE participation for services or purchases that involves the use of a joint check.

(C) Subcontracts (Non-Trucking)

A DBE may enter into subcontracts. Work that a DBE subcontracts to another DBE firm may be counted toward the contract goal requirement. Work that a DBE subcontracts to a non-DBE firm does not count toward the contract goal requirement. If a DBE Contractor or subcontractor subcontracts a significantly greater portion of the work of the contract than would be expected on the basis of standard industry practices, it shall be presumed that the DBE is not performing a commercially useful function. The DBE may present evidence to rebut this presumption to the City.

(D) Joint Venture

When a DBE performs as a participant in a joint venture, the Contractor may count toward its contract goal requirement a portion of the total value of participation with the DBE in the joint venture, that portion of the total dollar value being a distinct clearly defined portion of work that the DBE performs with its forces.

(E) Suppliers

A Contractor may count toward its DBE requirement 60 percent of its expenditures for materials and supplies required to complete the contract and obtained from a DBE regular dealer and 100 percent of such expenditures from a DBE manufacturer.

(F) Manufacturers and Regular Dealers

A Contractor may count toward its DBE requirement the following expenditures to DBE firms that are not manufacturers or regular dealers:

(1) The fees or commissions charged by a DBE firm for providing a *bona fide* service, such as professional, technical, Contractor, or managerial services, or for providing bonds or insurance specifically required for the performance of a DOT-assisted contract, provided the fees or commissions are determined to be reasonable and not excessive as compared with fees and commissions customarily allowed for similar services.
(2) With respect to materials or supplies purchased from a DBE, which is neither a manufacturer nor a regular dealer, count the entire amount of fees or commissions charged for assistance in the procurement of the materials and supplies, or fees or transportation charges for the delivery of materials or supplies required on a job site (but not the cost of the materials and supplies themselves), provided the fees are determined to be reasonable and not excessive as compared with fees customarily allowed for similar services.

Commercially Useful Function
(A) DBE Utilization

The Contractor may count toward its contract goal requirement only expenditures to DBEs that perform a commercially useful function in the work of a contract. A DBE performs a commercially useful function when it is responsible for execution of the work of the contract and is carrying out its responsibilities by actually performing, managing, and supervising the work involved. To perform a commercially useful function, the DBE shall also be responsible with respect to materials and supplies used on the contract, for negotiating price, determining quality and quantity, ordering the material and installing (where applicable) and paying for the material itself. To determine whether a DBE is performing a commercially useful function, the City will evaluate the amount of work subcontracted, industry practices, whether the amount the firm is to be paid under the contract is commensurate with the work it is actually performing and the DBE credit claimed for its performance of the work, and any other relevant factors.

(B) DBE Utilization in Trucking

The following factors will be used to determine if a DBE trucking firm is performing a commercially useful function:

(1) The DBE shall be responsible for the management and supervision of the entire trucking operation for which it is responsible on a particular contract, and there shall not be a contrived arrangement for the purpose of meeting DBE goals.

(2) The DBE shall itself own and operate at least one fully licensed, insured, and operational truck used on the contract.

(3) The DBE receives credit for the total value of the transportation services it provides on the contract using trucks it owns, insures, and operates using drivers it employs.

(4) The DBE may subcontract the work to another DBE firm, including an owner-operator who is certified as a DBE. The DBE who subcontracts work to another DBE receives credit for the total value of the transportation services the subcontracted DBE provides on the contract.

(5) The DBE may also subcontract the work to a non-DBE firm, including from an owner-operator. The DBE who subcontracts the work to a non-DBE is entitled to credit for the total value of transportation services provided by the non-DBE subcontractor not to exceed the value of transportation services provided by DBE-owned trucks on the contract. Additional participation by non-DBE subcontractors receives credit only for the fee or commission it receives as a result of the subcontract arrangement. The value of services performed under subcontract agreements between the DBE and the Contractor will not count towards the DBE contract requirement.

(6) A DBE may lease truck(s) from an established equipment leasing business open to the general public. The lease must indicate that the DBE has exclusive use of and control over the truck. This requirement does not preclude the leased truck from working for others during the term of the lease with the consent of the DBE, so long as the lease gives the DBE absolute priority for use of the leased truck. This type of lease may count toward the DBE's credit as long as the driver is under the DBE's payroll.

(7) Subcontracted/leased trucks shall display clearly on the dashboard the name of the DBE that they are subcontracted/leased to and their own company name if it is not identified on the truck itself. Magnetic door signs are not permitted.

DBE Replacement

When a Contractor has relied on a commitment to a DBE firm (or an approved substitute DBE firm) to meet all or part of a contract goal requirement, the Contractor shall not terminate the DBE for convenience. This includes, but is not limited to, instances in which the Contractor seeks to perform the work of the terminated subcontractor with another DBE subcontractor, a non-DBE subcontractor, or with the Contractor's own forces or those of an affiliate. A DBE may only be terminated after receiving the written approval based upon a finding of good cause for the termination.

The Contractor shall comply with the following for replacement of a committed DBE:

(A) Performance Related Replacement

If a replacement DBE is not found that can perform at least the same amount of work as the terminated DBE, the Contractor shall submit a good faith effort documenting the steps taken. Such documentation shall include, but not be limited to, the following:

(1) Copies of written notification to DBEs that their interest is solicited in contracting the work defaulted by the previous DBE or in subcontracting other items of work in the contract.
(2) Efforts to negotiate with DBEs for specific subcontracts including, at a minimum:
(a) The names, addresses, and telephone numbers of DBEs who were contacted.
(b) A description of the information provided to DBEs regarding the plans and specifications for portions of the work to be performed.
(3) A list of reasons why DBE quotes were not accepted.

(4) Efforts made to assist the DBEs contacted, if needed, in obtaining bonding or insurance required by the Contractor.

(B) Decertification Replacement

(1) When a DBE is decertified by the NCDOT after bid for a project contract has been received by the City, the City will not require the Contractor to solicit replacement DBE participation equal to the remaining work to be performed by the decertified firm. The participation equal to the remaining work performed by the decertified firm will count toward the contract goal requirement.
(2) When a DBE is decertified prior to the City receiving the Subcontract Approval form for the named DBE firm, the Contractor shall take all necessary and reasonable steps to replace the DBE subContractor with another DBE subContractor to perform at least the same amount of work to meet the DBE goal requirement. If a DBE firm is not found to do the same amount of work, a good faith effort must be submitted to NCDOT

Changes in the Work
When the City makes changes that result in the reduction or elimination of work to be performed by a DBE, the Contractor will not be required to seek additional participation. When the City makes changes that result in additional work to be performed by a DBE based upon the Contractor's commitment, the DBE shall participate in additional work to the same extent as the DBE participated in the original contract work. When the City makes changes that result in extra work, which has more than a minimal impact on the contract amount, the Contractor shall seek additional participation by DBEs unless otherwise approved by the City.

When the City makes changes that result in an alteration of plans or details of construction, and a portion or all of the work had been expected to be performed by a DBE, the Contractor shall seek participation by DBEs unless otherwise approved by the City. When the Contractor requests changes in the work that result in the reduction or elimination of work that the Contractor committed to be performed by a DBE, the Contractor shall seek additional participation by DBEs equal to the reduced DBE participation caused by the changes.

Reporting Disadvantaged Business Enterprise Participation
The Contractor shall provide the City with an accounting of payments made to all DBE firms, including material suppliers and Contractors at all levels (prime, subcontractor, or second tier subcontractor). This accounting shall be furnished to the City for any given month by the end of the following month. Failure to submit this information accordingly may result in the following action:

(A) Withholding of money due in the next partial pay estimate; or
(B) Removal of an approved Contractor from the prequalified bidders' list or the removal of other entities from the approved subcontractors list.

While each Contractor (prime, subcontractor, 2nd tier subcontractor) is responsible for accurate accounting of payments to DBEs, it shall be the prime Contractor's responsibility to report all monthly and final payment information in the correct reporting manner. The Contractor shall report the accounting of payments on the Subcontractor Payment Information form with each invoice. Invoices will not be processed for payment until the form is received.

Forms

LISTING OF DBE SUBCONTRACTORS (Submit with Bid)				
Firm Name and Address	Item No.	Item Description	* Agreed upon Unit Price	** Dollar Volume of Item
Name Address				
Name Address				
Name Address				
Name Address				
Name Address				

* The Dollar Volume shown in this column shall be the Actual Price Agreed Upon by the Prime Contractor and the DBE subcontractor, and these prices will be used to determine the percentage of the DBE participation in the contract.

** Dollar Volume of DBE Subcontractor Percentage of Total Contract Proposal Price:
If firm is a Material Supplier Only, show Dollar Volume as 60% of Agreed Upon Amount from Letter of Intent.
If firm is a Manufacturer, show Dollar Volume as 100% of Agreed Upon Amount from Letter of Intent.

LETTER OF INTENT TO PERFORM AS A SUBCONTRACTOR (Do not Submit with Bid)

Project Name _____

The undersigned intends to perform work in connection with the above contract upon execution of the proposal and subsequent award of contract by the Local Public Agency as:

Name of DBE Subcontractor_____
Address_____
City_____State_____Zip_____

Are you a certified Disadvantaged Business Enterprise (DBE)? Yes___ No___

The DBE status of the above named subcontractor is certified by the North Carolina Department of Transportation. The above named subcontractor is prepared to perform the described work listed on the original bid of the Listing of Subcontractors form, in connection with the above contract upon execution of the proposal and subsequent award of contract by the Local Public Agency. The above named subcontractor is prepared to perform the described for Subcontractor Price identified on the below.

Commitment Total based on estimated Unit Prices and Quantities: Amount $ _____

The above named bidder and subcontractor mutually accepts the Commitment Total estimated for the Unit Prices and Quantities. This commitment total is based on estimated quantities only and most likely will vary up or down as the project is completed. Final compensation will be based on actual quantities of work performed and accepted during the pursuance of work. The above listed amount represents the entire dollar amount quoted based on these estimated quantities. No conversations, verbal agreements, and/or other forms of non-written representations shall serve to add, delete, or modify the terms as stated.

This document shall not serve in any manner as an actual subcontract between the two parties. A separate subcontractor agreement will describe in detail the contractual obligations of the bidder and the DBE subcontractor.

Affirmation

The above named DBE subcontractor affirms that it will perform the portion(s) of the contract for the estimated dollar value as stated above.

Name of DBE Subcontractor	**Name of Bidder**
Signature / Title	**Signature / Title**
Date	**Date**

Monthly Payment Summary

All primes are required to list payments to **each subcontractor and supplier** paid during the period. Reports should be submitted to the Project Manager with each application for payment.

Reporting Period	_____ to _____	**Invoice Date**	_____
Project Name	_____	**Prime Contractor**	_____
Contact Person		**Telephone Number**	

DBE Participation Commitment		
Total Commitment:	$	%

Use additional sheets as necessary.

DBE Subcontractor/ Subcontractor/ Supplier ✓ Indicates supplier	**Describe Work Performed/Goods Supplied**	**Contract Amount**	**Amount Paid in THIS Reporting Period**	**Amount Paid To Date**
☐				
☐				
☐				
☐				
☐				
☐				
☐				
☐				
☐				
☐				
☐				
☐				
	Amount Paid to **DBE SUBCONTRACTORS** in THIS Period			
	Amount Paid to **DBE SUPPLIERS** in THIS Period*			

CUMMULATIVE SUMMARY
Total Paid to **DBE SUBCONTRACTORS** Through this Period (Total Amount Paid to Date)
Total Paid to **DBE SUPPLIERS** Through this Period (Total Amount Paid to Date)
Total Paid to Prime Through this Period (Total Amount Paid to Date)

**Note: A Contractor may count 60% of its expenditures to MWSB suppliers.*

By affixing my signature below, I certify that the information contained on this form is true and correct. I understand that the willful provision of false information shall constitute a breach of the contract to which this information applies.

Signature: _____ Date: _____

Print Name and Title of Authorized _____

PROCEDURE FOR REPORTING NORTH CAROLINA SALES TAX EXPENDITURES ON CITY OF GREENVILLE CONTRACTS

1. The following procedure in handling the North Carolina Sales Tax is applicable to this project. Contractors shall comply fully with the requirements outlined hereinafter, in order that the owner may recover the amount of the tax permitted under the law.

2. (a) It shall be the general contractor's responsibility to furnish the owner documentary evidence showing the materials used and sales tax paid by the general contractor and each of his subcontractors. Any county sales tax included in the contractor's statements must be shown separately from the state sales tax. If more than one county is shown, each county shall be listed separately.

(b) The documentary evidence shall consist of a certified statement, by the general contractor and each of his subcontractors individually, showing total purchases of materials from each separate vendor and total sales taxes by each county paid each vendor. The certified statement must show the invoice number (s) covered and inclusive dates of such invoices. State sales tax shall be listed separately from county sales tax. If more than one county is shown, each county shall be listed separately.

(c) Materials used from general contractor's or subcontractor's warehouse stock shall be shown in a certified statement at warehouse stock prices.

(d) The general contractor shall not be required to certify the subcontractor's statements.

(e) The documentary evidence to be furnished to owners eligible for sales or use tax refunds covers sales and/or use taxes paid on building materials used by contractors and subcontractors in the performance of contracts with churches, orphanages, hospitals not for profit, educational institutions not operated for profit and other charitable or religious institutions or organizations not operated for profit and incorporated cities, towns and counties in this State. The documentary evidence is to be submitted to the above-named institutions, organizations and governmental units to be included in claims for refunds to be prepared and submitted by them to obtain refunds provided by G.S. 105-164.14 and is to include the purchase of building materials, supplies, fixtures and equipment which become a part of or annexed to buildings or structures being erected, altered or repaired under contracts with such institutions, organizations or governmental units.

3. The contractor or contractors to whom an award is made on this project will be required to follow the procedure outlined above.

4. The contractor is advised that all requests for payment, partial or final, for work completed under this contract must include a sales tax report submitted in accordance with the procedures outlined above.

North Carolina Sales Tax

(Paid During This Estimate Period)

Project _____ Project Location_____County Estimate No._____

Contractor_____ Period Ending _____

Date	Vendor	Invoice Number	Invoice Amount	State 5.50%	County 2.25%	Total 7.75%	County
TOTALS							

I certify that the above listed vendors were paid sales tax upon purchases of building materials during the period covered by the construction estimate, and the property upon which such taxes were paid with or will be used in the performance of this contract. No tax on purchases or rentals of tools and/or equipment is included in the above list. All of the material above became a part of or is annexed to the building or structure being erected, altered or repaired.

_____ County, North Carolina

Signed and sworn to (or affirmed) before this day by _____ _____

(name of principal) (signature of principal)

Date: _____ _____

Notary Public's Signature

_____

(Notary's printed or typed name, Notary Public) (Official Seal) My commission expires: _____

General Conditions Of The Contract

The Standard Form, AIA Document A201, Fourteenth Edition, 1987 Edition of "General Conditions of the Contract for Construction", published by the American Institute of Architects, Articles 1 to 14 inclusive, pages 1 to 24 inclusive, shall be included as part of the Contract Documents. This document is referred to in the Contract Documents as "General Conditions".

Supplementary Conditions

The following supplements modify, change, delete from or add to the "General Conditions". Where any Article, Paragraph, Subparagraph or Clause thereof is modified or deleted by these supplements, the unaltered provisions of that Article, Paragraph, Subparagraph or Clause shall remain in effect.

ARTICLE 1, GENERAL PROVISIONS

1.1 BASIC DEFINITIONS

Add the following Paragraph 1.1.8:

1.1.8 OTHER DEFINITIONS

1.1.8.1 Wherever the terms "Subject to Approval", "as approved", "as required", or similar expressions appear in the Contract Documents, the meaning shall be construed as "approved by the Design Professional or Owner's Representative", or "as required by the Design Professional or Owner's Representative".

1.1.8.2 Wherever the term "Owner's Representative" appears in the Contract Documents, it shall be construed to mean whomever the Owner chooses to represent him during the Work.

1.1.8.3 Where the omission of such words as "the Contractor", "shall", "a", "an", "and", "the", "all", and the like are omitted, the sentence structure shall be considered to include such words to the effect that the Specifications are directional in describing work to be provided by the Contractor.

1.1.8.4 Within the Contract Documents, words such as "provide", "furnish and install", "include", and similar terms shall, unless otherwise specifically noted, be directions to the Contractor to provide and pay for all labor, materials, and necessary for the proper execution and completion of the work. As defined by the description phrase 1.1.8.4.1, 1.1.8.4.2, 1.1.8.4.3.

1.1.8.5 Within Contract Documents the term "trade" shall mean workmen or mechanics having special skills, or firms that hire them, as applicable.

1.1.8.6 The term "as indicated" or "as shown" shall mean "as indicated in the Contract Documents".

1.1.8.7 The term "any" in the Contract Documents shall be interpreted as "any and all" whenever more than one item would be applicable for completion of the Work of the Project; e.g., "any other general expenses".

1.1.8.8 The term "replace" in the Contract Documents shall be interpreted as "restore", "renew", "make good", "reconstruct, using new materials", as applicable to the type of work requiring replacement.

1.1.8.9 Wherever the terms "submit", "submit for approval" or similar expressions appear in the Contract Documents, the party making the submittal is the Contractor and the party receiving the submittal is the Design Professional.

1.1.8.10 Wherever the term "as directed" or similar expressions appear in the Contract Documents, it shall mean "as directed by the Design Professional or Owner's Representative".

1.1.8.11 Wherever the term "as selected" or similar expressions appear in the Contract Documents, it shall mean "as selected by the Design Professional or Owner's Representative".

1.1.8.12 Within the Contract Documents, singular and plural references shall mean one or more like items of work as necessary to complete the Work, unless specifically directed otherwise.

1.1.8.13 The Project Manual is the volume(s) which includes the Bidding

Requirements, the Contract Forms, and the General and Supplementary Conditions of the Contract and the Specifications.

1.2 EXECUTION, CORRELATION AND INTENT

1.2.1 Add "except where undivided responsibility for certain work is specifically called for."

ARTICLE 2, OWNER

2.2 INFORMATION AND SERVICES REQUIRED OF THE OWNER

2.2.5 Delete Paragraph 2.2.5 in its entirety and substitute the following:

2.2.5 The Contractor will be furnished free of charge electronic copies of the Drawings and electronic copies of the Project Manual. Hard copy sets will be furnished at the cost of reproduction.

ARTICLE 3, CONTRACTOR

3.1 DEFINITION

Add the following Paragraph 3.1.2:

3.1.2 Where term "Contractor" is modified in any way, such as, without limit, "this Contractor", "Plumbing Contractor", "Electrical Contractor", the modified term shall be deemed to refer to the Trade Contractor or Subcontractor involved with the work mentioned, but such meaning does not relieve the Contractor (as defined in Paragraph 3.1.1) from his responsibility for all Work, whether or not such Work is sublet.

3.2 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR

3.2.1 Add the following to Paragraph 3.2.1:

"...except as noted otherwise in Submittals: Division 01. After reporting to the Design Professional any error, inconsistency or omission he may discover in the Contract Documents, the Contractor shall not proceed with any work so affected without the Design Professional's written approval."

3.7 PERMITS, FEES, AND NOTICES

3.7.3 Add the following Subparagraph 3.7.3.1:

3.7.3.1 The requirements of Paragraph 3.7.3 do not waive the Contractor's responsibility of complying with the requirements of the Contract Documents when such requirements exceed those of any laws, ordinances, rules, regulations and orders of any public authority bearing on the Work.

3.10 CONTRACTOR'S CONSTRUCTION SCHEDULE

3.10.1 Delete this paragraph in its entirety and refer to Construction Schedules: Division 01.

3.11 DOCUMENTS AND SAMPLES AT THE SITE

3.11.1 Delete this paragraph in its entirety and refer to Project Record Documents: Division 01.

3.12 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

3.12.6 Add the following Subparagraph 3.12.6.1:

3.12.6.1 See Submittals: Division 01 for commencement of work prior to final approval.

ARTICLE 4, ADMINISTRATION OF THE CONTRACT

4.1 ARCHITECT

4.1.1.2 Wherever the term "Design Professional" appears in the Project Manual or on the Drawings, it shall be interpreted to mean "Architect" or "Engineer" as defined in Subparagraph 4.1.1.1.

ARTICLE 5, SUBCONTRACTORS

5.2 AWARD OF SUBCONTRACTS AND OTHER CONTRACTS FOR PORTIONS OF WORK

5.2.1 In first sentence, after the word "practicable," add "but not later than as specified under Construction Schedules: Division 01".

5.2.3 Add the following Subparagraph 5.2.3.1:

5.2.3.1 Subcontractors proposed by the Contractor will not be acceptable to either the Owner or the Design Professional where evidence exists that such proposed Subcontractors (1) are unable or unwilling to comply with the requirements of the Contract Documents which govern the Work of the Subcontracts involved; (2) are in circumstances similar to those cited in Paragraph 14.2.1, or (3) have experience, judged by the Design Professional or Owner, to be inconsistent with requirements for the Work of the Subcontracts involved. In these instances the Contractor will not be entitled to a change in the Contract Sum as provided in Paragraph 5.2.3 and shall propose substitute Subcontractors for those not accepted for causes stated herein.

5.3 SUBCONTRACTURAL RELATIONS

Add the following Paragraphs:

5.3.2 Where Contractor sublets portions of the Work, the entire responsibility for the subdividing of Work rests with the Contractor. The Owner and the Design Professional are not responsible for the manner of the subdivision of the Work and neither will enter into nor settle disagreements or disputes between Contractor and Subcontractors.

5.3.3 Contractor shall require each Subcontractor to (l) inspect surfaces and Project Site conditions before beginning Work at Project Site, and (2) accept or cite necessary corrections in surfaces or Project Site conditions before beginning Work at Project Site.

ARTICLE 7, CHANGES IN THE WORK

7.2 CHANGE ORDERS

7.2.1 Add the following Subparagraph 7.2.1.1 to Paragraph 7.2.1:

7.2.1.1 Before a Change Order is written, it shall be preceded by a Bulletin, a written Field Order or other written instructions to the Contractor. Drawings will accompany such instructions, when required. The Contractor shall promptly submit, in writing, a cost proposal and the effect upon contract time in the event the work is authorized.

7.2.3 Add the following Paragraph 7.2.3:

7.2.3 Changes in the Work shall be subject to the following provisions:

.l The Owner reserves the right to accept or reject Contractor's Proposal.

.2 Contractor agrees to exclude charges involving penalties, alleged damages, cancellation charges unless bona fide and unavoidable, and other charges which do not relate to the cost of labor, material, use of equipment, overhead and profit.

.3 When the contract time cannot be extended, due to commitments by the Owner, authorized changes in the work shall not affect the completion date. Where the contract time can be extended, such time extension shall not be the basis for extra payment claims by the Contractor in addition to the amount of the Change Order.

ARTICLE 8, TIME

8.1 DEFINITIONS

8.1.3 Add the following Subparagraph 8.1.3.1 to Paragraph 8.1.3:

8.1.3.1 As between the Owner and the Contractor: As to all acts or failures to act occurring prior to the relevant Date of Substantial Completion, any applicable statute of limitations shall commence to run and any alleged cause of action shall be deemed to have accrued in any and all events not later than such Date of Substantial Completion: As to all acts or failures to act occurring subsequent to the relevant Date of Substantial Completion, any applicable statute of limitations shall commence to run and any alleged cause of action shall be deemed to have accrued in any and all events not later than the date of issuance of the final Certificate for Payment.

ARTICLE 9, PAYMENTS AND COMPLETION

9.3 APPLICATIONS FOR PAYMENT

9.3.3 Add the following Subparagraph 9.3.3.1 to Paragraph 9.3.3:

9.3.3.1 WAIVER OF LIENS: The Contractor shall execute and deliver to the Owner within 48 hours before visible commencement of Work of the Project, a Waiver of Mechanics Liens on behalf of himself, all Subcontractors, and material men in a form acceptable to the Owner.

ARTICLE 11, INSURANCE AND BONDS

11.3 PROPERTY INSURANCE

11.3.1.2 Change the second sentence to read:

The Contractor may then effect insurance which will protect the interests of the Owner, Contractor, Subcontractors and Sub-subcontractors in the Work, and by appropriate Change Order the cost thereof shall be charged to the Owner.

11.3.1 Delete Paragraph 11.3.1 in its entirety and substitute the following:

11.3.1 The Contractor shall purchase and maintain, in a company or companies lawfully authorized to do business in the jurisdiction in which the Project is located, property insurance in the amount of the initial Contract Sum as well as subsequent modifications thereto for the entire Work at the site on a replacement cost basis without voluntary deductibles. Such property insurance shall be maintained, unless otherwise provided in the Contract Documents or otherwise agreed in writing by all persons and entities who are beneficiaries of such insurance, until final payment has been made as provided in Paragraph 9.10 or until no person or entity other than the Owner has an insurable interest in the property required by this Paragraph 11.3 to be covered, whichever is earlier. This insurance shall include interests of the Owner, the Contractor, Subcontractors and Sub-subcontractors in the Work. If not covered under "all risk" insurance or otherwise provided in the Contract Documents, the Contractor shall effect and maintain similar property insurance on portions of the Work stored off the site or in transit when such portions of the Work are to be included in an Application for Payment under Subparagraph 9.3.2.

11.3.1.2 Delete Subparagraph 11.3.1.2 in its entirety.

11.3.1.3 Delete Subparagraph 11.3.1.3 in its entirety and substitute the following:

11.3.1.3 If the property insurance requires minimum deductibles, the Contractor shall pay costs not covered by such deductibles. If the Owner or insurer increases the required minimum deductibles above the amounts so identified or if the Contractor elects to purchase this insurance with voluntary deductible amounts, the Contractor shall be responsible for payment of the additional costs not covered because of such increased or voluntary deductibles. If separate Contractors are added as insureds to be covered by this policy, the separate Contractors shall be responsible for payment of appropriate part of any deductibles in the event claims are paid on their part of the Project.

11.3.4 Delete Paragraph 11.3.4 in its entirety.

11.3.6 Delete Paragraph 11.3.6 in its entirety and substitute the following:

11.3.6 Before an exposure to loss may occur, the Contractor shall file with the Owner two certified copies of each policy that includes insurance coverages required by this Paragraph 11.3. Each policy shall contain all generally applicable conditions, definitions, exclusions and endorsements related to this Project. Each policy shall contain a provision that the policy will not be cancelled or allowed to expire until at least 30 days' prior written notice has been given to the Owner.

11.3.12 Add the following Paragraph 11.3.12:

11.3.12 This policy covers all entities mentioned in The Contract Documents as insureds for the full amount of their contract and approved extras during construction and after construction until fully paid including retention. It is understood that the property installed by the Contractor, Subcontractor, and Sub-subcontractor remain as their property until such payment has been made.

ARTICLE 13, MISCELLANEOUS PROVISIONS

13.1 GOVERNING LAW

Add the following Paragraph 13.1.2.

13.1.2 Nothing in the Contract Documents shall be construed to permit deviation from the governing law.

ARTICLE 15, EQUAL OPPORTUNITY

15.1 The Contractor shall maintain policies of employment as follows:

15.1.1 The Contractor and all Subcontractors shall not discriminate against any employee or applicant for employment because of race, religion, color, sex, national origin or age. The Contractor shall take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, religion, color, sex, national origin, or age. Such action shall include, but not be limited to the following: Employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the policies of nondiscrimination.

15.1.2 The Contractor and all Subcontractors shall, in all solicitations or advertisements for employees placed by them or on their behalf, state that all qualified applicants will receive consideration for employment without regard to race, religion, color, sex, national origin, or age.

ARTICLE 16, ERRORS AND OMISSIONS

16.1 Contractor shall notify Design Professional in writing regarding any necessary items which may have been omitted from the Specifications or Drawings or both, and any irregularities, discrepancies or duplications between Drawings and Specifications according to the evident intent. In case of such errors or omissions the Contractor shall not proceed with the work in uncertainty but shall consult the Design Professional, regarding proper intent, and revision if necessary.

16.2 Any duplication of Work specified in two (2) or more Sections shall require the Contractor to provide the Work so specified without extra or additional charge to the Owner. Such duplication, if any, is not intended.

16.3 Typographical and spelling errors will be interpreted by the Design Professional for their obvious meaning and intent.

16.4 In any conflict within Contract Documents, requirements for the more expensive work shall govern.

16.5 Where a job condition arises and detail drawings do not show the Design Professional's intent, the Contractor shall consult with the Design Professional to determine the manner of doing the Work, so that aesthetic effect is not compromised.

ARTICLE 17, USE OF PREMISES BY THE OWNER

17.1 The Contractor with concurrence by insurance company or companies as stated in Clause 11.3.9 hereinbefore, shall permit the Owner to install machinery or equipment not included in the Contract in any part of the new construction prior to completion of the Work. The Owner agrees to give the Contractor at least three (3) days notice of his intention of using any portion of the new construction and the Contractor in turn shall notify the Design Professional, who will inspect the portion to be used by the Owner. The use of part of the premises shall not be construed as acceptance of the new construction Work.

ARTICLE 18, INTERPRETATIONS IN WRITING

18.1 Neither the price bid for the Work of any Contract nor the contract sum, shall be based in any manner upon oral opinions or real or alleged instructions of an oral nature, regardless of whether such opinions or instructions are expressed by the Owner, the Design Professional, the Contractor, or agents or representatives of any of them.

18.2 These provisions do not intend to deny normal discussion, recommendations, explanations, suggestions, approvals, rejections, and similar activity in pursuit of the Work of the Project on an oral basis, such as at job conferences and otherwise at the Project Site. In such instances the written minutes, correspondences, shop drawing records, written field orders and other written data shall govern over personal claims regarding statements made contrary to the written data.

18.3 Interpretations of contract documents, to be effective for claim purposes or for justification as to proper procedure in performing the Work, must be obtained in writing before such claim is made or such Work begun.

END

No Obligation by the Federal Government.

(1) The City and Contractor acknowledge and agree that, notwithstanding any concurrence by the Federal Government in or approval of the solicitation or award of the underlying contract, absent the express written consent by the Federal Government, the Federal Government is not a party to this contract and shall not be subject to any obligations or liabilities to the City, Contractor, or any other party (whether or not a party to that contract) pertaining to any matter resulting from the underlying contract.

(2) The Contractor agrees to include the above clause in each subcontract financed in whole or in part with Federal assistance provided by FTA. It is further agreed that the clause shall not be modified, except to identify the sub Contractor who will be subject to its provisions.

Program Fraud and False or Fraudulent Statements or Related Acts.

(1) The Contractor acknowledges that the provisions of the Program Fraud Civil Remedies Act of 1986, as amended, 31 U.S.C. § 3801 et seq. and U.S. DOT regulations, "Program Fraud Civil Remedies," 49 C.F.R. Part 31, apply to its actions pertaining to this Project. Upon execution of the underlying contract, the Contractor certifies or affirms the truthfulness and accuracy of any statement it has made, it makes, it may make, or causes to be made, pertaining to the underlying contract or the FTA assisted project for which this contract work is being performed. In addition to other penalties that may be applicable, the Contractor further acknowledges that if it makes, or causes to be made, a false, fictitious, or fraudulent claim, statement, submission, or certification, the Federal Government reserves the right to impose the penalties of the Program Fraud Civil Remedies Act of 1986 on the Contractor to the extent the Federal Government deems appropriate.

(2) The Contractor also acknowledges that if it makes, or causes to be made, a false, fictitious, or fraudulent claim, statement, submission, or certification to the Federal Government under a contract connected with a project that is financed in whole or in part with Federal assistance originally awarded by FTA under the authority of 49 U.S.C. § 5307, the Government reserves the right to impose the penalties of 18 U.S.C. § 1001 and 49 U.S.C. § 5307(n)(1) on the Contractor, to the extent the Federal Government deems appropriate.

(3) The Contractor agrees to include the above two clauses in each subcontract financed in whole or in part with Federal assistance provided by FTA. It is further

agreed that the clauses shall not be modified, except to identify the sub Contractor who will be subject to the provisions.

Access **to Records**

The following access to records requirements apply to this Contract:

1. The Contractor agrees to provide the City, the FTA Administrator, the Comptroller General of the United States or any of their authorized representatives access to any books, documents, papers and records of the Contractor which are directly pertinent to this Contract for the purposes of making audits, examinations, excerpts and transcriptions. Contractor also agrees, pursuant to 49 C.P.R. 633.17 to provide the FTA Administrator or his authorized representatives including any PMO Contractor access to Contractor's records and construction sites pertaining to a major capital project, defined at 49 U.S.C. 5302(a)1, which is receiving federal financial assistance through the programs described at 49 U.S.C. 5307, 5309 or 5311.

2. The Contractor shall make available records related to the Contract to the City, the Secretary of Transportation and the Comptroller General or any authorized officer or employee of any of them for the purposes of conducting an audit and inspection.

3. The Contractor agrees to permit any of the foregoing parties to reproduce by any means whatsoever or to copy excerpts and transcriptions as reasonably needed.

4. The Contractor agrees to maintain all books, records, accounts and reports required under this Contract for a period of not less than three years after the date of termination or expiration of this Contract, except in the event of litigation or settlement of claims arising from the performance of this Contract, in which case Contractor agrees to maintain same until the City, the FTA Administrator, the Comptroller General, or any of their duly authorized representatives, have disposed of all such litigation, appeals, claims or exceptions related thereto. Reference 49 CFR 18.39(i)(11).

Federal Changes

Contractor shall at all times comply with all applicable FTA regulations, policies, procedures and directives, including without limitation those listed directly or by reference in the Master Agreement between City and FTA, as they may be

amended or promulgated from time to time during the term of this Contract. Contractor's failure to so comply shall constitute a material breach of this Contract.

Termination for Convenience

The City may terminate this Contract, in whole or in part, at any time by written notice to the Contractor when it is in the Government's best interest. The Contractor shall be paid its costs, including Contract close-out costs, and profit on work performed up to the time of termination. The Contractor shall promptly submit its termination claim to the City to be paid the Contractor. If the Contractor has any property in its possession belonging to the City, the Contractor will account for the same, and dispose of it in the manner the City directs.

Termination for Default (Construction)

If the Contractor refuses or fails to prosecute the work or any separable part, with the diligence that will insure its completion within the time specified in this Contract or any extension or fails to complete the work within this time, or if the Contractor fails to comply with any other provisions of this Contract, the City may terminate this Contract for default. The City shall terminate by delivering to the Contractor a Notice of Termination specifying the nature of the default. In this event, the City may take over the work and compete it by Contract or otherwise, and may take possession of and use any materials, appliances, and plant on the work site necessary for completing the work. The Contractor and its sureties shall be liable for any damage to the Recipient resulting from the Contractor's refusal or failure to complete the work within specified time, whether or not the Contractor's right to proceed with the work is terminated. This liability includes any increased costs incurred by the Recipient in completing the work.

The Contractor's right to proceed shall not be terminated nor the Contractor charged with damages under this clause if-

1. the delay in completing the work arises from unforeseeable causes beyond the control and without the fault or negligence of the Contractor. Examples of such causes include: acts of God, acts of the Recipient, acts of another Contractor in the performance of a Contract with the Recipient, epidemics, quarantine restrictions, strikes, freight embargoes; and

2. the Contractor, within 10 days from the beginning of any delay, notifies the City in writing of the causes of delay. If in the judgment of the City, the delay is

excusable, the time for completing the work shall be extended. The judgment of the City shall be final and conclusive on the parties, but subject to appeal under the Disputes clauses.

If, after termination of the Contractor's right to proceed, it is determined that the Contractor was not in default, or that the delay was excusable, the rights and obligations of the parties will be the same as if the termination had been issued for the convenience of the City.

Opportunity to Cure

The City in its sole discretion may, in the case of a termination for breach or default, allow the Contractor 14 days in which to cure the defect. In such case, the notice of termination will state the time period in which cure is permitted and other appropriate conditions

If Contractor fails to remedy to City's satisfaction the breach or default of any of the terms, covenants, or conditions of this Contract within 14 days after receipt by Contractor of written notice from the City setting forth the nature of said breach or default, the City shall have the right to terminate the Contract without any further obligation to Contractor. Any such termination for default shall not in any way operate to preclude the City from also pursuing all available remedies against Contractor and its sureties for said breach or default.

Waiver of Remedies for any Breach

In the event that the City elects to waive its remedies for any breach by Contractor of any covenant, term or condition of this Contract, such waiver by City shall not limit the City's remedies for any succeeding breach of that or of any other term, covenant, or condition of this Contract.

Civil Rights

The following requirements apply to the underlying Contract:

(1) Nondiscrimination- In accordance with Title VI of the Civil Rights Act, as amended, 42 U.S.C. § 2000d, section 303 of the Age Discrimination Act of 1975, as amended, 42 U.S.C. § 6102, section 202 of the Americans with Disabilities Act of 1990, 42 U.S.C. § 12132, and Federal transit law at 49 U.S.C. § 5332, the Contractor agrees that it will not discriminate against any employee or applicant

for employment because of race, color, creed, national origin, sex, age, or disability. In addition, the Contractor agrees to comply with applicable Federal implementing regulations and other implementing requirements FTA may issue.

(2) Equal Employment Opportunity - The following equal employment opportunity requirements apply to the underlying Contract:

(a) Race, Color, Creed, National Origin, Sex- In accordance with Title VII of the Civil Rights Act, as amended, 42 U.S.C. § 2000e, and Federal transit laws at 49 U.S.C. § 5332, the Contractor agrees to comply with all applicable equal employment opportunity requirements ofU.S. Department of Labor (U.S. DOL) regulations, "Office of Federal Contract Compliance Programs, Equal Employment Opportunity, Department of Labor," 41 C.P.R. Parts 60 et seq., (which implement Executive Order No. 11246, "Equal Employment Opportunity," as amended by Executive Order No. 11375, "Amending Executive Order 11246 Relating to Equal Employment Opportunity," 42 U.S.C. § 2000e note), and with any applicable Federal statutes, executive orders, regulations, and Federal policies that may in the future affect construction activities undertaken in the course of the Project. The Contractor agrees to take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, creed, national origin, sex, or age. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer, recruitment or recruitment advertising, layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. In addition, the Contractor agrees to comply with any implementing requirements FTA may issue.

(b) Age - In accordance with section 4 of the Age Discrimination in Employment Act of 1967, as amended, 29 U.S.C. § § 623 and Federal transit law at 49 U.S.C. § 5332, the Contractor agrees to refrain from discrimination against present and prospective employees for reason of age. In addition, the Contractor agrees to comply with any implementing requirements FTA may issue.

(c) Disabilities- In accordance with section 102 of the Americans with Disabilities Act, as amended, 42 U.S.C. § 12112, the Contractor agrees that it will comply with the requirements of U.S. Equal Employment Opportunity Commission, "Regulations to Implement the Equal Employment Provisions of the Americans with Disabilities Act," 29 C.P.R. Part 1630, pertaining to employment of persons with disabilities. In addition, the Contractor agrees to comply with any implementing requirements FTA may issue.

(3) The Contractor also agrees to include these requirements in each subContract financed in whole or in part with Federal assistance provided by FTA, modified only if necessary to identify the affected parties.

Equal Employment Opportunity

The Contractor agrees to comply with DOL regulations, "Office of Federal Contract Compliance Programs, Equal Employment Opportunity, Department of Labor," 41 CFR Chapter 60, which implement Executive Order No. 11246, "Equal Employment Opportunity," September 24, 1965, as amended by Executive Order No. 11375, "Amending Executive Order No. 11246 Relating to Equal Employment Opportunity," October 13, 1967.

Disadvantaged Business Enterprises

This Contract is subject to the requirements of Title 49, Code of Federal Regulations, Part 26, Participation by Disadvantaged Business Enterprises in Department of Transportation Financial Assistance Programs. The national goal for participation of Disadvantaged Business Enterprises (DBE) is 10%. The agency's overall goal for DBE participation is 4%. A separate Contract goal has been established for this procurement. It is percent of the total Contract pnce.

The Contractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this Contract. The Contractor shall carry out applicable requirements of 49 CFR Part 26 in the award and administration of this DOT-assisted Contract. Failure by the Contractor to carry out these requirements is a material breach of this Contract, which may result in the termination of this Contract or such other remedy as the City deems appropriate. Each sub Contract the Contractor signs with a sub Contractor must include the assurance in this paragraph (see 49 CFR 26.13(b)).

Bidders are required to document sufficient DBE participation to meet the stated Contract goal or, alternatively, document adequate good faith efforts to do so, as provided for in 49 CFR 26.53. Award of this Contract is conditioned on submission of the following concurrent with and accompanying sealed bid:

1. The names and addresses ofDBE firms that will participate in this Contract;

2. A description of the work each DBE will perform;

3. The dollar amount of the participation of each DBE firm participating;

4. Written documentation of the bidder's commitment to use a DBE sub Contractor whose participation it submits to meet the Contract goal;

5. Written confirmation from the DBE that it is participating in the Contract as provided in the prime Contractor's commitment; and

6. If the Contract goal is not met, evidence of good faith efforts to do so.

Bidders must present the information required above . *(see* 49 CFR 26.53(3)).

The Contractor is required to pay its sub Contractors performing work related to this Contract for satisfactory performance of that work no later than 30 days after the Contractor's receipt of payment for that work from the City. In addition, the Contractor may not hold retainage from its sub Contractors.

The Contractor must promptly notify the City whenever a DBE sub Contractor performing work related to this Contract is terminated or fails to complete its work, and must make good faith efforts to engage another DBE sub Contractor to perform at least the same amount of work. The Contractor may not terminate any DBE sub Contractor and perform that work through its own forces or those of an affiliate without prior written consent of the City.

Incorporation of Federal Transit Administration (FTA) Terms

The preceding provisions include, in part, certain Standard Terms and Conditions required by DOT, whether or not expressly set forth in the preceding Contract provisions. All Contractual provisions required by DOT, as set forth in FTA Circular 4220.1E, are hereby incorporated by reference. Anything to the contrary herein notwithstanding, all FTA mandated terms shall be deemed to control in the event of a conflict with other provisions contained in this Agreement. The Contractor shall not perform any act, fail to perform any act, or refuse to comply with any City requests which would cause the City to be in violation of the FTA terms and conditions.

Suspension and Debarment

This Contract is a covered transaction for purposes of 49 CFR Part 29. As

such, the Contractor is required to verify that none of the Contractor, its principals, as defined at 49 CFR 29.995, or affiliates, as defined at 49 CFR 29.905, are excluded or disqualified as defined at 49 CFR 29.940 and 29.945.
The Contractor is required to comply with 49 CFR 29, Subpart C and must include the requirement to comply with 49 CFR 29, Subpart C in any lower tier covered transaction it enters into.

By signing and submitting its bid or proposal, the bidder or proposer certifies as follows:

The certification in this clause is a material representation of fact relied upon by the City. If it is later determined that the bidder or proposer knowingly rendered an erroneous certification, in addition to remedies available to the City, the Federal Government may pursue available remedies, including but not limited to suspension and/or debarment.

The bidder or proposer agrees to comply with the requirements of 49 CFR 29, Subpart C while this offer is valid and throughout the period of any Contract that may arise from this offer. The bidder or proposer further agrees to include a provision requiring such compliance in its lower tier covered transactions.

Buy America

The Contractor agrees to comply with 49 U.S.C. 5323(j) and 49 C.P.R. Part 661, which provide that Federal funds may not be obligated unless steel, iron, and manufactured products used in PTA-funded projects are produced in the United States, unless a waiver has been granted by FTA or the product is subject to a general waiver. General waivers are listed in 49 C.P.R. 661.7, and include final assembly in the United States for 15 passenger vans and 15 passenger wagons produced by Chrysler Corporation, and microcomputer equipment and software. Separate requirements for rolling stock are set out at 49 U.S.C. 5323(j)(2)(C) and 49 C.P.R. 661.11. Rolling stock must be assembled in the United States and have a 60 percent domestic content.

A bidder or offeror must submit to the City the appropriate Buy America certification (below) with all bids or offers on PTA-funded Contracts, except those subject to a general waiver. Bids or offers that are not accompanied by a completed Buy America certification must be rejected as nonresponsive. This requirement does not apply to lower tier sub Contractors.

Certification Requirement for Procurement of Steel, Iron, or Manufactured Products.

Certificate of Compliance with 49 US.C. 5323(j)(l)

The bidder or offeror hereby certifies that it will meet the requirements of 49 U.S.C. 5323(j)(l) and the applicable regulations in 49 C.P.R. Part 661.5.

Date _____

Signature _____

CompanyName _____

Title _____

Certificate of Non-Compliance with 49 US.C. 5323(j)(l)

The bidder or offeror hereby certifies that it cannot comply with the requirements of 49 U.S.C. 5323(j)(l) and 49 C.P.R. 661.5, but it may qualify for an exception pursuant to 49 U.S.C. 5323(j)(2)(A), 5323(j)(2)(B), or 5323(j)(2)(D), and 49 C.P.R. 661.7.

Date _____

Signature _____

CompanyName _____

Title _____

Disputes

Disputes arising in the performance of this Contract which are not resolved by agreement of the parties shall be decided in writing by the authorized representative of City's Public Works Director. This decision shall be final and conclusive unless within ten (10) days from the date of receipt of its copy, the Contractor mails or otherwise furnishes a written appeal to the City's City Manager. In connection with any such appeal, the Contractor shall be afforded an opportunity to be heard and to offer evidence in support of its position. The decision of the City Manager shall be binding upon the Contractor and the Contractor shall abide be the decision.

Performance During Dispute

Unless otherwise directed by the City, Contractor shall continue performance under this Contract while matters in dispute are being resolved.

Claims for Damages

Should either party to the Contract suffer injury or damage to person or property because of any act or omission of the party or of any of his employees, agents or others for whose acts he is legally liable, a claim for damages therefor shall be made in writing to such other party within a reasonable time after the first observance of such injury of damage.

Remedies

Unless this Contract provides otherwise, all claims, counterclaims, disputes and other matters in question between the City and the Contractor arising out of or relating to this agreement or its breach will be decided by arbitration if the parties mutually agree, or in a court of competent jurisdiction within the State of North Carolina.

Rights and Remedies

The duties and obligations imposed by the Contract Documents and the rights and remedies available thereunder shall be in addition to and not a limitation of any duties, obligations, rights and remedies otherwise imposed or available by law. No action or failure to act by the City, or Contractor shall constitute a waiver of any right or duty afforded any of them under the Contract, nor shall any such action or

failure to act constitute an approval of or acquiescence in any breach thereunder, except as may be specifically agreed in writing.

Byrd Anti-Lobbying Amendment, 31 U.S.C. 1352, as amended by the Lobbying Disclosure Act of 1995, P.L. 104-65 [to be codified at 2 U.S.C. § 1601, et seq.]

Contractors who apply or bid for an award of$100,000 or more shall file the certification required by 49 CFR part 20, "New Restrictions on Lobbying." Each tier certifies to the tier above that it will not and has not used Federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a member of Congress, officer or employee of Congress, or an employee of a member of Congress in connection with obtaining any Federal Contract, grant or any other award covered by 31 U.S.C. 1352. Each tier shall also disclose the name of any registrant under the Lobbying Disclosure Act of 1995 who has made lobbying contacts on its behalfwith non-Federal funds with respect to that Federal Contract, grant or award covered by 31 U.S.C. 1352. Such disclosures are forwarded from tier to tier up to the recipient.

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CERTIFICATION REGARDING LOBBYING

Certification for Contracts, Grants, Loans, and Cooperative Agreements

The undersigned [Contractor] certifies, to the best ofhis or her knowledge and belief, that:

(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal Contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal Contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for making lobbying contacts to an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member ofCongress in connection with this Federal Contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form--LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions [as amended by "Government wide Guidance for New Restrictions on Lobbying," 61 Fed. Reg. 1413 (1/19/96). Note: Language in paragraph (2) herein has been modified in accordance with Section 10 of the Lobbying Disclosure Act of 1995 (P.L. 104-65, to be codified at 2 U.S.C. 1601, *et seq.)]*

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subContracts, subgrants, and Contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission ofthis certification is a prerequisite for making or entering into this transaction imposed by 31, U.S.C. § 1352 (as amended by the Lobbying Disclosure Act of 1995). Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

[Note: Pursuant to 31 U.S.C. § 1352(c)(1)-(2)(A), any person who makes a prohibited expenditure or fails to file or amend a required certification or disclosure form shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such expenditure or failure.]

The Contractor, certifies or affrrms the truthfulness and accuracy of each statement of its certification and disclosure, if any. In addition, the Contractor understands and agrees that the provisions of31 U.S.C. A 3801, *et seq.*, apply to this certification and disclosure, if any.

_____ Signature of Contractor's Authorized Official

_____ Name and Title of Contractor's Authorized Official

_____ Date

Clean Air - (1) The Contractor agrees to comply with all applicable standards, orders or regulations issued pursuant to the Clean Air Act, as amended, 42 U.S.C. §§ 7401 et seq. The Contractor agrees to report each violation to the City and understands and agrees that the City will, in turn, report each violation as required to assure notification to FTA and the appropriate EPA Regional Office.

(2) The Contractor also agrees to include these requirements in each sub Contract exceeding $100,000 financed in whole or in part with Federal assistance provided byFTA.

Clean Water- (1) The Contractor agrees to comply with all applicable standards, orders or regulations issued pursuant to the Federal Water Pollution Control Act, as amended, 33 U.S.C. 1251 et seq. The Contractor agrees to report each violation to the City and understands and agrees that the City will, in turn, report each violation as required to assure notification to FTA and the appropriate EPA Regional Office.

(2) The Contractor also agrees to include these requirements in each sub Contract exceeding $100,000 financed in whole or in part with Federal assistance provided byFTA.

Davis-Bacon and Copeland Anti-Kickback Acts

(1) Minimum wages- (i) All laborers and mechanics employed or working upon the site of the work (or under the United States Housing Act of 1937 or under the Housing Act of 1949 in the construction or development of the project), will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any Contractual relationship which may be alleged to exist between the Contractor and such laborers and mechanics.

Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph (1)(iv) of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to

be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in 29 CFR Part 5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: Provided, That the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classifications and wage rates conformed under paragraph (l)(ii) of this section) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the Contractor and its sub Contractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

(ii)(A) The Contracting officer shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the Contract shall be classified in conformance with the wage determination. The Contracting officer shall approve an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:

(1) Except with respect to helpers as defined as 29 CFR 5.2(n)(4), the work to be performed by the classification requested is not performed by a classification in the wage determination; and

(2) The classification is utilized in the area by the construction industry; and

(3) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination; and

(4) With respect to helpers as defined in 29 CFR 5.2(n)(4), such a classification prevails in the area in which the work is performed.

(B) If the Contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the Contracting officer agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by the Contracting officer to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, DC 20210. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of

receipt and so advise the Contracting officer or will notify the Contracting officer within the 30-day period that additional time is necessary.

(C) In the event the Contractor, the laborers or mechanics to be employed in the classification or their representatives, and the Contracting officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the Contracting officer shall refer the questions, including the views of all interested parties and the recommendation of the Contracting officer, to the Administrator for determination. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise the Contracting officer or will notify the Contracting officer within the 30-day period that additional time is necessary.

(D) The wage rate (including fringe benefits where appropriate) determined pursuant to paragraphs (a)(l)(ii) (B) or (C) of this section, shall be paid to all workers performing work in the classification under this Contract from the first day on which work is performed in the classification.

(iii) Whenever the minimum wage rate prescribed in the Contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the Contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

(iv) If the Contractor does not make payments to a trustee or other third person, the Contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, Provided, That the Secretary of Labor has found, upon the written request of the Contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the Contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

(v)(A) The Contracting officer shall require that any class of laborers or mechanics which is not listed in the wage determination and which is to be employed under the Contract shall be classified in conformance with the wage determination. The Contracting officer shall approve an additional classification and wage rate and fringe benefits therefor only when the following criteria have been met:

(1) The work to be performed by the classification requested is not performed by a classification in the wage determination; and

(2) The classification is utilized in the area by the construction industry; and

(3) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(B) If the Contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the Contracting officer agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by the Contracting officer to the Administrator of the Wage and Hour Division, Employment Standards Administration, Washington, DC 20210. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the Contracting officer or will notify the Contracting officer within the 30-day period that additional time is necessary.

(C) In the event the Contractor, the laborers or mechanics to be employed in the classification or their representatives, and the Contracting officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the Contracting officer shall refer the questions, including the views of all interested parties and the recommendation of the Contracting officer, to the Administrator for determination. The Administrator, or an authorized representative, will issue a determination with 30 days of receipt and so advise the Contracting officer or will notify the Contracting officer within the 30-day period that additional time is necessary.

(D) The wage rate (including fringe benefits where appropriate) determined pursuant to paragraphs (a)(l)(v) (B) or (C) of this section, shall be paid to all workers performing work in the classification under this Contract from the first day on which work is performed in the classification.

(2) **Withholding** - The City shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld from the Contractor under this Contract or any other Federal Contract with the same prime Contractor, or any other federally-assisted Contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime Contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the Contractor or any sub Contractor the full amount of

wages required by the Contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work (or under the United States Housing Act of 1937 or under the Housing Act of 1949 in the construction or development of the project), all or part of the wages required by the Contract, the City may, after written notice to the Contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

(3) **Payrolls and basic records** - (i) Payrolls and basic records relating thereto shall be maintained by the Contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work (or under the United States Housing Act of 1937, or under the Housing Act of 1949, in the construction or development of the project). Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereofofthe types described in section 1(b)(2)(B) ofthe Davis-Bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) t at the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the Contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

(ii)(A) The Contractor shall submit weekly for each week in which any Contract work is performed a copy of all payrolls to the City for transmission to the Federal Transit Administration. The payrolls submitted shall set out accurately and completely all of the information required to be maintained under section 5.5(a)(3)(i) of Regulations, 29 CFR part 5. This information may be submitted in any form desired. Optional Form WH-347 is available for this purpose and may be purchased from the Superintendent of Documents (Federal Stock Number 029-

005-00014-1), U.S. Government Printing Office, Washington, DC 20402. The prime Contractor is responsible for the submission of copies of payrolls by all sub Contractors.

(B) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the Contractor or sub Contractor or his or her agent who pays or supervises the payment of the persons employed under the Contract and shall certify the following:

(1) That the payroll for the payroll period contains the information required to be maintained under section 5.5(a)(3)(i) of Regulations, 29 CFR part 5 and that such information is correct and complete;

(2) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the Contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in Regulations, 29 CFR part 3;

(3) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the Contract.

(C) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by paragraph (a)(3)(ii)(B) of this section.

(D) The falsification of any of the above certifications may subject the Contractor or subContractor to civil or criminal prosecution under section 1001 of title 18 and section 231 of title 31 ofthe United States Code.

(iii) The Contractor or subContractor shall make the records required under paragraph (a)(3)(i) of this section available for inspection, copying, or transcription by authorized representatives of the Federal Transit Administration or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the Contractor or subContractor fails to submit the required records or to make them available, the Federal agency may, after written notice to the Contractor, sponsor, applicant, or owner, take such action as

may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

(4) **Apprentices and trainees-** (i) Apprentice -Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Bureau of Apprenticeship and Training, or with a State Apprenticeship Agency recognized by the Bureau, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Bureau of Apprenticeship and Training or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the Contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a Contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the Contractor's or sub Contractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. Ifthe apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator of the Wage and Hour Division of the U.S. Department of Labor determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. In the event the Bureau of Apprenticeship and Training, or a State Apprenticeship Agency recognized by the Bureau, withdraws approval of an apprenticeship program, the Contractor will no longer be permitted to utilize

apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(ii) Trainees - Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the Contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(iii) Equal emp1oyment opportunity - The utilization of apprentices, trainees and journeymen under this part shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR part 30.

(5) **Compliance with Copeland Act requirements-** The Contractor shall comply with the requirements of 29 CFR part 3, which are incorporated by reference in this Contract.

(6) **Sub Contracts-** The Contractor or sub Contractor shall insert in any sub

Contracts the clauses contained in 29 CFR 5.5(a)(1) through (10) and such other clauses as the Federal Transit Administration may by appropriate instructions require, and also a clause requiring the sub Contractors to include these clauses in any lower tier sub Contracts. The prime Contractor shall be responsible for the compliance by any sub Contractor or lower tier sub Contractor with all the Contract clauses in 29 CFR 5.5.

(7) **Contract termination: debarment** - A breach of the Contract clauses in 29 CFR 5.5 may be grounds for termination of the Contract, and for debarment as a Contractor and a sub Contractor as provided in 29 CFR 5.12.

(8) **Compliance with Davis-Bacon and Related Act requirements-** All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR parts 1, 3, and 5 are herein incorporated by reference in this Contract.

(9) **Disputes concerning labor standards-** Disputes arising out of the labor standards provisions of this Contract shall not be subject to the general disputes clause of this Contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the Contractor (or any of its sub Contractors) and the City, the U.S. Department of Labor, or the employees or their representatives.

(10) **Certification of eligibility-** (i) By entering into this Contract, the Contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the Contractor's firm is a person or firm ineligible to be awarded Government Contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(l).

(ii) No part of this Contract shall be sub Contracted to any person or firm ineligible for award of a Government Contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(l).

(iii) The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

Contract Work Hours and Safety Standards

(1) **Overtime requirements** -No Contractor or sub Contractor contracting for any part of the Contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any

workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-halftimes the basic rate of pay for all hours worked in excess of forty hours in such workweek.

(2) Violation; liability for unpaid wages; liquidated damages - In the event of any violation of the clause set forth in paragraph (1) of this section the Contractor and any sub Contractor responsible therefor shall be liable for the unpaid wages. In addition, such Contractor and sub Contractor shall be liable to the United States for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph (1) of this section, in the sum of $10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph (1) of this section.

(3) Withholding for unpaid wages and liquidated damages- The City shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the Contractor or sub Contractor under any such Contract or any other Federal Contract with the same prime Contractor, or any other federally-assisted Contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime Contractor, such sums as may be determined to be necessary to satisfy any liabilities of such Contractor or sub Contractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (2) of this section.

(4) Sub Contracts - The Contractor or sub Contractor shall insert in any sub Contracts the clauses set forth in paragraphs (1) through (4) of this section and also a clause requiring the sub Contractors to include these clauses in any lower tier sub Contracts. The prime Contractor shall be responsible for compliance by any sub Contractor or lower tier sub Contractor with the clauses set forth in paragraphs (1) through (4) of this section.

Performance and Payment Bonding Requirements (Construction)

The Contractor shall be required to obtain performance and payment bonds as follows:

(a) Performance bonds

1. The penal amount of performance bonds shall be 100 percent of the original Contract price, unless the City determines that a lesser amount would be adequate for the protection of the City.

2. The City may require additional performance bond protection when a Contract price is increased. The increase in protection shall generally equal 100 percent of the increase in Contract price. The City may secure additional protection by directing the Contractor to increase the penal amount of the existing bond or to obtain an additional bond.

(b) Payment bonds

1. The penal amount of the payment bonds shall equal:

(i) Fifty percent of the Contract price if the Contract price is not more than $1 million.

(ii) Forty percent of the Contract price if the Contract price is more than $1 million but not more than $5 million; or

(iii) Two and one half million if the Contract price is more than $5 million.

2. If the original Contract price is $5 million or less, the City may require additional protection as required by subparagraph 1 if the Contract price is increased.

Seismic Safety

The Contractor agrees that any new building or addition to an existing building will be designed and constructed in accordance with the standards for Seismic Safety required in Department of Transportation Seismic Safety Regulations 49 CFR Part 41 and will certify to compliance to the extent required by the regulation. The Contractor also agrees to ensure that all work performed under this Contract including work performed by a subContractor is in compliance with the standards required by the Seismic Safety Regulations and the certification of compliance issued on the project.

Energy Conservation

The Contractor agrees to comply with mandatory standards and policies relating to energy efficiency which are contained in the state energy conservation plan issued in compliance with the Energy Policy and Conservation Act.

Accessibility

Facilities to be used in public transportation service must comply with 42 U.S.C. Sections 12101 *et seq.;* DOT regulations, "Transportation Services for Individuals with Disabilities (ADA)," 49 CFR Part 37; and Joint ATBCBDOT regulations, "Americans with Disabilities (ADA) Accessibility Specifications for Transportation Vehicles," 36 CFR Part 1192 and 49 CFR Part 38. Notably, DOT incorporated by reference into Appendix A of its regulations at 49 CFR Part 37 the ATBCB's "Americans with Disabilities Act Accessibility Guidelines" (ADAAG), revised July 2004, which include accessibility guidelines for buildings and facilities. DOT also added specific provisions to Appendix A of 49 CFR Part 37 modifying the ADAAG, with the result that buildings and facilities must comply with both the ADAAG and the DOT amendments.

E-VERIFY COMPLIANCE: The Contractor shall comply with the requirements of Article 2 of Chapter 64 of the North Carolina General Statutes. Further, if the Contractor utilizes a Subcontractor, the Contractor shall require the Subcontractor to comply with the requirements of Article 2 of Chapter 64 of the North Carolina General Statutes. By submitting a proposal, The Proposer represents that their firm and its Subcontractors are in compliance with the requirements of Article 2 Chapter 64 of the North Carolina General Statutes.

IRAN DIVESTMENT ACT: Vendor certifies that; (i) it is not identified on the Final Divestment List or any other list of prohibited investments created by the NC State Treasurer pursuant to N.C.G.S. 143-6A-4; (ii) it will not take any actions causing it to appear on any such list during the term of this Purchase Order, and (iii) it will not utilize any subcontractor to provide goods and services hereunder that is identified on any list.

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Chases, openings and inserts required to complete Work.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Cutting and Patching: Division 01.

C. All Sections of Work in which chases, openings and inserts occur.

D. Plumbing: Division 22.

E. Electrical: Division 26.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Information Drawings: For structural steel, structural concrete, and cross-laminated timber panels only. Submit dimensionally scaled drawings indicating penetrations, chases, inserts and sleeves required for installation of Work.

Part 2 Products

2.1 Sleeves And Inserts

A. Shall be as specified in Specification Sections requiring inserts and sleeves for installation of that Work.

Part 3 Execution

3.1 General

A. Furnish sleeves and inserts required under individual Specification Sections for Work to be sleeved or to have inserts embedded. Select locations and assure proper installations in accordance with manufacturer's written instructions.

B. Penetrations required, but not indicated, shall be cut into Work in accordance with Division 01.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Preparation of Coordination Drawings to organize installation of products and equipment for efficient use of available space, for proper sequence of installation, and to identify potential conflicts.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Summary of Work: Division 01.

C. Project Coordination: Division 01.

D. Cutting and Patching: Division 01.

E. Chases, Openings and Inserts: Division 01.

F. Cross Laminated Timber Panels: Division 06.

G. Fire Suppression: Division 21.

H. Plumbing: Division 22.

I. Mechanical: Division 23.

J. Electrical: Division 26.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Deviation Requests: To Design Professional as indicated.

C. Coordination Drawings: To Design Professional as indicated.

Part 2 Products

Not used.

Part 3 Execution

3.1 Coordination Drawings

A. As soon as practical, but in no case starting later than thirty (30) days after Award of Contract, prepare preliminary Coordination Drawings at scale not less than 3/8 inch scale equals 1 foot for entire building.

1. Preliminary Coordination Drawings shall show registers, grilles, diffusers, lights, cameras, speakers and similar features, and be coordinated with Architectural Interior Elevations and Reflected Ceiling Plans. Indicate locations of valves, dampers, and other items requiring access for service and maintenance. Indicate beams, ceiling heights, walls, floor-to-floor dimensions, columns, doors, equipment curbs, and other major architectural and structural features as indicated on Architectural and Structural Drawings. Indicate zones of space allotted for routing of plumbing, sprinkler piping, electrical conduit and cable trays on Coordination Drawings using space allotments indicated. Coordinate locations of receptacles, lights, conduit, sprinklers, and similar items in exposed cross laminated timber panel areas.

B. Within sixty (60) days after Award of Contract, or on a schedule agreed to by Owner's Representative, submit one (1) reproducible and two (2) prints of Preliminary Coordination Drawings to all affected trade installers to mark on reproducible their own routings as well as other major items, including, valves, access panels and switch panels, as required to determine interrelationships and possible interferences with other trade Work and architectural or structural features. Marked-up reproducible Coordination Drawings shall then be returned to General Contractor no more than thirty (30) days after receipt.

3.2 Composite Coordination Drawings

A. Prepare a draft composite of such Coordination Drawings, incorporating all information and routings provided by affected trade installers. As a Contractor's Option, a group of transparent overlays may be substituted, provided that they clearly indicate relationship of all proposed installations. These composite Coordination Drawings, or overlays, shall then be reviewed during a series of meetings, called and chaired by General Contractor, at which each affected trade installer shall be represented, in order to review and resolve any real or apparent interferences or conflicts. Design Professional will not routinely attend these meetings unless specifically requested by General Contractor to help resolve specific issues.

B. After conflicts and interferences are resolved, develop final composite Coordination Drawings indicating agreed-upon routing, layout of ductwork, piping, major conduit, valves, panels, lighting fixtures, and other mechanical and electrical installations. In preparation of final composite Coordination Drawings, large-scale details, as well as cross-sections and longitudinal sections, shall be required to fully delineate all conditions.

1. Indicate locations, size and service clearance dimensions for equipment items, service aisles, shafts and similar features. Each installer shall then sign off on final composite Coordination Drawings to indicate their agreement with indicated routings and layouts and their interrelationship with adjoining or continuous Work.

2. Thereafter, no unauthorized deviations are permitted, and if made without agreement of General Contractor, this unauthorized Work shall be subject to removal and correction at no additional cost.

C. In preparing composite Coordination Drawings, when mutually agreed to, minor changes in duct, pipe or conduit routings that do not affect intended function may be made as required to avoid space conflicts. Items may not be re-sized or fittings changed or added without written approval of Design Professional and General Contractor. Requests for deviations shall be made in form of formal submittals to Design Professional, with areas affected clearly marked as a "deviation". Do not make changes in wall or chase locations, ceiling heights, door swings or locations, windows or other openings, or other features affecting function or aesthetic effect of building. If interferences cannot be satisfactorily resolved, General Contractor shall be notified for resolution. After Coordination Drawings are signed off, submit them to Design Professional for final review to assure that all equipment access issues have been identified and that comments from previous deviation submissions have been incorporated.

D. After final composite Coordination Drawings have been agreed upon and signed off, and after final review by Design Professional for deviations and access as described above, prepare and distribute four (4) prints to each installer, and eight (8) prints to General Contractor for reference and record purposes.

E. Record copies of final composite Coordination Drawings shall be retained by General Contractor and each installer as working reference. All equipment Shop Drawings, prior to their submittal, shall be compared with composite Coordination Drawings and developed accordingly by installer responsible. Note and accurately record revisions to composite Coordination Drawings, which may become necessary during progress of Work, on record copies. Each installer shall maintain up-to-date record copies of composite Coordination Drawings and shall keep one (1) copy available at Project Site. Composite Coordination Drawings and subsequent changes thereto shall be utilized by General Contractor and each installer in development of Record Drawings and Isometric Drawings, where required.

F. All Coordination Drawings need not be submitted at same time, but each shall be submitted in ample time to avoid construction delays. Coordination Drawings may lack complete data in certain instances pending receipt of Shop Drawings, but sufficient space shall be allotted for items affected. When final information is received, such data shall be promptly inserted on composite Coordination Drawings.

G. No extra compensation will be paid for relocating duct, pipe, conduit, or other material that has been installed without proper coordination between all Work involved. If improperly coordinated Work, or Work installed that is not in accordance with approved composite Coordination Drawings, necessitates additional Work, provide such additional Work at no additional cost.

H. Changes in Scope of Work due to revisions formally issued and approved shall be indicated on composite Coordination Drawings.

I. Work on composite Coordination Drawings shall be performed by competent personnel, and shall be clear and fully legible.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Construction operations required by Contract Documents, defines aspects of Contractor's relationship with Owner and Design Professional, and lists special Owner requirements.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Project Coordination: Division 01.

C. Construction Schedules: Division 01.

D. Schedule of Values: Division 01.

E. Construction Facilities: Division 01.

F. Material and Equipment: Division 01.

G. Project Closeout: Division 01.

1.3 Project Description

A. Work Includes: A new building, exterior canopies and related site work for the City of Greenville's Transportation Activity Center.

1.4 Contracts

A. Construct Work under a single lump sum Contract.

Part 2 Products

Not used.

Part 3 Execution

Not used.

END

Section 012100 Allowances

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Administrative and procedural requirements governing handling and processing allowances. Selected materials and equipment, and, in some cases, their installation, are indicated and specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements, and to defer selection of actual materials and equipment to a later date when additional information is available for evaluation. Additional requirements, if necessary, will be issued by Change Order through a Bulletin to the Project Manual.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Modification Procedures: Division 01.

C. Unit Prices: Division 01.

D. Measurement and Payment: Division 01.

E. Construction Schedules: Division 01.

F. Schedule of Values: Division 01.

G. Project Closeout: Division 01.

H. Earth Moving: Division 31.

1.3 Coordination

A. Designate required selection and delivery dates for products under each allowance in Contractor's Construction Schedule.

B. Designate each allowance with extensions based on estimated quantities for Unit Price Allowances on Contractor's Schedule of Values.

1.4 Allowances

A. Purchase products under each allowance as directed.

B. Include following amounts in Bid for inclusion in Contract Sum:

1. Provide in the Base Bid an allowance of 1200 cubic yards for excavation of unsuitable material where authorized or directed. Dispose of unsuitable material off-site and backfill with imported structural fill material compacted per specifications. Credit or additions to the Contract Price for actual quantities removed and replaced (based on volume of material cut) shall be made per the Unit Prices contained in the Bid Form.

C. Amount of each allowance includes:

1. Net cost of product.

2. Delivery to Project Site.

3. Applicable taxes.

4. Preparing submittals.

D. In addition to amounts of allowances, include in Contract Sum the Contractor's cost for:

1. Labor and installation.

2. Other expenses required to complete installation.

3. Overhead and profit.

1.5 Installation

A. Comply with requirements of referenced Specification Section, including warranties/guarantees.

1.6 Adjustment Of Costs

A. Should actual purchase cost be more or less than specified amount of allowance, Contract Sum shall be adjusted by Change Order equal to amount of difference. A percentage to cover Contractor's overhead and profit, as stated in agreement, shall be applied to difference in cost.

B. For products specified under unit cost allowance:

1. Unit cost applies to quantity listed in the Schedule of Values.

2. Should quantity used be more or less than that listed in Schedule of Values, unit cost applies to quantity actually used.

3. Submit invoices or other data to substantiate quantity actually used.

4. Submit request for other costs, claimed for additional work caused by increase over amount of allowance, prior to execution of Work.

C. At Contract Closeout, reflect all approved changes in contract amounts in the final statement of accounting.

Part 2 Products

Not used.

Part 3 Execution

Not used.

END

Section 012200 Unit Prices

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Unit Prices and describes the method of pricing the change in quantity of the item of Work for which the price is stated. Unit Prices may be used to price additions and subtractions to Contract Amount.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Method of Determining Cost of Changes in the Work: General and Supplementary Conditions.

C. Incorporation of Unit Prices into the Work: Owner-Contractor Agreement.

D. Schedule of Values: Division 01.

E. Field Engineering: Division 01.

F. Referenced Sections of Specifications stipulate pertinent requirements for products and methods to achieve Work required for each Unit Price. For applicable Specification Sections, refer to Schedule of Unit Prices in Paragraph, Schedule of Unit Prices.

1.3 Unit Prices

A. Payment for additional Work and credit for deductions in Work, ordered under the applicable provisions of the General and Supplementary Conditions shall be computed in accordance with the following Schedule of Unit Prices, which shall remain in effect until all Work of the Contract has been completed and accepted.

B. Unit Prices shall be firm lump sums all-inclusive cost of the materials, work, layout, drafting, balancing, testing, tools, sundries, scaffolding, trucking, transportation, cleaning, supervision, overhead, profit, and any and all other costs of whatsoever nature for each of the items listed.

C. Calculations for determining the number of Units of Work shall be of actual surface, volume, length, hours or number of individual items listed for the class of work, complete in place and accepted or omitted. No allowance for waste, loss, breakage, damage, or difficulties shall be made.

D. Determination of number of Units of Work for Work performed under Division 31: Specification Sections is specified in Field Engineering: Division 01.

E. Number of Units of Work for all other Work will be determined by Contractor.

F. Schedule of Unit Prices:

No.	Description of Work	Unit	Spec Section No.
1.	Removal and Replacement of Unsuitable Soils	CY	312000

Part 2 Products

Not used.

Part 3 Execution

Not used.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Identifies each Alternate by number and describes basic changes to be incorporated into Work, only when that Alternate is made part of Work by specific provisions in Owner-Contractor Agreement.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Summary of Work: Division 01.

1.3 Administrative Procedures

A. Referenced Sections of Specifications stipulate pertinent requirements for products and methods to achieve Work stipulated under each Alternate.

B. Coordinate pertinent related work and modify surrounding work as required to properly integrate Work under each Alternate, and to provide complete construction required by Contract Documents.

C. Immediately following Award of Contract, prepare and distribute to each party involved, notification of status of each Alternate. Indicate whether Alternates have been accepted, rejected, or deferred for consideration at a later date. Include a complete description of negotiated modifications to Alternates.

D. A “Schedule of Alternates” is included in this Section. Contract Documents referenced in Schedule contain requirements for materials and methods necessary to achieve Work described under each Alternate. Include, as part of each Alternate, miscellaneous devices, accessories and similar items incidental to or required for a complete installation whether or not mentioned as part of Alternate.

1.4 Definitions

A. An Alternate is an amount proposed by Bidders and stated on Bid Form for certain construction activities defined in this Section that may be added to or deducted from Base Bid amount.

B. An Alternate may affect Construction Time Schedule, and Bidders shall state on Bid Form any requirement for added or deducted Construction Time as a result of related Alternates.

Part 2 Products

Not used.

Part 3 Execution

3.1 Schedule Of Deductive Alternates

A. Alternate No. 1: Roadway improvements along S. Pitt Street south of the southern property line of the GTAC site.

B. Alternate No. 2: Roadway improvements along S. Clark Street south of the southern property line of the GTAC site.

C. Alternate No. 3: Replacement of Greenville Utilities water mains and services located north of the southern property line of the GTAC site in S. Clark Street, S. Pitt Street and Bonners Lane.

D. Alternate No. 4: Replacement of the Greenville Utilities water mains and services located in S. Pitt Street south of the southern property line of the GTAC site.

E. Alternate No. 4: Replacement of the Greenville Utilities water mains and services located in S. Clark Street south of the southern property line of the GTAC site.

F. Alternate No. 5: Provide cost specifically to utilize unit masonry Sienna Ironspot Velour as manufactured by Endicott Clay Products Company for color and texture of face brick, and matched solid paver units (see Section 042000).

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Administrative and procedural requirements for Contractor's requests for substitutions. made after Award of Contract. Procedural requirements governing Contractor's selection of products and product options are included under Section, Material and Equipment: Division 01.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Submittals: Division 01.

C. Material and Equipment: Division 01.

D. Construction Schedules: Division 01.

1.3 Substitution Procedure

A. Requests for Substitutions: Will be considered if received within 60 days after Notice to Proceed. Requests received more than 60 days after Notice to Proceed may be considered or rejected at discretion of Design Professional, except if Work specified becomes unavailable through, for example, unforeseen strikes or loss of manufacturer's plant through fire, flood or bankruptcy.

1. Submit three (3) copies of each Request for Substitution. Submit requests with form attached at end of this Section and in accordance with procedures required for Change Order proposals. Attach all other data and certification.

2. Provide information required for Design Professional to determine acceptability of requested substitution. Design Professional may reject substitution requests if submitted data is insufficient to determine equivalency.

3. Identify product, or fabrication or installation method to be replaced in each request. Include related Specification Section and Drawing Numbers. Submit complete documentation indicating compliance with requirements for substitutions, and the following information, as appropriate:

   a. Product Data, including drawings and descriptions of products, fabrication and installation procedures.
   b. Samples, where applicable or requested.

c. A detailed comparison of salient features and qualities of proposed substitution with those of Work specified. Salient features and qualities may include elements such as size, weight, durability, performance and visual effect as determined by Design Professional. Submit documentation of salient features and qualities from independent testing agencies performing industry-recognized tests. Manufacturer's claims of performance may or may not be used in evaluation of substitutions at discretion of Design Professional.

d. Coordination information, including a list of changes or modifications needed for other parts of Work and for construction performed by Owner and Work of other Contracts that shall become necessary to accommodate proposed substitution.

e. A statement indicating substitutions effect on Contractor's Construction Schedule compared to schedule without approval of substitution. Indicate effect of proposed substitution on overall Contract Time.

f. Cost information, including a proposal of net change, if any, in Contract Sum. Contractor shall certify that cost data presented is complete and includes all related costs under this Contract, but excludes Design Professional's redesign costs.

g. Certification by Contractor that substitution proposed is equal to or better in every significant respect to that required by Contract Documents, and that it shall perform adequately in application indicated. Include Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of substitution to perform adequately.

h. Certification that Contractor shall reimburse Owner for all costs for review and design changes resulting from substitution.

4. Design Professional's Action: Design Professional will notify Owner's Representative regarding acceptance or rejection of proposed substitution. Design Professional will be sole judge of acceptability of proposed substitution.

1.4 Definitions

A. Definitions used in this Article are not intended to change or modify meaning of other terms used in Contract Documents.

B. Substitution: Request for change from requirements of Contract Documents.

C. The following are not considered substitutions:

1. Revisions to Contract Documents requested by Owner or Design Professional.

2. Specified options of products and construction methods included in Contract Documents.

3. Contractor's determination of and compliance with governing regulations and orders issued by governing authorities.

D. "Or equal", "or equivalent", "approved equal", "approved equivalent", "equivalent substitution" and all other similar terms shall be interpreted as "substitutions" as defined above.

Part 2 Products

2.1 Substitutions

A. Contractor's substitution request will be received and considered by Design Professional when one (1) or more of the following conditions are satisfied as determined by Design Professional; otherwise, requests shall be returned without action except to record noncompliance with these requirements.

1. Extensive revisions to Contract Documents are not required.
2. Proposed changes are in keeping with general intent of Contract Documents.
3. Request is timely, fully documented and properly submitted.
4. Request is directly related to an "or approved substitution" clause or similar language in Contract Documents.
5. Specified product or method of construction cannot be provided within Contract Time. Request will not be considered if product or method cannot be provided as a result of failure to pursue Work promptly or coordinate activities properly.
6. Specified product or method of construction cannot receive necessary approval by a governing authority, and requested substitution can be approved.
7. A substantial advantage is offered to Owner, in terms of cost, time, energy conservation or other considerations of merit, after deducting offsetting responsibilities that Owner may be required to bear. Additional responsibilities for Owner may include additional compensation to Design Professional for redesign and evaluation services, increased cost of other construction by Owner or Separate Contractors, and similar considerations.
8. Specified product or construction cannot be provided in a manner that is compatible with other materials, and where Contractor certifies that substitution shall overcome incompatibility.
9. Specified product or construction cannot be coordinated with other materials, and where Contractor certifies that proposed substitution can be coordinated.
10. Specified product or method of construction cannot provide a Warranty required by Contract Documents, and where Contractor certifies that proposed substitution can provide required Warranty.

B. Contractor's submittal and Design Professional's acceptance of Shop Drawings, Product Data or Samples that relate to construction activities not complying with Contract Documents does not constitute an acceptable or valid request for substitution, nor does it constitute approval.

Part 3 Execution

3.1 Attachment

A. Substitution Request Form (see next four (4) pages).

END

SUBSTITUTION REQUEST FORM

A. INSTRUCTIONS:

1. This request must be submitted and signed by Contractor.
2. A request for each substitution must be exactly in this form, including all items. (One (1) item of substitution per form).
3. Attach complete information on changes to Drawings and Specifications that proposed substitution shall require for its proper installation.
4. Submit, with request, all necessary samples and substantiating data to prove quality and performance is equal to that which is specified. Clearly mark manufacturer's literature to indicate equality in performance.

B. DATE OF REQUEST:

1. CONTRACTOR:

2. PROJECT: Greenville Transportation Activity Center

C. We hereby submit for your consideration the following product instead of specified item for above Project:

DRAWING **SPEC. SECTION NO.** **PARAGRAPH** **SPECIFIED ITEM**

Proposed Substitution:

Name, address and phone number of installer. Include qualification data per original Specification Section.

`

Name, address and phone number of local product representative.

Name, address and phone number of manufacturer. Include qualification data per the original Specification section.

D. REASON FOR REQUEST: (See Article 2.1)

E. Itemized comparison of specified item(s) with proposed substitution:

1. Performance and Appearance:

2. Accurate cost data comparing proposed substitution with product specified:

3. Manufacturer's Warranties of proposed and specified items are:

Same ☐. Different ☐. (explained on an attachment):

4. Designation of maintenance services and sources:

Same ☐. Different ☐. (explained on an attachment):

F. RELATION TO OTHER WORK:

1. Does substitution affect dimensions indicated on Drawings?

   Yes ☐. No ☐. If yes, clearly indicate changes.

2. What effect does substitution have on other Contracts or other Sections?

3. What effect does substitution have on Construction Schedule?

4. What effect does substitution have on requirements for substrates to which substitution is applied?

5. Is any additional Work on substrates or structure required because of this substitution?

6. Is substitution compatible with substrates and adjacent materials?

G. CERTIFICATION OF EQUAL PERFORMANCE:

The undersigned certifies that Contractor shall:

1. Comply with requirements of Contract Documents after modification incorporating proposed substitution.
2. Warranty substitution in same manner as product specified.
3. Coordinate and make other changes as required in Work as a result of substitution.
4. Waive claims for additional costs or time as a result of substitution, with exception of those identified above.
5. Reimburse Owner, through modification of Contract Amount, for all costs for design change resulting from substitution.

Signature:_____

Date:_____

Name:_____

Title:_____

Firm:_____

Address:_____

Telephone:_____

Remarks:_____

H. Signature shall be by person having authority to legally bind his firm to above terms. Failure to provide legally binding signature shall result in rejection without further review by Design Professional.

I. Design Professional's Action:

1. Accepted ☐.
2. Accepted as noted ☐.
3. Not accepted ☐.
4. Received too late ☐.

END OF SUBSTITUTION REQUEST FORM

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Administrative and procedural requirements for handling and processing Contract Modifications.

1.2 Related Requirements Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Owner/Contractor Agreement: Division 01.

C. Contract Conditions: Division 01.

D. Application for Payment: Division 01.

E. Submittals: Division 01.

F. Project Meetings: Division 01.

G. Progress Reports: Division 01.

H. Construction Schedules: Division 01.

I. Schedule of Values: Division 01.

J. Material and Equipment: Division 01.

K. Product Substitution Procedures: Division 01.

1.3 Contractor's Responsibility To Inform

A. Communication, either verbal or written, between Owner's Representative, Design Professional and Contractor, Subcontractors, or other parties involved during normal course of administration of Contract does not in any way constitute acceptance of Contract Modification or direction to modify Contract unless this communication is in form of a written Change Order or Construction Change Directive as indicated.

B. Communication which includes direction from Owner's Representative or Design Professional including, but not limited to, the following, does not constitute approval of a Contract Modification:

1. Submittal review.

2. Project site observation conversations and reports.

3. Participation in preconstruction, preinstallation progress or other meetings.

4. Clarification sketches or Drawings.

C. Inform Design Professional when communication has, in Contractor's opinion, caused reason to modify Contract.

D. Do not undertake Work which, in Contractor opinion, requires modification to Contract without completing procedures outlined herein. Work done without completing modification procedures is entirely at Contractor's risk, even if Contractor believes that communications from Owner's Representative or Design Professional contains written instructions to do Work outside of Contract scope.

E. Owner's Representative and Design Professional will only instruct for Work to be done that differs from Contract Documents through written modifications.

1.4 Minor Changes In Work

A. Supplemental written instructions, not involving an adjustment to Contract Sum or Contract Time, will be issued on AIA Document G710, "Architect's Supplemental Instructions".

1.5 Change Order Proposal Requests

A. Owner-Initiated Proposal Requests: Proposed changes in Work that shall require adjustment to Contract Sum or Contract Time shall be issued by Design Professional with detailed description of proposed change and supplemental or revised Contract Documents, if required.

1. Proposal requests issued by Design Professional are for information only unless otherwise indicated. Do not consider them as instruction to stop Work in progress, accelerate Work or to execute proposed change.

2. Unless otherwise indicated in the Proposal Request, within 20 days of receipt of Proposal Request, submit to Design Professional for Owner's Representative review an estimate of cost and time required to execute proposed change.

   a. Include a list of quantities of products to be purchased and unit costs, along with total amount of purchases to be made. Where requested, furnish survey data to substantiate quantities.
   b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
   c. Include a statement indicating the effect proposed change in Work shall have on Contract Time, Contract Sum and special efforts of Contractor to be employed to reduce the delay.

B. Contractor-Initiated Change Order Proposal Requests: When unforeseen conditions require modifications to Contract, Contractor may propose changes by submitting a request for a change to Design Professional.

1. Include a statement outlining reasons for change and effect of change on Work. Provide a complete description of proposed change. Indicate effect of proposed change on Contract Sum and Contract Time.

2. Include a list of quantities of products to be purchased and unit costs along with total amount of purchases to be made. Where requested, furnish survey data to substantiate quantities.

3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.

4. Comply with requirements in Product Substitution Procedures: Division 01, if proposed change in Work requires substitution of one (1) product or system for a product or system indicated.

5. Comments made to submittals which are indicated “Approved as Noted” in no way constitutes approval of a Change Order. Comply with requirements in Submittals: Division 01.

C. Proposal Request Form: Submit AIA Document G709, “Proposal Request” for Change Orders.

D. Submit claims for increased costs because of a Change in Scope, whether for Purchase Order amount or Contractor’s handling, labor, installation, overhead and profit, within 20 days of receipt of Change Order or Construction Change Directive authorizing Work to proceed. Claims submitted later than 20 days shall be rejected.

E. Change Order Cost Amount shall not include Contractor’s or Subcontractor’s indirect expense except when it is clearly demonstrated that either the nature or Scope of Work required was changed from that which could have been foreseen from description of Allowance and other information in Contract Documents.

F. No change to Contractor’s indirect expense is permitted for selection of higher or lower priced materials or systems of same scope and nature as originally indicated.

1.6 Construction Change Directives

A. When Owner’s Representative and Contractor are not in agreement on terms of a Change Order Proposal Request, Design Professional may issue a Construction Change Directive on AIA Document G714, “Construction Change Directive”, instructing Contractor to proceed with a change in Work for subsequent inclusion in a Change Order.

B. Construction Change Directive shall contain a complete description of change in Work and designate method to be followed to determine change in Contract Sum or Contract Time.

C. Documentation: Maintain detailed records on a time and material basis of Work required by Construction Change Directive. After completion of change, submit an itemized account and supporting data necessary to substantiate Cost and Time Adjustments to Contract.

1.7 Change Order Procedures

A. Upon Owner's Representative approval of a Change Order Proposal Request, Design Professional will issue a Change Order for signatures of Owner's Representative and Contractor on AIA Document G701, "Change Order."

Part 2 Products

Not used.

Part 3 Execution

Not used.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Administrative requirements for Contractor's Schedule of Values.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Summary of Work: Division 01.

C. Application for Payment: Division 01.

D. Project Coordination: Division 01.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Schedule of Values: As indicated.

1.4 Coordination

A. Coordinate preparation of Schedule of Values with preparation of Contractor's Construction Schedule.

B. Correlate line items in Schedule of Values with other required administrative schedules and forms, including:

1. Contractor's Construction Schedule.
2. Application for Payment Form.
3. List of Subcontractors.
4. Schedule of Submittals.

C. Submit Schedule of Values to Design Professional at earliest feasible date, but in no case later than seven (7) days before date scheduled for submittal of initial Application for Payment.

1.5 Format And Content

A. Arrange Schedule of Values in a tabular form with separate columns to indicate the following for each item listed:

1. Generic name.
2. Related Specification Section.
3. Name of Subcontractor.
4. Name of manufacturer or fabricator.
5. Name of Supplier.
6. Change Orders (numbers) that have affected value.
7. Dollar Value. No line item in the Schedule of Values shall be larger than $50,000.
8. Percentage of Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.

B. Margins of Cost: Show line items for indirect costs, and margins on actual costs, only to extent that such items will be listed individually in Applications for Payment. Each item in Schedule of Values and Applications for Payment shall be complete, including its total cost and proportionate share of general overhead and profit margin, unless otherwise indicated.

1. At Contractor's option, temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown as separate line items in Schedule of Values or distributed as general overhead expense.

C. Itemize separate line item cost for each of construction cost items under Divisions 02 through 33 per individual Specification Sections.

D. Itemize separate line item cost for each Service Contract.

E. Break down costs into:

1. Delivered cost of material, with taxes paid, with Overhead and Profit.
2. Installation cost, with Overhead and Profit.

F. If requested, break down high value line items to list major materials or operations.

G. Round off figures to nearest ten dollars.

H. Make sum total costs of all items listed in Schedule of Values equal to total Contract Sum.

1.6 Schedule Of Unit Material Values (Use Only For Payment On Inventory)

A. Submit separate Schedule of Unit Prices for materials to be stored on site which Progress Payments will be made.

B. Make form of submittal parallel to Schedule of Values, with each line item identified same as line item in Schedule of Values.

C. Include in Unit Price only:

1. Cost of Material.

2. Delivery and Unloading at Project Site.

3. Sales Taxes.

D. Make sure that Unit Prices multiplied by quantities given equal material cost of that item in Schedule of Values.

E. Off-site materials shall be stored in a bonded warehouse or in Contractor's storage facilities provided that adequate insurance coverage is obtained.

1.7 Updating

A. After review by Design Professional, revise and resubmit Schedule of Values as required.

B. Update and resubmit Schedule of Values when change orders or construction change directions result in a change in Contract Sum.

Part 2 Products

Not used.

Part 3 Execution

Not used.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Administrative and procedural requirements governing Contractor's Applications for Payment.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Modification Procedures: Division 01.

C. Project Meetings: Division 01.

D. Construction Schedules: Division 01.

E. Schedule of Values: Division 01.

F. Progress Reports: Division 01.

G. Project Closeout: Division 01.

H. Final Cleaning: Division 01.

I. Project Record Documents: Division 01.

J. Operation and Maintenance Data: Division 01.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Application for Payment: As indicated.

1.4 General Requirements

A. Each Application for Payment shall be consistent with Schedule of Values and previous applications and payments as certified by Design Professional and paid for by Owner.

1. Initial Application for Payment, Application for Payment at Date of Substantial Completion, and Final Application for Payment involve additional requirements.

B. Withholding Application for Payment: Any application may be withheld in accordance with Contract and Conditions of Contract. Any application may be withheld if procedural requirements, including submittal of current administrative items listed, are incomplete.

C. Payment Application Times: Date for each Progress Payment is 15th day of each month. Period of Construction Work covered by each Application for Payment is period ending 15 days prior to date for each Progress Payment and starting day following end of preceding period.

D. Payment Application Forms: Use AIA Documents G702 and Continuation Sheet G703 as form for Application for Payment.

E. Transmittal: Three (3) executed copies of each Application for Payment to Design Professional by means ensuring receipt within 24 hours; one (1) copy shall be complete, including waivers of lien and similar attachments, when required.

F. Transmit each copy with a transmittal form listing attachments, and recording appropriate information related to application in a manner acceptable to Design Professional.

1.5 Initial Application For Payment

A. Administrative actions and submittals that shall precede or coincide with submittal of 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 (preliminary, if not final).
5. Submittal Schedule (preliminary if not final).
6. List of Contractor’s staff assignments.
7. List of Contractor’s principal consultants.
8. Copies of building permits.
9. Copies of authorizations and licenses from governing authorities for performance of Work.
10. Report of pre-construction meeting.
11. Certificates of insurance.
12. Performance and payment bonds (if required).
13. Data needed to acquire Owner’s insurance.
14. Current Weekly and Monthly Reports.

1.6 Periodic Application For Payment

A. The following administrative procedures shall be current at time of application for payment. Indicate status of each or submit copies with transmittal.

1. Progress Meeting Minutes.
2. Weekly Reports.
3. Monthly Report.
4. Updated Construction Schedule.
5. Updated Schedule of Submittals.
6. Updated Schedule of Values.
7. Project Record Documents.

1.7 Application For Payment At Substantial Completion

A. Following issuance of Certificate of Substantial Completion, submit an Application for Payment; this application shall reflect any Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of Work.

B. Administrative actions and submittals which shall precede or coincide with this application include:

1. Occupancy permits and similar approvals.
2. Warranties (guarantees) and maintenance agreements.
3. Maintenance instructions.
4. Final cleaning.
5. Application for reduction of retainage, and consent of surety.
6. List of incomplete Work (punchlist), recognized as exceptions to Architect's (Design Professional's) Certificate of Substantial Completion.
7. Project Record Documents.

1.8 Final Payment Application

A. Administrative actions and submittals which shall precede or coincide with submittal of Final Application for Payment include the following:

1. Completion of Project closeout requirements.
2. Completion of items specified for completion after Date of Substantial Completion.
3. Assurance that unsettled claims will be settled.

4. Assurance that Work not complete and accepted will be completed without undue delay.
5. Transmittal of required Project Construction Records to Owner.
6. Proof that taxes, fees and similar obligations have been paid.
7. Removal of temporary facilities and services.
8. Removal of surplus materials, rubbish and similar elements.

Part 2 Products

Not used.

Part 3 Execution

Not used.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Contractor's responsibilities to coordinate Work and related administrative procedures including RFIs.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Summary of Work: Division 01.

C. Construction Schedules: Division 01.

D. Schedule of Values: Division 01.

E. Application for Payment: Division 01.

F. Progress Reports: Division 01.

G. Project Meetings: Division 01.

H. Coordination Drawings: Division 01.

I. Material and Equipment: Division 01.

1.3 Submittals

A. Submit per the requirements of Division 01 and submit the following prior to or coincidental with initial Application for Payment.

B. List of Contractor's Staff: Assigned to Project and responsibilities, including personnel on and off Project Site. Include, for example, mailing address, delivery address, phone, fax, e-mail address and mobile phone. For at least three (3) staff, list phone numbers where personnel can be reached during non-working hours for emergencies.

C. List of Contractor's Consultants: With similar requirements as above.

D. List of Subcontractors: With similar requirements as above.

E. List of Principal Suppliers and Fabricators: With similar requirements as above. No emergency phone number is required.

1.4 Observation Of Work By Others

A. Observation of Work by Owner's Representative, Design Professional, Inspection and Testing Agencies or any other party shall not be interpreted as relieving Contractor from responsibility for coordination of all Work, superintendence of Work, and scheduling and direction of Work or any other requirement of Contract.

1.5 Requests For Information (RFIs)

A. General: This Article includes administrative and procedural requirements for processing RFIs.

B. Definition: An RFI is a request from Contractor to Design Professional, seeking interpretation or clarification of Contract Documents.

C. Exclusions (Non-inclusive): The following items shall not be submitted or identified as RFIs.

1. Routine communications such as letters, field reports, memorandum, meeting minutes, phone conversation minutes.
2. Submittals.
3. Substitution Requests.
4. Schedules.
5. Scheduling or communications with Design Professional regarding site observations, pre-construction meetings or other similar meetings.
6. Value Engineering suggestions or voluntary alternates.
7. Change Orders, Change Order Requests, or other forms of modifications to the Contract.
8. Evaluation of bids or proposals from Contractor, Subcontractor or suppliers.
9. Correspondence regarding Contractor's non-conformance with requirements of Contract or methods to correct non-conformance.

D. Required Information: RFIs shall be transmitted on a copy of form attached to end of this Section or on Contractor's form acceptable to Design Professional containing all of the information included on attached form. Use same form for duration of Project. Complete form as follows:

1. RFI Number shall be unique and sequential.
2. Date of original and each subsequent transmittal.
3. Contractor's clear and concise interpretation of the requirements of Contract and a suggested answer.
4. Attach sketches or marked-up portions of Drawings identifying specific issues.

5. A clear and concise request for information or clarification from Design Professional.

E. Processing:

1. Transmit each RFI in writing via email to Design Professional.

2. Include only one (1) topic per RFI.

3. Include all required information. Design Professional may return RFIs which do not contain all required information. Contractor shall indicate current date when RFI is transmitted with all required information. Indicate RFI was returned because of insufficient data on Log.

4. Design Professional will review RFI to determine whether it complies with definitions and other requirements indicated. If Design Professional determines that document is not an RFI it shall be returned without action. Indicate determination on Log. Contractor may revise document and transmit as RFI or under other proper form.

5. RFIs that are repeats of previous RFI shall be returned by Design Professional without action. Indicate transmittal and rejection in Log.

F. Responses:

1. Design Professional's response to RFIs does not constitute a change to Contract Sum or Schedule.

2. In the event that Contractor believes that a response to a RFI causes a change to Contract Sum or Schedule, give written notice to Owner's Representative and Design Professional within 3 Working Days or before initiating Work covered by content of RFI, which ever is sooner.

G. Categories: Design Professional will assign each RFI a category to facilitate tracking, as follows:

1. Clarification Required.

2. Repeat or duplicate RFI.

3. Not a RFI, some other form of written communication.

4. Not a RFI, Contractor's coordination or responsibility.

5. Information included in Documents.

6. Incomplete form or unclear request.

7. Other.

H. RFI Log: Maintain an ongoing log of RFIs, indicating date originally transmitted, date returned, date if subsequently transmitted and returned, category assigned by Design Professional, and remarks.

1. Maintain a running total of each category of RFI.

2. Review Log at each periodic Progress Meeting.

3. Include Log in each monthly report.

I. Owner reserves the right to charge Contractor for cost resulting from responses to Contractor's RFI except for RFIs categorized as "Clarification Required":

1.6 Contractor's Responsibilities

A. Coordinate and Schedule Work as specified under Division 01.

B. Establish a Schedule of Values for Work as specified under Division 01.

C. Coordinate construction activities included under various Contract Documents to assure efficient and orderly installation of each part of Work. Coordinate construction operations included under various Contract Documents that are dependent upon each other for proper installation, connection and operation.

1. Where installation of one (1) part of Work is dependent on installation of other components, either before or after its own installation, schedule construction activities in sequence required to obtain best results.

2. Where availability of space is limited, coordinate installation of different components to assure maximum accessibility for required maintenance, service and repair.

3. Make adequate provisions to accommodate items scheduled for later installation.

4. 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. Prepare similar memoranda for Owner and Separate Contractors where coordination of their Work is required.

5. Coordinate compatibility of products. Refer to Material and Equipment: Division 01.

D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and ensure orderly progress of Work. Such administrative activities shall include, but 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.

1.7 Subcontractor's Responsibilities

A. Comply with written directions of Contractor in preparation of Construction Schedules and Schedule of Values.

B. Cooperate with all other Subcontractors and with Contractor as indicated above.

Part 2 Products

Not used.

Part 3 Execution

3.1 Attachment

A. Request for Information (RFI) Form (one (1) page).

END

Request for Information (RFI) Form

Project:	Greenville Transportation Activity Center	RFI No.:	
Project Location:	600 South Pitt Street, Greenville, NC 27834	Jacobs Project No.:	L3005900
Owner:	City of Greenville	Owner Project No.:	
Date:		Date of Resubmission:	

Contractor:

Interested Subcontractors and Suppliers:

Related Drawings, Details and Specifications:

Interpretation or Clarification Required:

Contractor's Interpretation and Suggested Answer:

Attachments:

Design Professional's Response:

- ☐ Clarification Required
- ☐ Repeat or Duplicate RFI
- ☐ Not a RFI, Some Other Form of Written Communication
- ☐ Not a RFI, Contractor's Coordination or Responsibility
- ☐ Information Included in Documents
- ☐ Incomplete Form or Unclear Request
- ☐ Other

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Administrative and procedural requirements for Project Meetings.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Project Coordination: Division 01.

C. Construction Schedules: Division 01.

1.3 Administration

A. Contractor shall schedule and administer Preconstruction Meetings, bi-weekly Project Meetings, and specially called meetings throughout progress of Work. Perform the following:

1. Prepare agenda for meetings.
2. Distribute written notice of each meeting four (4) days in advance of meeting date.
3. Make physical arrangements for meetings.
4. Preside at meetings.
5. Record minutes, including all significant proceedings and decisions.
6. Reproduce and distribute copies of minutes within three (3) days after each meeting.
    a. To all participants in meeting.
    b. To all parties affected by decisions made at meeting.
7. Representatives of Contractors, Subcontractors and Suppliers attending meetings shall be qualified and authorized to act on behalf of entity each represents.

1.4 Preconstruction Meeting

A. Schedule within fifteen (15) days after Date of Notice to Proceed.

B. Location: A central site, convenient for all parties.

C. Attendance:

1. Owner's Representative.

2. Design Professional's Representative.

3. Contractor's Representative.

4. Major Subcontractors.

5. Major suppliers.

6. Others as appropriate.

D. Suggested Agenda:

1. Discussion on major subcontracts and suppliers and projected Construction Schedules.

2. Critical work sequencing.

3. Major equipment deliveries and priorities.

4. Project coordination and designation of responsible personnel.

5. Procedures and processing of Field Changes, Proposal Requests, Submittals, Change Orders and Applications for Payment.

6. Method for distribution of Contract Documents.

7. Procedures for maintaining Record Documents.

8. Use of premises, office, work and storage areas, and Owner's Representative requirements.

9. Housekeeping procedures.

10. Dispute resolution.

1.5 Progress, Preinstallation And Coordination Meetings

A. Schedule regular and special meetings, as required by progress of Work.

B. Location of Meetings: Project Field Office of Contractor.

C. Attendance:

1. Owner's Representative.

2. Design Professional's Representative.

3. Contractor's Representative.

4. Subcontractors as appropriate to agenda.

5. Suppliers as appropriate to agenda.

6. Others as appropriate.

D. Suggested Agenda:

1. Review and approval of minutes of previous meeting.
2. Review of work progress since previous meeting.
3. Field observations, problems, conflicts.
4. Problems which impede Construction Schedule.
5. Review of off Project Site fabrication, Delivery Schedules.
6. Corrective measures and procedures to regain projected schedule.
7. Revisions to Construction Schedule.
8. Plan progress, schedule, during succeeding work period.
9. Coordination of schedules.
10. Review Submittal Schedules; expedite as required.
11. Maintenance of quality standards.
12. Review proposed changes for:
    a. Effect on Construction Schedule and on Completion Date.
    b. Effect on other Contracts of Project.
13. Review Record Drawings.
14. Other business.

Part 2 Products

Not used.

Part 3 Execution

Not used.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Administrative and procedural requirements for progress reports prepared by Contractor.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Construction Schedules: Division 01.

C. Application for Payment: Division 01.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Quality Control Procedures:

1. Weekly Reports: As indicated.

2. Monthly Reports: As indicated.

1.4 Weekly Reports

A. Submit Weekly Reports including:

1. Name of project.

2. Project number.

3. Date of report.

4. Weather conditions.

5. Manpower status on each type of work being performed by building.

6. Overtime worked and planned.

7. Work progress.

8. Environmental problems and corrections.

9. Other information, such as special events or occurrences, accidents, recommendations, suggestions, visitors, major equipment or materials received, tests, inspections, equipment startup and checkout, and occupancy.

1.5 Monthly Reports

A. Submit Monthly Reports containing a synopsis of previous month's activities, including:

1. Name of project.
2. Project number.
3. Date of report.
4. Weather conditions for month compared to normal.
5. Work progress from previous month.
6. Copies of all previous month’s schedules.
7. Updated schedules with explanations of deviation from previous schedules.
8. Milestone schedule events for upcoming month.
9. Corrective measures and procedures to regain projected Construction Schedule.
10. Review of status of submittals.
11. Review of status of Change Orders and/or requested Change Orders.
12. Other information of importance from previous month or forecasted for upcoming month.
13. Bind in submission of Construction Photographs.
14. Bind in submission of monthly settlement survey.

Part 2 Products

Not used.

Part 3 Execution

Not used.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Administrative and procedural requirements for schedules prepared by Contractor.

1.2 Related Requirements Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Summary of Work: Division 01.

C. Schedule of Values: Division 01.

D. Submittal Register: Division 01.

E. Submittals: Division 01.

F. Material and Equipment: Division 01.

G. Project Coordination: Division 01.

H. Coordination Drawings: Division 01.

I. Application for Payment: Division 01.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Construction Schedule: As indicated.

C. Schedule of Submittals: As indicated.

1.4 Construction Schedule

A. Prepare Construction Schedules, including all phases of Work outlined as follows:

1. Initial Construction Schedule: Within 10 calendar days after Award of Contract or Notice to Proceed, submit for approval, an initial Construction Schedule, showing basic elements of construction, including: Excavation, concrete work, structural steel, masonry, cross laminated timber, finishes, mechanical work and electrical work. This Schedule shall be phased to allow the construction to be performed within the attached schedule of available construction dates. Coordinate schedule with the following:

a. Application for Payments.
b. Coordination Drawings.
c. Mock-ups.
d. Schedule of Submittals.
e. Schedule of Values.
f. Submission required in Material and Equipment: Division 01.

2. Final Construction Schedule: Within 30 calendar days after Award of Contract or Notice to Proceed, submit for approval, a complete detailed Construction Schedule showing each activity having impact upon timely completion of Project. Activities shall be broken down generally similar to individual Specification Sections. Schedule shall include, but is not limited to, the following:

a. Time limit per activity not to exceed ten (10) working days.
b. Time frames for shop fabrication and delivery of all parts of Work. Identify by Specification Section Number and Title. Coordinate with Schedule of Submittals. Allow time for reviews, resubmissions and approval.
c. Identification for Work of mock-ups, separate floors, separate buildings, separate phases or other logically grouped activities.
d. Separate network for each trade or operation.

B. Format:

1. Initial Construction Schedule: Horizontal bar chart form divided vertically by weeks.

2. Final Construction Schedule: Horizontal bar chart form showing each trade or operation.

1.5 Schedule Of Submittals

A. Coincidental with Contractor's initial Construction Schedule, prepare a complete Schedule of Submittals. Submit a preliminary Schedule of Submittals for submittals within first thirty (30) days after Notice to Proceed with initial Construction Schedule. Submit Final Schedule with Contractor's Final Construction Schedule.

B. Coordinate Submittal Schedule with list of Subcontracts, Schedule of Values, Submittal Register and Contractor's Construction Schedule.

C. Coordinate interrelated submissions to allow for concurrent review. Data included in submissions shall be coordinated. For example, exterior enclosure, operating and interconnected systems.

D. Estimate quantity of resubmissions required for each submittal based on complexity. However, Submittal Schedule in no way binds Design Professional to approve a submittal to meet Submittal Schedule or Construction Schedule. It is Contractor's sole responsibility to prepare acceptable submissions in a timely fashion in order to maintain schedule.

E. Allow ten (10) working days for Design Professional's review of each submission and resubmission.

F. Prepare schedule in chronological order. Provide the following information:

1. Scheduled date for first submittal.

2. Related Specification Section Number.

3. Submittal category.

4. Name of Subcontractor.

5. Description of part of Work covered.

6. Scheduled date for resubmittal or resubmittals.

7. Scheduled date of Design Professional's final release or approval.

G. Distribution:

1. Following response to initial submittal, print and distribute copies to Design Professional, Owner's Representative, Subcontractors, and other parties required to comply with submittal dates indicated. Post copies in Project Meeting Room and Field Office.

2. When revisions are made, distribute to same parties and post in same locations. Delete parties from distribution when they have completed their assigned portion of Work and are no longer involved in the Work.

1.6 Coordination

A. Subcontractors shall submit their schedules to Contractor.

B. Prepare an overall schedule, including all trades and contracts.

1.7 Updating

A. Update Final Construction Schedule and Schedule of Submittals on a bi-weekly basis.

B. Show changes occurring since previous submission of updated schedules.

C. Indicate progress of each activity and show completion dates.

D. Include major changes in scope, activities modified since previous updating, revised projections due to changes and other identifiable changes.

1.8 Distribution

A. Distribute copies of reviewed schedules to:

1. Owner's Representative.

2. Design Professional.

3. Project Site File.

4. Subcontractors.

5. Other Concerned Parties, including Surety and Insurance Carrier.

B. Instruct recipients to report inability to comply, and provide detailed explanation, with suggested remedies.

Part 2 Products

Not used.

Part 3 Execution

Not used.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Administrative and procedural requirements for submission of Shop Drawings, Product Data, Samples, Calculations, Certifications, and other information as required by Contract Documents.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Modification Procedures: Division 01.

C. Coordination Drawings: Division 01.

D. Construction Schedules: Division 01.

E. Submittal Register: Division 01.

F. Material and Equipment: Division 01.

G. Sustainability Requirements: Division 01.

1.3 Definitions

A. Submittals: Shop Drawings, Product Data, Samples, Calculations, Certifications, and other similar data required by Contract Documents and prepared by Contractor to illustrate some portion of Work.

1. Submittals are not part of Contract Documents.

2. Purpose of submittals is to demonstrate, for portion of Work for which submittal is required by Contract Documents, the way by which Contractor proposes to conform to information given and design concept expressed in Contract Documents.

1.4 Shop Drawings

A. Shop Drawings:

1. Contractor's drawings, diagrams, schedules or other data made specifically for this Project to illustrate some portion of Work.

2. Individual piece fabrication drawings, cutting or tooling drawings, shop tickets, or other similar drawings prepared for manufacturing or fabrication may not be considered as Shop Drawings as determined by Design Professional and will not be reviewed.

B. Show sufficient data to establish compliance with Contract Documents.

1. Show field dimensions, clearly identified as such.

2. Identify finishes.

3. Show shipping and operating weights when required or applicable.

4. Show gauges, fastenings, reinforcements, and welding details.

5. Indicate relationships with adjacent construction.

6. Do not use reproductions of Drawings as Shop Drawings unless specifically permitted in Contract Documents.

7. Identify details by reference to sheet and detail numbers indicated on Drawings and by reference to paragraphs and Specification Section.

8. Orient Shop Drawings in same manner as Drawings.

9. Do not use manufacturer’s standard details as Shop Drawings unless they are altered to specifically suit the Work as indicated.

1.5 Product Data

A. Product Data: Manufacturer's catalog sheets, brochures, diagrams, standard schematic drawings, schedules, performance charts, illustrations, instructions and other standard descriptive data. Manufacturer’s standard specifications are not Product Data.

1. Mark each copy to identify materials, products or models applicable to this Project.

2. Show colors when required for evaluation, record or other purpose. Where Product Data is printed in color, submit all copies in original colors as published.

3. Show dimensions and clearances required.

4. Show performance, characteristics and capacities.

5. Show wiring and piping diagrams, and controls.

6. Show finishes.

7. Show shipping and operating weights.

8. Show gauges, fastenings, reinforcements, and welding details.

9. Show compliance with applicable reference standards.

10. Show by reference to paragraphs and Specification Section.

11. Mark out or delete information that is not applicable to the Work. Data showing information that is not applicable shall be returned without review.

B. For Mechanical Items, Include:

1. For Driven Equipment: hp, voltage, phase, Hz, rpm.

2. For Pumps: gpm, total discharge head, pump curves, seals, noise levels, certified factory test report.

C. For Electrical include: Manufacturer's name, model number and pertinent engineering data in order to evaluate equipment as specified in Division 26.

D. Material Safety Data Sheets: Unless indicated otherwise, the Design Professional will not review MSDS sheets. Where indicated for submission, MSDS sheets are for the Owner's Record and will not be reviewed by the Design Professional.

1.6 Samples

A. Samples: Actual Samples of products proposed for use. Samples shall be of sufficient size and quantity to clearly illustrate:

1. Functional characteristics of product or material, with integrally related parts and attachment devices.

2. Full range of color, texture and patterns.

B. Field Samples and Mock-ups: Portions of Work, constructed specifically for the Work, to establish compliance with Contract Documents.

1. Erect in location indicated.

2. Construct each Field Sample or Mock-up complete, including Work of all Sections required in Finished Work.

3. Obtain approval of Field Sample or Mock-up prior to commencing remainder of Work, unless otherwise indicated.

4. Protect Field Samples and Mock-ups in approved condition until Date of Substantial Completion or other time indicated for removal.

1.7 Calculations

A. Calculations shall be prepared and sealed by Professional Engineers licensed to practice in State of North Carolina, unless otherwise indicated.

B. Calculations shall include sufficient detail and data to allow Design Professional to determine engineer's understanding of and conformance with Contract Documents.

1.8 Qualifications

A. Statements by Contractor and third-parties showing compliance with required experience and credentials to provide the Work. Statements shall include duration that firm has been in business performing similar work and shall list references from Owners and Design Professionals from other similar projects.

1.9 Quality Control Procedures

A. Procedures, plans and reports serving to demonstrate by factory or field that the Work complies with indicated requirements.

1.10 Certifications

A. Certifications: Statements from Contractor, installers, manufacturers and others as indicated, stating that construction complies with Contract Document requirements.

B. Certifications shall be on company letterhead, and shall identify project name and address. Certifications shall be signed by an authorized representative of company.

C. Certifications shall include sufficient description of requirement of the Work and method of compliance to allow Design Professional to determine certifier's understanding of Contract Documents.

1.11 Closeout Submittals

A. Final documents including updated Record Drawings and Specifications, Operation and Maintenance Data, Warranty Certificates and other information as indicated in other Sections.

1.12 Coordination

A. Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals and related activities that requires sequential activity.

2. Coordinate transmittal of different types of submittals for related elements of Work so processing shall not be delayed by need to review submittals concurrently for coordination.

B. Submit all submittals required in an individual Specification Section together as a single package for simultaneous review, unless otherwise indicated.

C. When Coordination Drawings are required, complete Coordination Drawings before submittal of Shop Drawings related to affected Work.

D. When mock-ups are required, submittals for all products used in mock-ups shall be coordinated with schedule for mock-up construction.

E. Design Professional reserves right to withhold action on a submittal requiring coordination.

1.13 Submission Requirements

A. Submittals shall demonstrate, for those portions of Work for which Submittals are required by Contract Documents, the way by which Contractor proposes to conform to information given and design concept expressed in Contract Documents.

B. Failure to comply with requirements of Contract Documents may result in return of submittal by Design Professional without action.

C. Review submittals for compliance with Contract Documents, approve and submit to Design Professional, Submittals required by Contract Documents. Submittals not marked as reviewed for compliance with Contract Documents and approved by Contractor may be returned by Design Professional without action.

D. Comply with Schedule of Submittals indicated in Construction Schedules: Division 01. Allow for Design Professional’s review, resubmissions, rejected submissions and re-reviews.

E. Show, on all Submittal transmittals, reference Specification numbers and submission numbers adjacent to each identified Submittal.

F. Use "Submittal Summary" (see sample at end of this Section) or facsimile as cover sheet for each submittal. "Submittal Summary" is not intended to take place of Contractor's letter of transmittal, but shall accompany each individual Specification Section submittal separately. Do not combine submittals of more than one (1) product or Section.

G. Submit one (1) digital color pdf of each Shop Drawing via email.

H. Submit one (1) digital color pdf of Product Data via email.

I. For Sample selections, submit one (1) set. For Sample approval, submit three (3) sets. One (1) set will be returned to Contractor.

J. For Preliminary Submittals, submit one (1) digital color pdf. Design Professional will review and return one (1) digital pdf.

K. For Final Submittals, including Operation and Maintenance Manuals, submit one (1) copy which will be reviewed and returned.

L. For revised Final Submittals, including Operation and Maintenance Manuals, submit six (6) sets prior to, or concurrent with Final Application for Payment.

M. Do not mark submittals with “highlighters” or other marks that do not easily reproduce or copy.

N. Cross out all information included on pre-printed data which does not apply to the Work.

O. In addition to information required on "Submittal Summary", submittals shall include the following on each page of Shop Drawings, on labels applied to each Sample and on first page of all other types of submittals:

1. A blank space, 3 inches by 10 inches for Design Professional's Stamp.

2. Contractor's approval stamp, dated, initialed or signed, which includes language acceptable to Design Professional certifying approval of submittal, verification of field measurements, coordination with all trades involved and compliance with Contract Documents.

P. Contractor is not relieved of requirement to conform to Contract Documents by Design Professional's approval of Submittals unless Contractor has specifically informed Design Professional in writing of deviation at time of submission and Design Professional has given written approval to specific deviation.

Q. Identify deviations from Contract Documents in writing on “Submittal Summary” and annotate in print larger and darker than adjacent notes, on Submittals. If deviations are accepted by Design Professional, Contractor shall coordinate all Work affected by deviation.

R. Contractor is not relieved from responsibility for errors or omissions in Submittals by Design Professional's approval thereof.

1.14 Design Professional’s Duties

A. Review submittals with reasonable promptness.

B. Review of submittals is expressly limited to purpose of checking for conformance with information given and design concept expressed in Contract Documents.

C. Review of submittals is not conducted for purpose of determining accuracy and completeness of other information such as, but not limited to, dimensions and quantities, for coordinating Work, or for substantiating instructions for installation or performance of equipment or systems, all of which remain Work of Contractor.

D. Design Professional is not responsible to review individual piece fabrication or tooling drawings, shop tickets or other drawings prepared for manufacturing or fabrication of individual components if, in the opinion of the Design Professional, the drawing is not required to determine conformance with information given and design concept expressed in Contract Documents.

E. Review of separate item does not constitute review of an assembly in which item functions.

F. Submittals that are not required by Contract Documents may be returned by Design Professional without action.

G. Affix stamp and initials or signature certifying to review of submittal.

H. Return submittals to Contractor with approval for distribution or directions to correct and resubmit.

I. Design Professional's action on submittals shall result in making of one (1) of the following notations with related meanings:

1. APPROVED: Work involved may proceed, and no further submission is required.

2. APPROVED AS NOTED: Work involved may proceed incorporating Design Professional's comments. Approval does not authorize changes to Contract Sum unless stated in a separate letter or Change Order.

3. REVISE AND RESUBMIT: Work involved may not proceed. Submittal must be corrected and resubmitted.

4. DISAPPROVED - RESUBMIT: Submittal is not in accordance with Contract Documents, and a completely new submittal is required.

J. In the event that comment made to Submittal by Design Professional results in a claim for a change in Contract, Design Professional shall be notified immediately and fabrication shall not be undertaken until Contract Modification Procedures are completed.

1.15 Resubmission Requirements

A. Show changes made from initial submittal other than those requested by Design Professional. Annotate in print larger and darker than adjacent notes. Design Professional may review only changes identified in previous submissions and new changes identified by Contractor.

B. Make resubmittals in same manner as specified for original submittals in Article, Submission Requirements.

1. Identify resubmittal as a resubmittal.

2. Date resubmittal.

3. Resubmittals shall be complete, unless otherwise marked by Design Professional.

4. Design Professional will review resubmittal and take appropriate action in same manner as for original submittal.

5. As with original submittal, review returned submittal and take appropriate action as marked. Continue to revise and resubmit, identifying changes made since previous submittal, until final action by Design Professional.

1.16 Distribution Of Approved Submittals

A. Reproduce and distribute copies of submittals having Design Professional's stamp ("Approved" or "Approved as Noted") as required to coordinate and complete Work and to Project Record Documents file.

1.17 Substitutions

A. Do not submit substitutions as a Shop Drawing, Product Data or Sample.

Part 2 Products

Not used.

Part 3 Execution

3.1 Delivery Of Submittals

A. Deliver, ship or mail submittals.

B. Submittals For Review: Forward to:

Jacobs.
333 Fayetteville Street
Suite 1100
Raleigh, NC 27601
919-334-3111
919-334-3122 (fax)
Attention: John Stevermer
Email: john.stevermer@jacobs.com

3.2 Attachment: Sample Submittal Summary

A. See next page.

END

SAMPLE SUBMITTAL SUMMARY

Project Name: Greenville Transportation Activity Center

Location: 600 South Pitt Street, Greenville, NC 27834

Design Professional's Project No.: L3005900

Reference Specification No.: _____

Submission No.: _____

Date of Submission: _____

Item Submitted: _____

_____

Contractor: _____

Subcontractor: _____

Supplier/Vendor/Manufacturer: _____

_____

Deviations from Contract Documents: (Describe in Detail) (If there are no deviations from Contract Documents, state "No Deviations")

- END OF SAMPLE SUBMITTAL SUMMARY -

LEED v4 for BD+C: New Construction and Major Renovation

Project Checklist

Project Name: GTAC
Date:

Y	?	N			
1			Credit	Integrative Process	1

6	3	23	Location and Transportation		16
		16	Credit	LEED for Neighborhood Development Location	16
1			Credit	Sensitive Land Protection	1
		2	Credit	High Priority Site	2
2	2	1	Credit	Surrounding Density and Diverse Uses	5
3		2	Credit	Access to Quality Transit	5
		1	Credit	Bicycle Facilities	1
		1	Credit	Reduced Parking Footprint	1
	1		Credit	Green Vehicles	1

3	3	4	Sustainable Sites		10
Y			Prereq	Construction Activity Pollution Prevention	Required
1			Credit	Site Assessment	1
		2	Credit	Site Development - Protect or Restore Habitat	2
		1	Credit	Open Space	1
	2	1	Credit	Rainwater Management	3
2			Credit	Heat Island Reduction	2
	1		Credit	Light Pollution Reduction	1

3	0	4	Water Efficiency		11
Y			Prereq	Outdoor Water Use Reduction	Required
Y			Prereq	Indoor Water Use Reduction	Required
Y			Prereq	Building-Level Water Metering	Required
2			Credit	Outdoor Water Use Reduction	2
1		1	Credit	Indoor Water Use Reduction	6
		2	Credit	Cooling Tower Water Use	2
		1	Credit	Water Metering	1

13	3	9	Energy and Atmosphere		33
Y			Prereq	Fundamental Commissioning and Verification	Required
Y			Prereq	Minimum Energy Performance	Required
Y			Prereq	Building-Level Energy Metering	Required
Y			Prereq	Fundamental Refrigerant Management	Required
3	3		Credit	Enhanced Commissioning	6
9		1	Credit	Optimize Energy Performance	18
1			Credit	Advanced Energy Metering	1
		2	Credit	Demand Response	2
		3	Credit	Renewable Energy Production	3
		1	Credit	Enhanced Refrigerant Management	1
		2	Credit	Green Power and Carbon Offsets	2

6	3	5	Materials and Resources		13
Y			Prereq	Storage and Collection of Recyclables	Required
Y			Prereq	Construction and Demolition Waste Management Planning	Required
	3	2	Credit	Building Life-Cycle Impact Reduction	5
1		1	Credit	Building Product Disclosure and Optimization - Environmental Product Declarations	2
1		1	Credit	Building Product Disclosure and Optimization - Sourcing of Raw Materials	2
2		1	Credit	Building Product Disclosure and Optimization - Material Ingredients	2
2			Credit	Construction and Demolition Waste Management	2

8	4	3	Indoor Environmental Quality		16
Y			Prereq	Minimum Indoor Air Quality Performance	Required
Y			Prereq	Environmental Tobacco Smoke Control	Required
		2	Credit	Enhanced Indoor Air Quality Strategies	2
2	1		Credit	Low-Emitting Materials	3
1			Credit	Construction Indoor Air Quality Management Plan	1
2			Credit	Indoor Air Quality Assessment	2
1			Credit	Thermal Comfort	1
1	1		Credit	Interior Lighting	2
	2		Credit	Daylight	3
1			Credit	Quality Views	1
		1	Credit	Acoustic Performance	1

1	2	3	Innovation		6
	2	3	Credit	Innovation	5
1			Credit	LEED Accredited Professional	1

3	1	0	Regional Priority		4
1			Credit	Regional Priority: outdoor water use above 2	1
1			Credit	Regional Priority: Optimize Energy above 9	1
	1		Credit	Regional Priority: Rainwater management above 2	1
1			Credit	Regional Priority: Heat island reduction above 1	1

44	19	51	TOTALS	Possible Points:	110

Certified: 40 to 49 points, **Silver:** 50 to 59 points, **Gold:** 60 to 79 points, **Platinum:** 80 to 110

Part 1 General

1.1 Summary (Non-inclusive)

A. The proposed Project, as described in Summary of Work: Division 01 is designed to be a sustainable or "green" building, and as a result the requirements of this Section are made a part of the Contract Requirements of this Project.

B. Sustainable Design Intent: Comply with Project requirements intended to achieve a minimum Certified Rating, measured and documented according to the LEED Green Building Rating System BD+C for New Construction, Version 4 of the US Green Building Council (USGBC).

1. Other LEED Prerequisites and Credits needed to obtain LEED certification depend on material selections and may not be specifically identified as LEED requirements. Compliance with requirements needed to obtain LEED Prerequisites and Credits may be used as one criterion to evaluate substitution requests and comparable product requests.

2. Additional LEED prerequisites and credits needed to obtain the indicated LEED certification depend on Design Professional's design and other aspects of Project that are not part of the Work of the Contract.

3. A copy of the LEED Project Checklist is attached at the end of this Section for information only.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Summary of Work: Division 01.

C. Construction Indoor Air Quality (IAQ) Management: Division 01.

D. Construction Waste Management: Division 01.

E. General Commissioning Requirements: Division 01.

F. Individual Specifications Sections identifying sustainable requirements.

1.3 Sustainability Submittals

A. Online Forms: Fill out LEED online forms for the credits indicated below and notify Design Professional and Owner as they are completed.

1. Sustainable Sites:

    a. Prereq. – Construction Activity Pollution Prevention.

2. Materials and Resources:

    a. Prereq. – Construction and Demolition Waste Management Planning.
    b. Building Product Disclosure and Optimization – Environmental Product Declarations.
    c. Building Product Disclosure and Optimization – Sourcing of Raw Materials.
    d. Building Product Disclosure and Optimization – Material Ingredients.
    e. Construction and Demolition Waste Management.

3. Indoor Environmental Quality:

    a. Low Emitting Materials.
    b. Construction Indoor Air Quality Management Plan.
    c. Indoor Air Quality Assessment.

1.4 Action Submittals

A. General: Submit additional sustainable design submittals required by other Specification Sections.

B. Sustainable design submittals are in addition to other submittals.

1. If submitted item is identical to that submitted to comply with other requirements, include an additional copy with other submittal as a record copy of compliance with indicated LEED requirements instead of separate sustainable design submittal. Mark additional copy "Sustainable design submittal."

2. Complete the USGBC calculator download for each product and submit.

    a. http://www.usgbc.org/resources/bpdo-calculator

C. Sustainable Design Documentation Submittals:

1. Environmental Product Declarations complying with LEED requirements.

2. Documentation for products that comply with LEED requirements for multi-attribute optimization.

    a. Include documentation for regional materials, indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material and costs of regional materials.

3. Documentation for products that comply with LEED requirements for leadership extraction practices. Include the following:

    a. Product data and certification letter from product manufacturers, indicating participation in an extended producer responsibility program and statement of costs.

b. Product data and certification for bio-based materials, indicating that they comply with requirements. Include statement of costs.
c. Product data and chain-of-custody certificates for products containing certified wood. Include statement of costs.
d. Receipts for salvaged and refurbished materials used for Project, indicating sources and costs.
e. Product data and certification letter from product manufacturers, indicating percentages by weight of postconsumer and preconsumer recycled content for products having recycled content. Include statement of costs.
f. Documentation for regional materials, indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material and costs of regional materials.

4. Material ingredient reports for products that comply with LEED requirements for material ingredient reporting.

5. Documentation for products that comply with LEED requirements for material ingredient optimization.

6. Documentation complying with Section 017419 "Construction Waste Management."

7. Product data for adhesives and sealants used inside the weatherproofing system, indicating VOC content and laboratory test reports showing compliance with requirements for low-emitting materials.

8. Product data for paints and coatings used inside the weatherproofing system, indicating VOC content and laboratory test reports showing compliance with requirements for low-emitting materials.

9. Laboratory test reports for flooring, indicating compliance with requirements for low-emitting materials.

10. Laboratory test reports for products containing composite wood or agrifiber products or wood glues, indicating compliance with requirements for low-emitting materials.

11. Laboratory test reports for ceilings, walls, and thermal insulation, indicating compliance with requirements for low-emitting materials.

12. Construction Indoor-Air-Quality (IAQ) Management:
    a. Construction IAQ management plan.
    b. Product data for temporary filtration media.
    c. Product data for filtration media used during occupancy.
    d. Construction Documentation: Six photographs at three different times during the construction period, along with a brief description of the SMACNA approach employed, documenting implementation of the IAQ management measures, such as protection of ducts and on-site stored or installed absorptive materials.

13. IAQ Assessment:

    a. 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.
    b. Product data for filtration media used during flush-out and occupancy.
    c. Report from testing and inspecting agency indicating results of IAQ testing and documentation showing compliance with IAQ testing procedures and requirements.

1.5 Informational Submittals

A. Qualification Data: For LEED coordinator.

B. Project Materials Cost Data: Provide statement indicating total cost for materials used for Project. Costs exclude labor, overhead, and profit. Include breakout of costs for the following categories of items:

    1. Plumbing.
    2. Mechanical.
    3. Electrical.
    4. Specialty items, such as elevators and equipment.

C. Sustainable Design Action Plans: Provide preliminary submittals within 14 days of date established for the Notice to Proceed, indicating how the following requirements will be met:

    1. List of proposed products with Environmental Product Declarations.
    2. List of proposed products complying with requirements for multi-attribute optimization.
    3. List of proposed products complying with requirements for raw material and source extraction reporting.
    4. List of proposed products complying with requirements for leadership extraction practices.
    5. List of proposed products complying with requirements for material ingredient reporting.
    6. List of proposed products complying with requirements for material ingredient optimization.
    7. Waste management plan complying with Section 017419 "Construction Waste Management."
    8. Construction IAQ management plan.

D. Sustainable Design Progress Reports: Concurrent with each Application for Payment, submit reports comparing actual construction and purchasing activities with sustainable design action plans.

1.6 Administrative Requirements

A. Respond to questions and requests from Architect and the USGBC regarding LEED credits that are the responsibility of the Contractor, that depend on product selection or product qualities, or that depend on Contractor's procedures until the USGBC has made its determination on the Project's LEED certification application. Document responses as informational submittals.

1.7 Definitions

A. LEED: USGBC's "LEED Version 4 for Building Design and Construction."

1. Definitions that are a part of "LEED Version 4 for Building Design and Construction" (LEED v4 BD+C) apply to this Section.

B. Chain-of-Custody Certificates: Certificates signed by manufacturers certifying that wood used to make products was obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001. Certificates shall include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body.

C. Regional Materials: Materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site. If only a fraction of a product or material is extracted/harvested/recovered and manufactured locally, then only that percentage (by weight) shall contribute to the regional value.

D. Recycled Content: The recycled content value of a material assembly shall be determined by weight. The recycled fraction of the assembly is then multiplied by the cost of assembly to determine the recycled content value.

1. "Postconsumer" material is defined as waste material generated by households or by commercial, industrial, and institutional facilities in their role as end users of the product, which can no longer be used for its intended purpose.

2. "Preconsumer" material is defined as material diverted from the waste stream during the manufacturing process. Excluded is reutilization of materials, such as rework, regrind, or scrap, generated in a process and capable of being reclaimed within the same process that generated it.

1.8 Quality Assurance

A. Contractor's Qualifications:

1. Experience: Contractors providing work in excess of 10 percent of the total value of the Project shall have provided a similar level of work on at least one (1) previous project of scope, schedule and complexity and with sustainability goals similar to this Project, as acceptable to Design Professional. Include project descriptions with Owner and Design Professional contacts to document required previous experience.

B. Referenced Standards: Comply with the following in accordance with Division 01.

1. Applicable Environmental and Sustainability Regulations as determined by Authority Having Jurisdiction.

2. LEED Reference Guide for above noted Rating System and Version, by US Green Building Council. Also included are any standards referenced in the Reference Guide.

C. Preconstruction Sustainability Meeting: Not more than two weeks after Notice to Proceed, meet at Project Site to discuss requirements for sustainability.

1. Attendees: Contractors providing work in excess of 10 percent of the total value of the Project and their major suppliers and manufacturers, Design Professional, Owner's Representative, and other representatives concerned with Work, including (where applicable) Owner's insurers, and governing authorities.

2. Review foreseeable methods and procedures:

   a. Review LEED rating system checklist and review associated items of work that will need coordination. Designate responsibilities for each credit and who will collect and track information related to that specific point. For points where multiple different groups will contribute, designate a single person to oversee the effort.
   b. Review Action Plans specified above in Sustainability Submittals article.
   c. Review process and methodology for collection of information related to sustainability strategies.
   d. Review requirements for submittals and review of submittals related to sustainability requirements.
   e. Review strategies that will require construction phase coordination, such as Construction Indoor Air Quality and Construction Waste Management. Review the intent behind these specific plans, and if available, review the details of these specific plans.

3. Record discussions of conference, including decisions, agreements and unresolved issues. When unresolved issues exist at conclusion of conference, determine how they will be resolved and set date for reconvening conference.

Part 2 Products

2.1 Materials

A. Provide products and procedures necessary to obtain LEED credits required in this Section. Although other Sections may specify some requirements that contribute to these LEED credits, the Contractor shall provide additional materials and procedures necessary to obtain LEED credits indicated.

B. At least 20 different products from at least five different manufacturers shall have Environmental Product Declarations that comply with LEED requirements. Industry-wide (generic) Environmental Product Declarations shall be valued as one-half of a product.

C. At least 50 percent, by cost, of the permanently installed products for the Project shall comply with LEED requirements for multi-attribute optimization.

D. At least 20 different products from at least five different manufacturers shall have publically released reports that comply with LEED requirements for raw material source and extraction reporting. Self-declared reports by manufacturers shall be valued as one-half of a product.

E. At least 20 different products from at least five different manufacturers shall comply with LEED requirements for material ingredient reporting.

F. At least 25 percent, by cost, of the permanently installed products for the Project shall comply with LEED requirements for material ingredient optimization.

G. Not less than 25 percent of building materials, by cost, shall comply with LEED requirements for leadership extraction practices.

1. Structure and enclosure materials shall not be more than 30 percent, by cost, of the materials used to comply with this requirement.

H. Extended Producer Responsibility Program: Not less than 25 percent of building materials, by cost, shall be manufactured by a participant in an extended producer responsibility program.

I. Recycled Content: Building materials shall have recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content for Project constitutes a minimum of 50 percent of cost of materials used for Project.

1. Cost of postconsumer recycled content plus one-half of preconsumer recycled content of an item shall be determined by dividing weight of postconsumer recycled content plus one-half of preconsumer recycled content in the item by total weight of the item and multiplying by cost of the item.

2. Do not include furniture, plumbing, mechanical and electrical components, and specialty items, such as elevators and equipment, in the calculation.

J. Certified Wood: Not less than 10 percent, by cost, of wood-based materials shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001.

2.2 Low-Emitting Materials

A. Paints and Coatings: For field applications that are inside the weatherproofing system, paints and coatings shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 50 g/L.
3. Dry-Fog Coatings: 150 g/L.
4. Primers, Sealers, and Undercoaters: 100 g/L.
5. Rust-Preventive Coatings: 100 g/L.
6. Zinc-Rich Industrial Maintenance Primers: 100 g/L.
7. Pretreatment Wash Primers: 420 g/L.
8. Clear Wood Finishes, Varnishes: 275 g/L.
9. Clear Wood Finishes, Lacquers: 275 g/L.
10. Floor Coatings: 50 g/L.
11. Shellacs, Clear: 730 g/L.
12. Shellacs, Pigmented: 550 g/L.
13. Stains: 100 g/L.

B. Paints and Coatings: For field applications that are inside the weatherproofing system, 90 percent of paints and coatings shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Adhesives and Sealants: For field applications that are inside the weatherproofing system, adhesives and sealants shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:

1. Wood Glues: 30 g/L.
2. Metal-to-Metal Adhesives: 30 g/L.
3. Adhesives for Porous Materials (Except Wood): 50 g/L.

4. Subfloor Adhesives: 50 g/L.
5. Plastic Foam Adhesives: 50 g/L.
6. Carpet Adhesives: 50 g/L.
7. Carpet Pad Adhesives: 50 g/L.
8. VCT and Asphalt Tile Adhesives: 50 g/L.
9. Cove Base Adhesives: 50 g/L.
10. Gypsum Board and Panel Adhesives: 50 g/L.
11. Rubber Floor Adhesives: 60 g/L.
12. Ceramic Tile Adhesives: 65 g/L.
13. Multipurpose Construction Adhesives: 70 g/L.
14. Fiberglass Adhesives: 80 g/L.
15. Contact Adhesives: 80 g/L.
16. Structural Glazing Adhesives: 100 g/L.
17. Wood Flooring Adhesives: 100 g/L.
18. Structural Wood Member Adhesives: 140 g/L.
19. Single-Ply Roof Membrane Adhesives: 250 g/L.
20. Special-Purpose Contact Adhesives (That Are Used to Bond Melamine-Covered Board, Metal, Unsupported Vinyl, Rubber, or Wood Veneer 1/16 Inch or Less in Thickness to Any Surface): 250 g/L.
21. Top and Trim Adhesives: 250 g/L.
22. Plastic Cement Welding Compounds: 250 g/L.
23. ABS Welding Compounds: 325 g/L.
24. CPVC Welding Compounds: 490 g/L.
25. PVC Welding Compounds: 510 g/L.
26. Adhesive Primer for Plastic: 550 g/L.
27. Sheet-Applied Rubber Lining Adhesives: 850 g/L.
28. Aerosol Adhesive, General-Purpose Mist Spray: 65 percent by weight.
29. Aerosol Adhesive, General-Purpose Web Spray: 55 percent by weight.

30. Special-Purpose Aerosol Adhesives (All Types): 70 percent by weight.

31. Other Adhesives: 250 g/L.

32. Architectural Sealants: 250 g/L.

33. Nonmembrane Roof Sealants: 300 g/L.

34. Single-Ply Roof Membrane Sealants: 450 g/L.

35. Other Sealants: 420 g/L.

36. Sealant Primers for Nonporous Substrates: 250 g/L.

37. Sealant Primers for Porous Substrates: 775 g/L.

38. Modified Bituminous Sealant Primers: 500 g/L.

39. Other Sealant Primers: 750 g/L.

D. Adhesives and Sealants: For field applications that are inside the weatherproofing system, 90 percent of adhesives and sealants shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

E. Flooring: Flooring shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

F. Composite Wood: Composite wood, agrifiber products, and adhesives shall be made using ultra-low-emitting formaldehyde resins as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products" or shall be made with no added formaldehyde.

G. Ceilings, Walls, and Thermal Insulation: Ceilings, walls, and thermal insulation shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

Part 3 Execution

3.1 Nonsmoking Building

A. Smoking is not permitted within the building or within 25 feet of entrances, operable windows, or outdoor-air intakes.

3.2 Construction Waste Management

A. Comply with Section 017419 "Construction Waste Management."

3.3 Construction IAQ Management

A. Comply with SMACNA's "SMACNA IAQ Guideline for Occupied Buildings under Construction."

1. If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period as specified in Section 015200 "Construction Facilities," install MERV 8 filter media at each return-air inlet for the air-handling system used during construction.

2. Replace air filters immediately prior to occupancy.

3.4 IAQ Assessment

A. 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 14,000 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. If occupancy is desired prior to flush-out completion, the space may be occupied following delivery of a minimum of 3500 cu. ft. of outdoor air per sq. ft. of floor area to the space. Once a space is occupied, it shall be ventilated at a minimum rate of 0.30 cfm per sq. ft. of outside air or the design minimum outside-air rate, whichever is greater. During each day of the flush-out period, ventilation shall begin a minimum of three hours prior to occupancy and continue during occupancy. These conditions shall be maintained until a total of 14,000 cu. ft./sq. ft. of outside air has been delivered to the space.

B. Air-Quality Testing: Engage testing agency to perform the following:

1. Conduct baseline IAQ 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 Reference Guide for Building Design and Construction."

2. Demonstrate that the contaminant maximum concentrations listed below are not exceeded:

   a. Formaldehyde: 27 ppb.
   b. Particulates (PM10): 50 micrograms/cu. m.
   c. Ozone: 0.075 ppm, according to ASTM D 5149.
   d. Total Volatile Organic Compounds: 500 micrograms/cu. m.
   e. 4-Phenylcyclohexene (4-PH): 6.5 micrograms/cu. m.
   f. Carbon Monoxide: 9 ppm and no greater than 2 ppm above outdoor levels.

g. Target Chemicals in California Department of Public Health "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers," Table 4-1 (except formaldehyde): Allowable concentrations in California Department of Public Health "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers," Table 4-1.

3. For each sampling point where the maximum concentration limits are exceeded, take corrective action until requirements have been met.

4. Air-sample testing shall be conducted as follows:

   a. All measurements shall be conducted prior to occupancy but during normal occupied hours, and with building ventilation system starting at the normal daily start time and operated at the minimum outside-air flow rate for the occupied mode throughout the duration of the air testing.
   b. Building shall have all interior finishes installed, including, but not limited to, millwork, doors, paint, carpet, and acoustic tiles. Nonfixed furnishings, such as workstations and partitions, are encouraged, but not required, to be in place for the testing.
   c. Number of sampling locations varies depending on the size of building and number of ventilation systems. For each portion of building served by a separate ventilation system, the number of sampling points shall not be less than one per 5000 sq. ft.
   d. Air samples shall be collected between 3 and 6 feet from the floor to represent the breathing zone of occupants, and over a minimum four-hour period.

3.5 Attachments

A. Complete the USGBC calculator download for each product and submit.

   1. http://www.usgbc.org/resources/bpdo-calculator

B. Sample Materials Environmental Impact Documentation Form.

C. LEED Checklist/Scorecard.

END

SAMPLE MATERIALS SUSTAINABILITY DOCUMENTATION FORM

MATERIAL OR PRODUCT:	
MATERIAL COST (less labor, overhead, and profit):	
Contractor/Installer:	Manufacturer:
Address:	Manufacturer Address:
Contact:	

Signed by:_____ Date:_____

Company:_____

Instructions to Contractor/Installer: Please complete the following information in all appropriate categories. Use one documentation form for each product or material (e.g. tile and grout each get their own form). Attach any other additional information to this form (e.g. cut sheets, letters from manufacturers, etc.)

Step A - VOC Emittance

Does the product emit VOCs?

Material Category (e.g. flat paint)	
Category VOC Limit per LEED	g/L
Amount of VOCs	g/L
Quantity of VOC-containing product used	L

- END OF SAMPLE Materials Sustainability Documentation FORM -

In addition to the requirements for submissions as specified under Submittals: Division 01, Construction Manager shall submit to Design Professional (DP) for review, and to Owner for record, those items indicated by an "X". In the event of discrepancies between this Section and requirements in individual Specification Sections, the requirements of Specification Section shall govern.

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
004325	**SUBSTITUTION REQUEST FORM (DURING PROCUREMENT):**		
	Procurement Substitution Request		X
	Architect's Action		X
010460	**CHASES, OPENINGS AND INSERTS:**		
	Information Drawings	X	
010490	**COORDINATION DRAWINGS:**		
	Deviation Requests	X	
	Coordination Drawings	X	
012973	**SCHEDULE OF VALUES:**		
	Schedule of Values	X	
012976	**APPLICATION FOR PAYMENT:**		
	Application for Payment	X	
013100	**PROJECT COORDINATION:**		
	List of Contractor's Staff		X
	List of Contractor's Consultants		X
	List of Subcontractors		X
	List of Principal Suppliers and Fabricators		X

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
013200	**PROGRESS REPORTS:**		
	Quality Control Procedures		X
013216	**CONSTRUCTION SCHEDULES:**		
	Construction Schedule	X	X
	Schedule of Submittals	X	X
013329	**SUSTAINABILITY REQUIREMENTS:**		
	Sustainable Design Documentation Submittals	X	X
	Qualification Data	X	X
	Project Materials Cost Data	X	X
	Sustainable Design Action Plans	X	X
	Sustainable Design Progress Reports	X	X
014523	**INSPECTION AND TESTING SERVICES:**		
	Quality Control Procedures		X
	Certifications		X
014527	**INSPECTION AND TESTING OF EARTHWORK:**		
	Quality Control Procedures		X
	Certifications		X
014533	**INSPECTION AND TESTING OF CAST-IN-PLACE CONCRETE:**		
	Quality Control Procedures		X
	Certifications		X

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
014535	**INSPECTION AND TESTING OF MASONRY:**		
	Quality Control Procedures		X
	Certifications		X
014537	**INSPECTION AND TESTING OF ASPHALTIC CONCRETE:**		
	Samples	X	
	Quality Control Procedures		X
	Certifications		X
014551	**INSPECTION AND TESTING OF STRUCTURAL STEEL:**		
	Quality Control Procedures		X
	Certifications		X
014570	**INSPECTION AND TESTING OF EXTERIOR ENCLOSURE:**		
	Qualifications	X	
	Quality Control Procedures		X
	Certifications		X
014571	**INSPECTION AND TESTING OF ROOFING AND WATERPROOFING:**		
	Quality Control Procedures		X
	Certifications		X
015200	**CONSTRUCTION FACILITIES:**		
	Quality Control Procedures		X

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
016000	**MATERIAL AND EQUIPMENT:**		
	Certifications		X
016610	**TESTING AND BALANCING OF MECHANICAL SYSTEMS:**		
	Quality Control Procedures		X
	Testing and Balancing (TAB) Reports		X
	Certifications		X
017123	**FIELD ENGINEERING:**		
	Surveyor Data	X	
	Certifications		X
	Record Documents		X
017329	**CUTTING AND PATCHING:**		
	Demolition Procedures and Operational Sequences	X	
	Calculations	X	
017400	**WARRANTIES AND BONDS:**		
	Closeout Submittals		X
017419	**CONSTRUCTION WASTE MANAGEMENT:**		
	Construction Waste Management Plan		X
	Construction Waste Documentation		X
017700	**PROJECT CLOSEOUT:**		
	Quality Control Procedures		X
	Certifications		X
	Closeout Submittals		X

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
017823	**OPERATION AND MAINTENANCE DATA:**		
	Closeout Submittals		X
017839	**PROJECT RECORD DOCUMENTS:**		
	Closeout Submittals		X
018120	**CONSTRUCTION INDOOR AIR QUALITY (IAQ) MANAGEMENT:**		
	Quality Control Procedures		X
019113	**GENERAL COMMISSIONING REQUIREMENTS:**		
	Two (2) Copies of all equipment and Component Submittals	X to CxA	
	Manufacturers Product Data	X to CxA	
	Coordination Drawings	X to CxA	
	Manufacturer's Installation Instructions	X to CxA	
	Manufacturer's Controls Calibration Instructions	X to CxA	
024116.13	**BUILDING DEMOLITION:**		
	Quality Control Procedures		X
031000	**CONCRETE FORMWORK:**		
	Shop Drawings	X	
	Sustainability Submittals	X	X
032000	**CONCRETE REINFORCEMENT:**		
	Shop Drawings	X	
	Product Data	X	
	Certifications		X

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
	Sustainability Submittals	X	X
032500	**CONCRETE ACCESSORIES:**		
	Product Data	X	
	Certifications		X
	Sustainability Submittals	X	X
033000	**CAST-IN-PLACE CONCRETE:**		
	Product Data	X	
	Quality Control Procedures		X
	Sustainability Submittals	X	X
033543	**POLISHED CONCRETE FINISHING:**		
	Product Data	X	
	Sustainability Submittals	X	X
	Polishing Schedule	X	
	Samples for Initial Selection	X	
	Samples for Verification	X	
	Qualification Data		X
	Material Certificates		X
042000	**UNIT MASONRY:**		
	Shop Drawings	X	
	Product Data	X	
	Samples	X	
	Quality Control Procedures		X
	Certifications		X

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
050513	**FLUOROPOLYMER COATINGS:**		
	Product Data	X	
	Samples	X	
	Qualifications	X	
	Quality Control Procedures		X
	Certifications		X
	Closeout Submittals		X
051200	**STRUCTURAL STEEL FRAMING:**		
	Shop Drawings	X	
	Product Data	X	
	Calculations	X	
	Quality Control Procedures		X
	Certifications		X
051213	**ARCHITECTURALLY-EXPOSED STRUCTURAL STEEL FRAMING:**		
	Shop Drawings	X	
	Product Data	X	
	Samples	X	
	Calculations	X	
	Quality Control Procedures		X
	Certifications		X
	Sustainability Submittals	X	X
055000	**METAL FABRICATIONS:**		
	Shop Drawings	X	

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
	Product Data	X	
	Calculations	X	
	Sustainability Submittals	X	X
055213	**PIPE AND TUBE RAILINGS:**		
	Product Data	X	
	Shop Drawings	X	
	Concrete Reinforcing	X	
	Samples	X	
	Delegated-Design Submittal	X	
	Qualification Data	X	
	Welding Certificates		X
	Paint Compatibility Certificates		X
	Product Test Reports		X
	Evaluation Reports		X
	Sustainability Submittals	X	X
061000	**ROUGH CARPENTRY:**		
	Product Data	X	
	Certifications		X
	Sustainability Submittals	X	X
061543	**CROSS LAMINATED TIMBER PANELS:**		
	Product Data	X	
	Shop Drawings	X	
	Fully Accurate Three-Dimensional (3D) Model	X	

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
	Structural Design Calculations	X	
	Samples	X	
	APA Product Report and Certified ANSI PRG 320 Certificate		X
	Local/Regional Materials	X	
	VOC Content	X	
	Sustainability Submittals	X	X
061600	**SHEATHING:**		
	Product Data	X	
	Sustainability Submittals	X	X
061800	**GLUED-LAMINATED CONSTRUCTION:**		
	Product Data	X	
	Sustainable Design Submittals	X	X
	Shop Drawings	X	
	Samples	X	
	Delegated-Design Submittal	X	
	Certificates of Conformance		X
	Material Certificates		X
	Research/Evaluation Reports		X
062000	**FINISH CARPENTRY:**		
	Shop Drawings	X	
	Samples	X	
	Sustainability Submittals	X	X

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
064000	**ACHITECTURAL WOODWORK:**		
	Shop Drawings	X	
	Product Data	X	
	Samples	X	
	Qualifications		X
	Quality Control Procedures		X
	Sustainability Submittals	X	X
070050	**EXTERIOR ENCLOSURE, GENERAL:**		
	Shop Drawings	X	
	Product Data	X	
	Calculations	X	
	Quality Control Procedures		X
	Certifications		X
071352	**MODIFIED BITUMINOUS SHEET WATERPROOFING:**		
	Shop Drawings	X	
	Product Data	X	
	Closeout Submittals		X
	Sustainability Submittals	X	X
072100	**THERMAL INSULATION:**		
	Product Data	X	
	Sustainability Submittals	X	X
072600	**AIR/VAPOR BARRIERS:**		
	Shop Drawings	X	

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
	Product Data	X	
	Qualifications	X	
	Quality Control Procedures		X
	Certifications		X
	Sustainability Submittals	X	X
074233	**PHENOLIC WALL PANELS:**		
	Shop Drawings	X	
	Product Data	X	
	Code Compliance	X	X
	Engineering Calculations	X	
	Selection Samples	X	
	Verification Samples	X	
	Operation and Maintenance Data		X
	Sustainability Submittals	X	X
075000	**MEMBRANE ROOFING (SINGLE-PLY):**		
	Shop Drawings	X	
	Product Data	X	
	Samples		
	Qualifications	X	
	Quality Control Procedures		X
	Certifications		X
	Closeout Submittals		X
	Sustainability Submittals	X	X

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
076000	**FLASHING AND SHEET METAL:**		
	Shop Drawings	X	
	Product Data	X	
	Samples	X	
	Sustainability Submittals	X	X
077200	**ROOF ACCESSORIES:**		
	Shop Drawings	X	
	Product Data	X	
	Calculations	X	
	Certifications		X
	Closeout Submittals		X
	Sustainability Submittals	X	X
077210	**FALL ARREST ROOF ANCHORS:**		
	Shop Drawings	X	
	Product Data	X	
	Calculations	X	
	Qualifications	X	
	Quality Control Procedures		X
	Certifications		X
	Sustainability Submittals	X	X
	Closeout Submittals		X
078400	**FIRESTOPPING:**		
	Shop Drawings	X	
	Product Data	X	

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
	Qualifications	X	
	Quality Control Procedures		X
	Certifications		X
	Closeout Submittals		X
	Sustainability Submittals	X	X
079200	**JOINT SEALANTS:**		
	Product Data	X	
	Samples	X	
	Quality Control Procedures		X
	Certifications		X
	Sustainability Submittals	X	X
081113	**STANDARD HOLLOW METAL DOORS AND FRAMES:**		
	Shop Drawings	X	
	Product Data	X	
	Qualifications	X	
	Sustainability Submittals	X	X
081400	**WOOD DOORS:**		
	Shop Drawings	X	
	Product Data	X	
	Samples	X	
	Qualifications	X	
	Certifications		X
	Closeout Submittals		X

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
	Sustainability Submittals	X	X
081500	**FIBERGLASS-REINFORCED PLASTIC DOORS:**		
	Shop Drawings	X	
	Product Data	X	
	Samples	X	
	Sustainability Submittals	X	X
083100	**ACCESS DOORS AND PANELS:**		
	Product Data	X	
	Closeout Submittals		X
	Sustainability Submittals	X	X
084113	**ALUMINUM ENTRANCES AND STOREFRONTS:**		
	Shop Drawings	X	
	Product Data	X	
	Samples	X	
	Calculations	X	
	Qualifications		X
	Sustainability Submittals	X	X
	Closeout Submittals		X
084413	**GLAZED ALUMINUM CURTAINWALL:**		
	Shop Drawings	X	
	Product Data	X	
	Samples	X	
	Calculations	X	

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
	Qualifications	X	
	Quality Control Procedures		X
	Certifications		X
	Sustainability Submittals	X	X
	Closeout Submittals		X
087100	**DOOR HARDWARE:**		
	Product Data	X	
	Door Hardware Schedule	X	
	Shop Drawings	X	
	Proof of Certification		X
	Keying Schedule		X
	Product Test Reports		X
	Operating and Maintenance Manuals		X
088000	**GLAZING:**		
	Product Data	X	
	Samples	X	
	Qualifications	X	
	Quality Control Procedures		X
	Certifications		X
	Sustainability Submittals	X	X
	Closeout Submittals		X

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
088300	**MIRRORS:**		
	Product Data	X	
	Shop Drawings	X	
	Samples	X	
	Product Certificates		X
	Sustainability Submittals	X	X
	Closeout Submittals		X
089100	**LOUVERS:**		
	Shop Drawings	X	
	Product Data	X	
	Samples	X	
	Calculations	X	
	Certifications		X
	Sustainability Submittals	X	X
	Closeout Submittals		X
092116	**GYPSUM BOARD ASSEMBLIES:**		
	Product Data	X	
	Calculations	X	
	Certifications		X
	Sustainability Submittals	X	X
093013	**CERAMIC TILING:**		
	Product Data	X	
	Submittal Layout Drawings	X	

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
	Samples	X	
	Sustainability Submittals	X	X
	Closeout Submittals		X
095100	**ACOUSTICAL CEILINGS:**		
	Product Data	X	
	Samples	X	
	Sustainability Submittals	X	X
096519	**RESILIENT TILE FLOORING:**		
	Product Data	X	
	Samples	X	
	Certifications		X
	Sustainability Submittals	X	X
	Closeout Submittals		X
096543	**LINOLEUM FLOORING:**		
	Product Data	X	
	Sustainable Design Submittals	X	X
	Shop Drawings	X	
	Samples	X	
	Qualification Data		X
	Closeout Submittals		X
096813	**TILE CARPETING:**		
	Shop Drawings	X	
	Product Data	X	

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
	Samples	X	
	Sustainability Submittals	X	X
	Closeout Submittals		X
099100	**PAINTING:**		
	Product Data	X	
	Samples	X	
	Qualifications	X	
	Sustainability Submittals	X	X
099600	**HIGH-PERFORMANCE COATINGS:**		
	Product Data	X	
	Samples	X	
	Qualifications	X	
	Certifications		X
	Sustainability Submittals	X	X
101400	**EXTERIOR SIGNS:**		
	Shop Drawings	X	
	Samples	X	
	Closeout Submittals		X
101401	**INTERIOR SIGNS:**		
	Shop Drawings	X	
	Samples	X	
	Sustainability Submittals	X	X
	Closeout Submittals		X

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
102113	**COMPACT LAMINATE (SOLID PHENOLIC) TOILET COMPARTMENTS:**		
	Product Data	X	
	Shop Drawings	X	
	Samples for Verification	X	
	Product Schedule	X	
	Sustainability Submittals	X	X
	Product Certificates		X
	Maintenance Data		X
	Maintenance Material Submittals		X
102813	**TOILET ACCESSORIES:**		
	Product Data	X	
	Quality Control Procedures	X	
	Sustainability Submittals	X	X
104413	**FIRE EXTINGUISHERS AND CABINETS:**		
	Product Data	X	
	Samples	X	
	Certifications		X
	Sustainability Submittals	X	X
113113	**RESIDENTIAL KITCHEN APPLIANCES:**		
	Product Data	X	
122113	**HORIZONTAL LOUVER BLINDS:**		
	Samples	X	

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
124813	**ENTRANCE MATS AND FRAMES:**		
	Shop Drawings	X	
	Samples	X	
	Closeout Submittals		X
	Sustainability Submittals	X	X
129300	**SITE FURNISHING AND STRUCTURES:**		
	Manufacturer's Data & Shop Drawings	X	
	Fabrication Data, Shop Drawings and/or Catalogue Cuts	X	
	Color and Material Samples	X	
	Recommended Maintenance Manual		X
	Shop Drawings for All Custom Site Furnishings and Structures	X	
	Shop Drawing of Structural Details for Flagpole	X	
142400	**MACHINE ROOMLESS HOLESSS HYDRAULIC ELEVATORS:**		
	Product Data	X	
	Shop Drawings	X	
	Samples for Initial Selection	X	
	Samples for Verification	X	
	Qualification Data	X	
	Manufacturer Certificates		X
	Sample Warranty		X
	Operation and Maintenance Data		X

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
	Inspection and Acceptance Certificates and Operating Permits		X
	Continuing Maintenance Proposal		X
	Sustainability Submittals	X	X
210517	**SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING:**		
	Action Submittals:		
	Product Data	X	
210518	**ESCUTCHEONS FOR FIRE-SUPPRESSION PIPING:**		
	Action Submittals:		
	Product Data	X	
210523	**GENERAL-DUTY VALVES FOR WATER-BASED FIRE-SUPPRESSION PIPING:**		
	Action Submittals:		
	Product Data	X	
211100	**FACILITY FIRE-SUPPRESSION WATER-SERVICE PIPING:**		
	Action Submittals:		
	Product Data	X	
	Informational Submittals:		
	Field Quality-Control Reports		X
211313	**WET-PIPE SPRINKLER SYSTEMS:**		
	Action Submittals:		
	Product Data	X	

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
	Shop Drawings	X	
	Delegated-Design Submittal	X	
	Informational Submittals:		
	Qualification Data		X
	Approved Sprinkler Piping Drawings		X
	Welding Certificates		X
	Fire-Hydrant Flow Test Report		X
	Field Test Reports and Certificates		X
	Field Quality-Control Reports		X
	Closeout Submittals:		
	Operation and Maintenance Data		X
	Maintenance Material Submittals		X
211316	**DRY-PIPE SPRINKLER SYSTEMS:**		
	Action Submittals:		
	Product Data	X	
	Shop Drawings	X	
	Delegated-Design Submittal	X	
	Informational Submittals:		
	Qualification Data		X
	Approved Sprinkler Piping Drawings		X
	Fire-Hydrant Flow Test Report		X
	Field Test Reports and Certificates		X
	Field Quality-Control Reports		X

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
	Closeout Submittals:		
	Operation and Maintenance Data		X
	Maintenance Material Submittals		X
220517	**SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING:**		
	Action Submittals:		
	Product Data	X	
220518	**ESCUTCHEONS FOR PLUMBING PIPING:**		
	Action Submittals:		
	Product Data	X	
220519	**METERS AND GAGES FOR PLUMBING PIPING:**		
	Action Submittals:		
	Product Data	X	
	Informational Submittals:		
	Product Certificates		X
	Closeout Submittals:		
	Operation and Maintenance Data		X
220523	**GENERAL-DUTY VALVES FOR PLUMBING PIPING:**		
	Action Submittals:		
	Product Data	X	

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
220529	**HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT:**		
	Action Submittals:		
	Product Data	X	
	Shop Drawings	X	
	Delegated-Design Submittal	X	
	Informational Submittals:		
	Welding Certificates		X
220553	**IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT:**		
	Action Submittals:		
	Product Data	X	
	Samples	X	
	Equipment Label Schedule	X	
	Valve Numbering Scheme	X	
	Valve Schedules	X	
220716	**PLUMBING EQUIPMENT INSULATION:**		
	Action Submittals:		
	Product Data	X	
	LEED Submittals	X	X
	Shop Drawings	X	
	Samples	X	
	Informational Submittals:		
	Qualification Data		X
	Material Test Reports		X

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
	Field Quality-Control Reports		X
220719	**PLUMBING PIPING INSULATION:**		
	Action Submittals:		
	Product Data	X	
	LEED Submittals	X	X
	Shop Drawings	X	
	Informational Submittals:		
	Qualification Data		X
	Field Quality-Control Reports		X
220800	**COMMISSIONING OF PLUMBING SYSTEMS:**		
	General Construction Progress and Status Reports	X To CxA	
	Updated Architect, Owner, System Design Professional, and Contractor Deficiency Logs	X To CxA	
	Minutes from All Construction and Coordination Meetings Not Otherwise Conducted by the Commissioning Agent	X To CxA	
	Pre Start-Up and Start-Up Procedures	X To CxA	
	Value Engineering Proposals and a List of all Accepted VE Items	X To CxA	
	Pressure Test Reports, Flushing Reports and Start-Up Reports	X to CxA	
	Construction Document Changes Resulting from Plumbing Requests for Information	X To CxA	

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
	Hardware and Software Submittals	X To CxA	
	Control Panel Construction Shop Drawings	X To CxA	
	Narrative Description of Each Control Sequence for Each Piece of Equipment Controlled	X To CxA	
	Diagrams Showing All Control Points, Sensor Locations, Point Names, Actuators, Controllers and, Where Necessary, Points of Access, Superimposed On Diagrams of the Physical Equipment	X To CxA	
	Logic Diagrams Showing the Logic Flow of the System	X To CxA	
	List of All Control Points	X To CxA	
	Complete Control Language Program Listing and a Program Write-Up	X To CxA	
	Application Software and Project Applications Code Manuals	X To CxA	
	Operations and Maintenance Staff Comments on the BAS Graphics Submittal	X To CxA	
221113	**FACILITY WATER DISTRIBUTION PIPING:**		
	Action Submittals:		
	Product Data	X	
	Shop Drawings	X	
	Informational Submittals:		
	Coordination Drawings		X

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
	Field Quality-Control Reports		X
	Closeout Submittals:		
	Operation and Maintenance Data		X
221116	**DOMESTIC WATER PIPING:**		
	Action Submittals:		
	Product Data	X	
	LEED Submittals	X	X
	System Purging And Disinfecting Activities Report		X
	Field Quality-Control Reports		X
221119	**DOMESTIC WATER PIPING SPECIALTIES:**		
	Action Submittals:		
	Product Data	X	
	Shop Drawings	X	
	Informational Submittals:		
	Field Quality-Control Reports		X
	Closeout Submittals:		
	Operation and Maintenance Data		X
221123	**DOMESTIC WATER PUMPS:**		
	Action Submittals:		
	Product Data	X	
	LEED Submittals	X	X
	Closeout Submittals:		
	Operation and Maintenance Data		X

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
221313	**FACILITY SANITARY SEWERS:**		
	Action Submittals:		
	Product Data	X	
	Shop Drawings	X	
	Informational Submittals:		
	Coordination Drawings		X
	Product Certificates		X
	Field Quality-Control Reports		X
221316	**SANITARY WASTE AND VENT PIPING:**		
	Action Submittals:		
	Product Data	X	
	Informational Submittals:		
	Field Quality-Control Reports		X
221319	**SANITARY WASTE PIPING SPECIALTIES:**		
	Action Submittals:		
	Product Data	X	
	Shop Drawings	X	
	Informational Submittals:		
	Field Quality-Control Reports		X
	Closeout Submittals:		
	Operation and Maintenance Data		X

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
221319.13	**SANITARY DRAINS:**		
	Action Submittals:		
	Product Data	X	
221413	**FACILITY STORM DRAINAGE PIPING:**		
	Action Submittals:		
	Product Data	X	
	LEED Submittals	X	X
	Shop Drawings	X	
221423	**STORM DRAINAGE PIPING SPECIALTIES:**		
	Action Submittals:		
	Product Data	X	
221429	**SUMP PUMPS:**		
	Action Submittals:		
	Product Data	X	
	Wiring Diagrams	X	
	Closeout Submittals:		
	Operation and Maintenance Data		X
223300	**ELECTRIC, DOMESTIC-WATER HEATERS:**		
	Action Submittals:		
	Product Data	X	
	LEED Submittals	X	X
	Shop Drawings	X	

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
	Informational Submittals:		
	Product Certificates		X
	Source Quality-Control Reports		X
	Field Quality-Control Reports		X
	Warranty		X
	Closeout Submittals:		
	Operation and Maintenance Data		X
224213.13	**COMMERCIAL WATER CLOSETS:**		
	Action Submittals:		
	Product Data	X	
	LEED Submittals	X	X
	Shop Drawings	X	
	Closeout Submittals:		
	Operation and Maintenance Data		X
	Maintenance Material Submittals		X
224213.16	**COMMERCIAL URINALS:**		
	Action Submittals:		
	Product Data	X	
	LEED Submittals	X	X
	Shop Drawings	X	
	Closeout Submittals:		
	Operation and Maintenance Data		X
	Maintenance Material Submittals		X

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
224216.13	**COMMERCIAL LAVATORIES:**		
	Action Submittals:		
	Product Data	X	
	LEED Submittals	X	X
	Shop Drawings	X	
	Informational Submittals:		
	Coordination Drawings		X
	Closeout Submittals:		
	Operation and Maintenance Data		X
	Maintenance Material Submittals		X
224216.16	**COMMERCIAL SINKS:**		
	Action Submittals:		
	Product Data	X	
	LEED Submittals	X	X
	Informational Submittals:		
	Coordination Drawings		X
	Closeout Submittals:		
	Maintenance Data		X
	Maintenance Material Submittals		X
224713	**DRINKING FOUNTAINS:**		
	Action Submittals:		
	Product Data	X	
	LEED Submittals	X	X

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
	Closeout Submittals:		
	Maintenance Data		X
224723	**REMOTE WATER COOLERS:**		
	Action Submittals:		
	Product Data	X	
	LEED Submittals	X	X
	Shop Drawings	X	
	Closeout Submittals:		
	Maintenance Data		X
	Maintenance Material Submittals		X
230517	**SLEEVES AND SLEEVE SEALS FOR HVAC PIPING:**		
	Action Submittals:		
	Product Data	X	
230518	**ESCUTCHEONS FOR HVAC PIPING:**		
	Action Submittals:		
	Product Data	X	
230523	**GENERAL-DUTY VALVES FOR HVAC PIPING:**		
	Action Submittals:		
	Product Data	X	
230529	**HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT:**		
	Action Submittals:		
	Product Data	X	

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
	Shop Drawings	X	
	Informational Submittals:		
	Welding Certificates		X
230553	**IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT:**		
	Action Submittals:		
	Product Data	X	
	Samples	x	
	Equipment Label Schedule	X	
	Valve Numbering Scheme	X	
	Valve Schedules	X	
230593	**TESTING, ADJUSTING, AND BALANCING FOR HVAC:**		
	Action Submittals:		
	LEED Submittals	X	X
	Informational Submittals:		
	Qualification Data		X
	Contract Documents Examination Report		X
	System Readiness Checklists		X
	Examination Report		X
	Certified TAB Reports		X
	Sample Report Forms		X
	Instrument Calibration Reports		X

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
230713	**DUCT INSULATION:**		
	Action Submittals:		
	Product Data	X	
	LEED Submittals	X	X
	Shop Drawings	X	
	Informational Submittals:		
	Qualification Data		X
	Field Quality-Control Reports		X
230800	**COMMISSIONING OF MECHANICAL SYSTEMS:**		
	General Construction Progress and Status Reports	X To CxA	
	Updated Architect, Owner, System Design Professional, and Contractor Deficiency Logs	X To CxA	
	Minutes from All Construction and Coordination Meetings Not Otherwise Conducted by the Commissioning Agent	X To CxA	
	Pre Start-Up and Start-Up Procedures	X To CxA	
	Value Engineering Proposals and a List of all Accepted VE Items	X To CxA	
	Pressure Test Reports, Flushing Reports and Start-Up Reports	X to CxA	
	Construction Document Changes Resulting from Mechanical Requests for Information	X To CxA	
	Hardware and Software Submittals	X To CxA	

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
	Control Panel Construction Shop Drawings	X To CxA	
	Narrative Description of Each Control Sequence for Each Piece of Equipment Controlled	X To CxA	
	Diagrams Showing All Control Points, Sensor Locations, Point Names, Actuators, Controllers and, Where Necessary, Points of Access, Superimposed On Diagrams of the Physical Equipment	X To CxA	
	Logic Diagrams Showing the Logic Flow of the System	X To CxA	
	List of All Control Points	X To CxA	
	Complete Control Language Program Listing and a Program Write-Up	X To CxA	
	Hardware Operation and Maintenance Manuals	X To CxA	
	Application Software and Project Applications Code Manuals	X To CxA	
	Operations and Maintenance Staff Comments on the BAS Graphics Submittal	X To CxA	
230900	**INSTRUMENTATION AND CONTROL FOR HVAC:**		
	Action Submittals:		
	Product Data	X	
	Shop Drawings	X	
	Samples for Initial Selection	X	
	Samples for Verification	X	

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
	Informational Submittals:		
	Data Communications Protocol Certificates (ASHRAE 135)		X
	Data Communications Protocol Certificates (LonWorks)		X
	Qualification Data	X	
	Software Upgrade Kit		X
	Field Quality-Control Test Reports		X
	Closeout Submittals:		
	Operation and Maintenance Data		X
	Software and Firmware Operational Documentation		X
250800	**COMMISSIONING OF INTEGRATED AUTOMATION SYSTEMS:**		
	General Construction Progress and Status Reports	X To CxA	
	Updated Architect, Owner, System Design Professional, and Contractor Deficiency Logs	X To CxA	
	Minutes from All Construction and Coordination Meetings Not Otherwise Conducted by the Commissioning Agent	X To CxA	
	Pre Start-Up and Start-Up Procedures	X To CxA	
	Value Engineering Proposals and a List of all Accepted VE Items	X To CxA	
	Pressure Test Reports, Flushing Reports and Start-Up Reports	X to CxA	
	Construction Document Changes Resulting from Mechanical Requests for Information	X To CxA	

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
	Hardware and Software Submittals	X To CxA	
	Control Panel Construction Shop Drawings	X To CxA	
	Narrative Description of Each Control Sequence for Each Piece of Equipment Controlled	X To CxA	
	Diagrams Showing All Control Points, Sensor Locations, Point Names, Actuators, Controllers and, Where Necessary, Points of Access, Superimposed On Diagrams of the Physical Equipment	X To CxA	
	Logic Diagrams Showing the Logic Flow of the System	X To CxA	
	List of All Control Points	X To CxA	
	Complete Control Language Program Listing and a Program Write-Up	X To CxA	
	Application Software and Project Applications Code Manuals	X To CxA	
	Operations and Maintenance Staff Comments on the BAS Graphics Submittal	X To CxA	
232300	**REFRIGERANT PIPING:**		
	Action Submittals:		
	Product Data	X	
	Shop Drawings	X	
	Closeout Submittals:		
	Operation and Maintenance Data		X

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
233113	**METAL DUCTS:**		
	Action Submittals:		
	Product Data	X	
	LEED Submittals	X	X
	Shop Drawings	X	
	Delegated-Design Submittal	X	
	Informational Submittals:		
	Coordination Drawings		X
	Field Quality-Control Reports		X
233300	**AIR DUCT ACCESSORIES:**		
	Action Submittals:		
	Product Data	X	
	LEED Submittals	X	X
	Shop Drawings	X	
	Informational Submittals:		
	Coordination Drawings		X
	Closeout Submittals:		
	Operation and Maintenance Data		X
233423	**HVAC POWER VENTILATORS:**		
	Action Submittals:		
	Product Data	X	
	Shop Drawings	X	
	Informational Submittals:		
	Coordination Drawings		X

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
	Field Quality-Control Reports		X
	Closeout Submittals:		
	Operation and Maintenance Data		X
233713	**DIFFUSERS, REGISTERS, AND GRILLES:**		
	Action Submittals:		
	Product Data	X	
234100	**PARTICULATE AIR FILTRATION:**		
	Action Submittals:		
	Product Data	X	
	LEED Submittals	X	X
	Shop Drawings	X	
	Informational Submittals:		
	Field Quality-Control Reports		X
	Closeout Submittals:		
	Operation and Maintenance Data		X
	Maintenance Material Submittals		X
236200	**PACKAGED COMPRESSOR AND CONDENSER UNITS:**		
	Action Submittals:		
	Product Data	X	
	LEED Submittals	X	X
	Shop Drawings	X	
	Informational Submittals:		
	Coordination Drawings		X

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
	Field Quality-Control Reports		X
	Warranty		X
	Closeout Submittals:		
	Operation and Maintenance Data		X
236313	**AIR-COOLED REFRIGERANT CONDENSERS:**		
	Action Submittals:		
	Product Data	X	
	LEED Submittals	X	X
	Shop Drawings	X	
	Delegated-Design Submittal	X	
	Informational Submittals:		
	Coordination Drawings		X
	Field Quality-Control Reports		X
	Closeout Submittals:		
	Operation and Maintenance Data		X
237433	**DEDICATED OUTDOOR-AIR UNITS:**		
	Action Submittals:		
	Product Data	X	
	LEED Submittals	X	X
	Shop Drawings	X	
	Informational Submittals:		
	Coordination Drawings		X
	Startup Service Reports		X

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
	Sample Warranty		X
	Closeout Submittals:		
	Operation and Maintenance Data		X
	Maintenance Material Submittals		X
238219	**FAN COIL UNITS:**		
	Action Submittals:		
	Product Data	X	
	LEED Submittals	X	X
	Shop Drawings	X	
	Warranty		X
	Closeout Submittals:		
	Operation and Maintenance Data		X
	Maintenance Material Submittals		X
238239	**UNIT HEATERS:**		
	Action Submittals:		
	Product Data	X	
	LEED Submittals	X	X
	Shop Drawings	X	
	Closeout Submittals:		
	Operation and Maintenance Data		X
260519	**LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES:**		
	Action Submittals:		
	Product Data	X	

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
	Sustainable Design Submittals	X	X
	Product Schedule	X	
	Informational Submittals:		
	Qualification Data	X	
	Field Quality-Control Reports		X
260526	**GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS:**		
	Action Submittals:		
	Product Data	X	
	Sustainable Design Submittals	X	X
	Informational Submittals:		
	Coordination Drawings		X
	Qualification Data	X	
	Field Quality-Control Reports		X
	Closeout Submittals:		
	Operation and Maintenance Data		X
260529	**HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS:**		
	Action Submittals:		
	Product Data	X	
	Shop Drawings	X	
	Delegated-Design Submittal	X	
	Informational Submittals:		
	Coordination Drawings		X
	Welding Certificates		X

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
260533	**RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS:**		
	Action Submittals:		
	Product Data	X	
	Shop Drawings	X	
	Informational Submittals:		
	Coordination Drawings		X
260543	**UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS:**		
	Action Submittals:		
	Product Data	X	
	Shop Drawings	X	
	Informational Submittals:		
	Duct-Bank Coordination Drawings		X
	Product Certificates		X
	Qualification Data	X	
	Source Quality-Control Reports		X
	Field Quality-Control Reports		X
	Maintenance Material Submittals		X
260544	**SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING:**		
	Action Submittals:		
	Product Data	X	

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
260553	**IDENTIFICATION FOR ELECTRICAL SYSTEMS:**		
	Action Submittals:		
	Product Data	X	
	Identification Schedule	X	
	Delegated-Design Submittal	X	
260572	**OVERCURRENT PROTECTIVE DEVICE SHORT-CIRCUIT STUDY:**		
	Action Submittals:		
	Product Data	X	
	Short-Circuit Study Input Data	X	
	Short-Circuit Study and Equipment Evaluation Report	X	
	Informational Submittals:		
	Qualification Data	X	
	Product Certificates		X
260573	**OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY:**		
	Action Submittals:		
	Product Data	X	
	Coordination-Study Input Data	X	
	Study and Equipment Evaluation Reports	X	
	Overcurrent Protective Device Coordination Study Report	X	
	Informational Submittals:		
	Qualification Data	X	

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
	Product Certificates		X
	Closeout Submittals:		
	Operation and Maintenance Data		X
260574	**OVERCURRENT PROTECTIVE DEVICE ARC-FLASH STUDY:**		
	Action Submittals:		
	Product Data	X	
	Arc-Flash Study Input Data	X	
	Arc-Flash Study Report	X	
	Informational Submittals:		
	Qualification Data	X	
	Product Certificates		X
	Closeout Submittals:		
	Operation and Maintenance Data		X
260800	**COMMISSIONING OF ELECTRICAL SYSTEMS:**		
	General Construction Progress and Status Reports	X To CxA	
	Updated Architect, Owner, System Design Professional, and Contractor Deficiency Logs	X To CxA	
	Minutes from All Construction and Coordination Meetings Not Otherwise Conducted by the Commissioning Agent	X To CxA	
	Pre Start-Up and Start-Up Procedures	X To CxA	
	Value Engineering Proposals and a List of all Accepted VE Items	X To CxA	

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
	Coordination Studies, Manufacture Inspection Reports, Authority Having Jurisdiction Inspection Reports, etc.	X To CxA	
	Construction Document Changes Resulting from Electrical Requests for Information	X To CxA	
260913	**ELECTRICAL POWER MONITORING AND CONTROL:**		
	Product Data	X	
	Drawings, Documentation, Operation and Maintenance (O&M) Manuals		X
260923	**LIGHTING CONTROL DEVICES:**		
	Action Submittals:		
	Product Data	X	
	Shop Drawings	X	
	Informational Submittals:		
	Field Quality-Control Reports		X
	Closeout Submittals:		
	Operation and Maintenance Data		X
260936	**MODULAR DIMMING CONTROLS:**		
	Action Submittals:		
	Product Data	X	
	Samples for Verification	X	
262416	**PANELBOARDS:**		
	Action Submittals:		
	Product Data	X	
	Shop Drawings	X	

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
	Informational Submittals:		
	Qualification Data	X	
	Panelboard Schedules	X	
	Closeout Submittals:		
	Operation and Maintenance Data		X
	Maintenance Material Submittals		X
262713	**ELECTRICITY METERING:**		
	Action Submittals:		
	Product Data	X	
	Shop Drawings	X	
	Informational Submittals:		
	Coordination Drawings	X	
	Qualification Data	X	
	Field Quality-Control Reports		X
	Sample Warranty		X
	Closeout Submittals:		
	Operation and Maintenance Data		X
262726	**WIRING DEVICES:**		
	Action Submittals:		
	Product Data	X	
	Shop Drawings	X	
	Samples	X	
	Informational Submittals:		
	Field Quality-Control Reports		X

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
	Closeout Submittals:		
	Operation and Maintenance Data		X
262813	**FUSES:**		
	Action Submittals:		
	Product Data	X	
	Closeout Submittals:		
	Operation and Maintenance Data		X
	Maintenance Material Submittals		X
262816	**ENCLOSED SWITCHES AND CIRCUIT BREAKERS:**		
	Action Submittals:		
	Product Data	X	
	Shop Drawings	X	
	Informational Submittals:		
	Qualification Data	X	
	Field Quality-Control Reports		X
	Manufacturer's Field Service Report		X
	Closeout Submittals:		
	Operation and Maintenance Data		X
	Maintenance Material Submittals		X
265119	**LED INTERIOR LIGHTING:**		
	Action Submittals:		
	Product Data	X	
	Shop Drawings	X	

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
	LEED Submittals	X	X
	Samples	X	
	Product Schedule	X	
	Informational Submittals:		
	Coordination Drawings	X	
	Qualification Data	X	
	Detailed Description of Equipment Anchorage Devices	X	
	Product Certificates		X
	Product Test Reports		X
	Sample Warranty		X
	Closeout Submittals:		
	Operation and Maintenance Data		X
265219	**EMERGENCY AND EXIT LIGHTING:**		
	Action Submittals:		
	Product Data	X	
	Shop Drawings	X	
	Sustainable Design Submittals	X	X
	Samples	X	
	Product Schedule	X	
	Informational Submittals:		
	Coordination Drawings	X	
	Qualification Data	X	
	Product Certificates		

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
	Product Test Reports		
	Sample Warranty		
	Closeout Submittals:		
	Operation and Maintenance Data		X
265613	**LIGHTING POLES AND STANDARDS:**		
	Action Submittals:		
	Product Data	X	
	LEED Submittals	X	X
	Shop Drawings		
	Informational Submittals:		
	Pole and Support Component Certificates		X
	Material Test Reports		X
	Source Quality-Control Reports		X
	Field Quality-Control Reports		X
	Sample Warranty		X
	Soil Test Reports		X
	Closeout Submittals:		
	Operation and Maintenance Data		X
	Maintenance Material Submittals		X
265619	**EXTERIOR LIGHTING:**		
	Action Submittals:		
	Product Data	X	
	LEED Submittals	X	X

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
	Samples	X	
	Product Schedule	X	
	Delegated-Design Submittal for Luminaire Supports	X	
	Informational Submittals:		
	Coordination Drawings	X	
	Qualification Data	X	
	Product Certificates		X
	Product Test Reports		X
	Source Quality-Control Reports		X
	Sample Warranty		X
	Closeout Submittals:		
	Operation and Maintenance Data		X
	Maintenance Material Submittals		X
270000	**COMMUNICATIONS:**		
	Product Data	X	
270526	**GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS:**		
	Product Data	X	
	Ground Terminal Block Schedule	X	
	Test Results		X
	Project Record Documents		X
270529	**HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS:**		
	Product Data	X	

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
	Manufacturer's Installation Instructions	X	
	Manufacturer's Certificate		X
	Engineering Judgments		X
	Project Record Documents		X
270533	**CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS:**		
	Product Data	X	
	Manufacturer's Installation Instructions	X	
	Project Record Documents		X
270536	**CABLE TRAY FOR COMMUNICATIONS SYSTEMS:**		
	Shop Drawings	X	
	Product Data	X	
	Manufacturer's Installation Instructions	X	
	Project Record Documents		X
270553	**IDENTIFICATION FOR COMMUNICATIONS SYSTEMS:**		
	Within 30 Days After Award of Contract:		
	Communications Identification Plan	X	
	Samples of Label Materials, Finished Labels and Nameplates	X	
	Project Record Documents		X
270800	**COMMISSIONING OF COMMUNICATIONS:**		
	Calibration Certification of Test Equipment		X
	Product Data	X	

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
	Calibration Certificates for Review Prior to the Start of Testing		X
	Test Documentation in Specifications		X
271116	**COMMUNICATIONS CABINETS, RACKS, FRAMES AND ENCLOSURES:**		
	Within 30 Days After Award of Contract:		
	Communications Room Material Lists	X	
	Single-Line Shop Drawings	X	
	Closeout Submittals		X
271119	**COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS:**		
	Product Data	X	
	As-Built Records		X
271519	**DATA COMMUNICATIONS HORIZONTAL CABLING:**		
	Shop Drawings	X	
	Product Data	X	
	Manufacturer's Installation Instructions	X	
	Project Record Documents		X
271543	**COMMUNICATIONS FACEPLATES AND CONNECTORS:**		
	Product Data	X	
275116	**PUBLIC ADDRESS SYSTEMS:**		
	Product Data	X	
	Manufacturer's Installation Instructions	X	
	Test Reports		X

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
	Manufacturer's Certificate		X
	Manufacturer's Field Reports		X
	Manufacturer’s Statement of Warranty		X
	Project Record Documents		X
	Operation and Maintenance Data		X
280513	**CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY:**		
	Action Submittals:		
	Product Data	X	
	Shop Drawings	X	
	Informational Submittals:		
	Qualification Data	X	
	Source Quality-Control Reports		X
	Field Quality-Control Reports		X
281300	**ACCESS CONTROL:**		
	Product Data	X	
282300	**VIDEO SURVEILLANCE:**		
	Action Submittals:		
	Product Data	X	
	Equipment List	X	
	Informational Submittals:		
	Field Quality-Control Reports		X
	Warranty		X

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
	Closeout Submittals:		
	Operation and Maintenance Data		X
283111	**DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM:**		
	Action Submittals:		
	Product Data	X	
	Shop Drawings	X	
	Informational Submittals:		
	Qualification Data	X	
	Field Quality-Control Reports		X
	Sample Warranty		X
	Closeout Submittals:		
	Operation and Maintenance Data		X
	Maintenance Material Submittals		X
312000	**EARTH MOVING:**		
	Resumes	X	
	Soil Samples	X	
321216	**ASPHALT PAVING:**		
	Data and Test Reports		X
	Certifications		X
	State Highway Department Specifications		X
	MSDS (Material Safety Data Sheets) for All Chemicals Used on Ground		X

SPEC. SECTION NO.	SPEC. SECTION TITLE/ DESCRIPTION OF SUBMITTAL	SUBMIT TO DP FOR REVIEW	SUBMIT TO OWNER FOR RECORD
321313	**CONCRETE FOR EXTERIOR IMPROVEMENTS:**		
	Manufacturers' Certificates and Data		X
	Data and Test Reports		X
321416	**BRICK PAVERS, MORTAR BED:**		
	Shop Drawings	X	
	Samples	X	
321723	**PAVEMENT MARKINGS:**		
	Manufacturer's Certificates and Data		X
329000	**PLANTING:**		
	Product Data	X	
	Samples and Manufacturer’s Literature	X	
	Qualification Data	X	
	Notarized Certificates	X	X
	Material Test Reports		X
	Maintenance Instructions		X
331000	**WATER UTILITIES:**		
	Manufacturers' Literature and Data	X	
	Testing Certifications		X
333000	**SANITARY SEWERAGE UTILITIES:**		
	Manufacturers' Literature and Data	X	
334000	**STORM SEWER UTILITIES:**		
	Manufacturers' Literature and Data	X	

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Requirements for protection, both on and off Project Site, of atmosphere, waterways, groundwater, plants, animal habitats, soils and similar conditions due to Work.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Building Demolition: Division 02.

1.3 Definitions

A. Sediment: Soil that has been eroded and transported by runoff water.

B. Degradable Debris: Debris which can undergo biodegradation or combustion, or which can be dissolved in or suspended by water.

C. Nondegradable Debris: Inorganic debris which will not disintegrate nor dissolve when exposed to moisture or water.

D. Chemicals: Petroleum or cementitous products, bituminous materials, salts, acids, alkalies, herbicides and pesticides.

E. Waste: Sewage, including domestic sanitary sewage, garbage and trash.

1.4 Quality Assurance

A. Regulatory Agencies and Codes: Comply with the following in accordance with Division 01.

1. United States Department of Agriculture (USDA)
    a. Urban Hydrology for Small Watersheds, Technical Release No. 55, Engineering Division, Soil Conservation Service
    b. National Engineering Handbooks, Section 4 (Hydrology); Section 5 (Hydraulics); Section 16 (Drainage), Soil Conservation Service
2. County Conservation District (local Soil Conservation Service), Handbook for Sedimentation and Erosion Control Measures

Part 2 Products

2.1 Silt Fences

A. 3 foot wide fabric, as manufactured by Mirafi, Inc., Amoco or Exxon, and as approved by local Soil Conservation Service (SCS).

2.2 Earth Stabilizer

A. Rye grass seed, hay, straw mulch, chemical stabilizer, or other devices approved by Environmental Protection Agency Having Jurisdiction and by Design Professional.

2.3 Rip-Rap

A. Size(s) and location(s) as indicated.

2.4 Geotextile Filter Fabric

A. Type as indicated.

Part 3 Execution

3.1 General

A. Establish and enforce ecological preservation measures which, for example, will avoid pollution of atmosphere, waterways, groundwater, plants, soils, animal habitats, landfills, wetlands, Project Site, adjacent Sites and Roadways.

B. Prevent spilling of chemicals or waste. Develop and comply with emergency plans and methods for abatement of accidental spills of toxic substances.

C. Comply with supplemental requirements on Documents.

3.2 Sediment Control

A. As temporary measure, provide silt fences, arranged along toe of surface drainage ways and inlets, in such manner that water will pass through silt fences and filter out sediment. Embed silt fence in ground 6 inches deep and anchor to ground with posts, as indicated. Silt fence is not to be placed at locations of concentrated flow of runoff. See alternate design as indicated. Replace silt fences when they become clogged and ineffective. Lines of silt fences indicated do not constitute quantity of fences nor exact locations. Quantity and position of silt fence shall be adequate to filter sediment.

B. During pipe laying work, prevent silt from entering piping systems by use of silt fence, temporary closures of pipe ends, or other means as best suited to conditions.

C. During pipe laying work, prevent silt from entering piping systems by use of silt fence, temporary closures of pipe ends, or other means as best suited to conditions.

3.3 Controls During Earth Moving

A. Perform earth moving in phases to minimize area and extent of exposed land.

B. Control rate of water runoff by diversion ditches, benches, berms, and other earth-formed shaping so that rate of flow is retarded and silting shall be minimized. Reshape and restore conditions showing evidence of earth erosion.

C. Stabilize disturbed earth with temporary seeding, temporary mulching, or other approved means.

3.4 Dust Control

A. Keep dust down at all times, including nonworking days, weekends, and holidays. Wet down or treat disturbed soil with dust suppressers as required and approved.

B. Do not leave areas of disturbed earth unworked for long periods of time. Provide temporary or permanent earth stabilization promptly.

3.5 Noise Control

A. Provide mufflers on internal combustion engine equipment. Maximum noise level shall be 90 dbA at 50 feet

B. Where blasting is permitted, special permit and other requirements of governing authorities regarding blasting shall govern.

C. Limit hours of operation of noisy construction from as per Raleigh Zoning Ordinance.

3.6 Disposal Of Debris, Chemicals And Waste

A. Dispose of debris, chemicals, and waste off Project Site in compliance with federal, state, and local laws and regulations.

B. Collect and contain materials before disposal in orderly fashion and by means which prevent contamination of air, water and soil.

C. Store chemicals in watertight containers.

D. Do not burn materials on Project Site.

E. Debris shall be removed from Project Site on a daily basis or at any time as directed by Owner's Representative.

F. Debris shall be segregated and shall be transported to an approved debris facility for disposal.

G. Containers for debris shall be changed out when filled or as requested by Owner's Representative.

H. Clean-up debris left by Contractor personnel on a daily basis.

3.7 Trucks

A. Dump trucks shall be tarpaulin-covered so that spillage does not occur.

B. Provide a truck wheel-washing area. Clean truck wheels of mud and debris before they leave Project Site. Provide a gravel-surfaced area at construction entrance for this purpose.

3.8 Snow And Ice

A. Remove snow and ice in and about premises periodically in compliance with local regulations, as required to perform Work and as directed by Owner's Representative.

3.9 Maintenance And Termination

A. Maintain in working order environmental protection measures until they are no longer required.

B. Terminate environmental control measures when there is no longer threat of pollution. Remove temporary control measures. Complete or, if required, restore permanent construction that may have been delayed or damaged because of interference with environmental controls.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Requirements regarding codes, regulations and standards included in Contract Documents by reference.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Contract Conditions: Bidding and Contract Requirements.

C. General Conditions: Bidding and Contract Requirements.

D. All technical Sections.

1.3 Applicable Codes, Regulations And Standards

A. Comply with the following in accordance with Division 01.

1. The following codes, regulations and standards including, but not limited to those indicated, are applicable to the Work.
    a. Building Code:
        1) North Carolina State Building Code, 2012 Edition, and
    b. Fire Prevention Code:
        1) North Carolina State Building Code, Fire Prevention Code 2012 Edition.
    c. Electrical Code:
        1) 2013 NEC with 2014 North Carolina Amendments
    d. Mechanical Code:
        1) North Carolina State Building Code, Mechanical Code 2012 Edition
    e. Plumbing Code:
        1) North Carolina State Building Code, Plumbing 2012 Edition
    f. Fuel Gas Code:
        1) North Carolina State Building Code, Fuel Gas Code 2012 Edition
    g. Energy Code:
        1) North Carolina State Building Code, Energy Code 2012 Edition

h. Accessibility Code:

1) North Carolina State Building Code, Building Code 2012 Edition

i. Boiler Code:

1) Uniform Boiler and Pressure Vessel Act of North Carolina

j. Code of Federal Regulations (CFR) Title 40:

1) Protection of Environment

k. The Americans with Disabilities Act Accessibility Guidelines (ADAAG), 2010 Standards

l. Code of Federal Regulations (CFR) Title 29, Part 1910:

1) Labor/Occupational Safety and Health Administration (OSHA) “Occupational Safety and Health Standards”

B. The following is a list of some but not all of the NFPA Standards which may be applicable to this project:

1. NFPA 10 Portable Fire Extinguishers, 2002
2. NFPA 13 Automatic Sprinkler System, 2002
3. NFPA 14 Installation of Standpipe and Hose Systems, 2003
4. NFPA 25 Water Based Fire Protection Systems, 2002
5. NFPA 54 International Fuel Gas Code, 2009
6. NFPA 70 National Electric Code, 2002
7. NFPA 72 National Fire Alarm Code, 2007
8. NFPA 80 Fire Doors and Windows, 1999
9. NFPA 90A Installation of Air Conditioning and Ventilating Systems, 2012
10. NFPA 90B Installation of Warm Air Heating and Air Conditioning Systems, 2012
11. NFPA 101 Code for Safety to Life from Fire in Buildings and Structures, 2006
12. NFPA 110 Emergency and Standby Power Systems, 2005
13. NFPA 241 Construction, Alteration and Demolition Operations, 2000
14. NFPA 780 Standard for the Installation of Lightning Protection Systems, 2008

C. The following is a partial list of other standards which may be applicable to this project:

1. American Architectural Manufacturers’ Association (AAMA)

AAMA 501	Methods of Test for Exterior Walls
AAMA 1503	Voluntary Test Method for Thermal Resistance and Condensation Resistance of Windows, Doors and Glazed Wall Sections

2. American Concrete Institute (ACI)

ACI 318	Building Code Requirements for Structural Concrete
ACI 530	Building Code Requirement for Masonry Structures

3. Industrial Ventilation Manual (24th Edition, 2001).

4. American Society of Civil Engineers (ASCE)

ASCE 5	Building Code Requirements for Masonry Structures
ASCE 7	Minimum Design Loads for Buildings and Other Structures

5. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

Fundamental Handbook – 2013

HVAC Applications Handbook – 2011

Refrigeration Handbook – 2010

HVAC Systems and Equipment Handbook – 2012

Guideline 1.1 – 2007 “The HVAC Commissioning Process”

6. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)/American National Standards Institute (ANSI).

ANSI/ASHRAE 15-2010	Safety Code for Mechanical Refrigeration.
ANSI/ASHRAE 55-2010	Thermal Environmental Conditions for Human Occupancy.
ANSI/ASHRAE 62-2010	Ventilation for Acceptable Indoor Air Quality.
ANSI/ASHRAE 90.1-2007	Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings

7. American Society of Mechanical Engineers (ASME)/American National Standards Institute (ANSI)

ANSI/ASME A17.1	Safety Code for Elevators and Escalators – 2000
ANSI/ASME B31.9	Building Services Piping, 2011

8. American Society for Testing and Materials (ASTM)

ASTM A36	Specification for Carbon Structural Steel
ASTM A53	Standard Specification for Pipe, Steel, Black and Hot-dipped, Zinc-coated, Welded and Seamless
ASTM A185	Specification for Steel Welded Fabric, Plain for Concrete Reinforcement
ASTM A500	Standard Specification for Cold-formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A653	Specification for Steel Sheet, Zinc-coated or Zinc-coated by the Hot-dip Process
ASTM A992	Standard Specification for Steel for Structural Shapes for Use in Building Framing

ASTM E283	Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E331	Standard Test Method for Water Penetration of Exterior Walls, Doors by Uniform Static Air Pressure Difference
ASTM E1155	Standard Test Method for Determining Floor Flatness and Floor Levelness Numbers

9. Brick Institute of America (BIA)

   Technical Notes of Brick Construction

10. Builders Hardware Manufacturers' Association (BHMA) / American National Standards Institute (ANSI)

ANSI/BHMA A156	Builders Hardware Standards

11. Electronics Industry Association (EIA) / Telecommunications Industry Association (TIA)/ American National Standards Institute (ANSI)

ANSI/EIA/TIA – 568A	Commercial Building Telecommunications Cabling Standard
ANSI/EIA/TIA – 569A	Commercial Building Standard for Telecommunications Pathways and Spaces
ANSI/EIA/TIA – 606A	Administration Standard for Telecommunications Infrastructures of Commercial Buildings
ANSI/EIA/TIA – 607	Commercial Building and Bonding Requirements for Telecommunications

12. Illuminating Engineering Society (IES)

    Lighting Handbook, Ninth Edition

13. National Electrical Manufacturers' Association (NEMA)

NEMA 250	Enclosures for Electrical Equipment

14. Sealant, Waterproofing and Restoration Institute (SWRI)

    Below Grade Waterproofing Manual

    Sealants: The Professional Guide

15. Sheet Metal and Air Conditioning Contractors National Association (SMACNA)

    Guide for Steel Stack Design and Construction (1996)

    HVAC Duct Construction Standards – Metal and Flexible (2006)

    HVAC Air Duct Leakage Test Manual, 2nd Edition (2012)

    Architectural Sheet Metal Manual

16. Single Ply Roofing Institute (SPRI)

ES-1 Wind Design Standard for Edge Systems Used With Low Slope Roofing Systems

D. For products or workmanship specified by association, trade, or Federal Standards, comply with requirements of standard, except when more rigid requirements are specified or are required by applicable codes or intended use.

E. Referenced standards shall have same force and effect as if bound or copied directly into Contract Documents to extent referenced. Such standards are made a part of Contract Documents by reference.

F. Should indicated reference standards conflict with Contract Documents, request clarification from Design Professional before proceeding. Most stringent requirement shall apply.

G. In absence of express instructions in Specifications, materials, products, equipment, and their installation shall conform to applicable codes, regulations and standards indicated.

H. Contractual relationship of parties to Contract shall not be altered from Contract Documents by mention or inference otherwise in any referenced document.

I. Dates of reference standards:

1. Standards referenced in the applicable building codes and regulations having jurisdiction: Version of standard recognized by code or regulation.

2. Standards included but not referenced in applicable codes and regulations: Version published 180 calendar days prior to date of issue of Contract Documents.

1.4 Associations, Institutions And Societies

A. Associations, Institutions, and Societies and their abbreviations, shall be as generally recognized in industry. Refer to “Encyclopedia of Associations” published by Gale Research Company for unlisted abbreviations, addresses and phone numbers. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

Part 2 Products

Not used.

Part 3 Execution

Not used.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Definitions of terms used in Contract Documents and explanation of documentation standards for format, usage and language interpretation.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Drawings and General Provisions of the Contract, including Contract Conditions apply to this Section.

C. Methods and Means Engineering: Division 01.

D. Material and Equipment: Division 01.

1.3 Complementary Drawings

A. Drawings with notes and Specifications, including schedules and bound-in Drawings, shall be interpreted as a whole, each part complementary to the other. Cross-referencing between information is implied by similar naming, graphics and by direct notation. Absence of a direct cross-reference or notation does not relieve Contractor of any requirements that may reasonably be interpreted from particular information. Refer to Article, Overlapping Or Conflicting Requirements of this Section for overlapping or conflicting requirements.

1.4 Definitions

A. Indicated: Term “indicated” refers to graphic representations, notes or schedules on Drawings, other Paragraphs or Schedules in Specifications, and similar requirements in Contract Documents. Terms such as indicated, noted, scheduled, and specified are used to help reader locate reference. There is no limitation on location.

B. Directed: Terms such as “directed”, “requested”, “authorized”, “selected”, “approved”, “required”, and “permitted” mean directed by Design Professional, requested by Design Professional, and similar phrases.

C. Approved: Term “approved” refers to Design Professional’s action on Contractor’s submittals.

D. Regulations: Term “regulations” includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of Work.

E. Typical: Where term “typical” is used to describe, for example, an assembly, system, material and detail, incorporate indicated element into all other situations with matching or similar conditions, even if not cross-referenced back to original location.

F. Remove: Term “remove” shall mean, for example, remove construction elements, materials, products or system complete including all anchors, hangers, supports and accessories from construction. Upon removal, all materials become property of Contractor, unless otherwise indicated. Dispose of all removed materials legally off Project Site.

G. Replace: Term “replace” in Contract Documents shall be interpreted as “restore”, “renew”, “make good”, “reconstruct, using new materials”, as applicable to type of Work requiring replacement.

H. Salvage: Term “salvage” shall mean to carefully remove without damage construction elements, materials, products, or system complete and deliver to Owner or save for re-use indicated. Remove, for example, anchors, hangers and supports remaining after salvage. If plumbing, mechanical, electrical or other similar connections were disconnected from salvaged item, then remove system feeder back to main line or panel box, and cap.

I. Furnish: Term “furnish” means supply and deliver to Project Site, ready for unloading, unpacking, assembly, installation, and similar operations.

J. Install: Term “install” describes operations at Project Site, including actual unloading, unpacking, assembly, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

K. Provide: Term “provide” means to furnish and install, complete and ready for intended use.

L. Installer: An “Installer” is Contractor or other entity engaged by Contractor, either as an employee, Subcontractor, or Contractor of lower tier, to perform a particular construction activity, including installation, erection, application, and similar operations. Installers are required to be experienced in operations they are engaged to perform.

1. Term “experienced”, when used with term “Installer”, unless otherwise indicated, means having a minimum of five (5) previous projects similar in size and scope to this Project, being familiar with special requirements indicated, and having complied with requirements of authority having jurisdiction.

2. Within Contract Documents, term “trade” shall mean workers or mechanics having special skills, or firms that hire them, as applicable.

3. Trades: Using terms such as “carpentry” is not intended to imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as carpenter. It also does not imply that requirements specified apply exclusively to tradespersons of corresponding generic name.

4. Requirements for installers shall not be interpreted to conflict with enforcing building codes and similar regulations governing Work. It is also not intended to interfere with local trade union jurisdictional settlements and similar conventions.

M. Project Site: Project Site is space available to Contractor for performing construction activities either exclusively or in conjunction with others performing other Work as part of Project. Extent of Project Site is indicated and may or may not be identical with description of land on which Project is to be built.

N. Inspection and Testing Agency: An Inspection and Testing Agency is an independent entity engaged to perform specific inspections or tests, either at Project Site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.

O. Products, Materials, Equipment: Refer to Material and Equipment: Division 01.

P. Contractor’s Option: A written provision where indicated in Contract Documents giving Contractor the option of selecting certain specified materials, methods or systems without change in Contract Sum or Contract Time.

Q. Non-Inclusive: Lists following a heading of “non-inclusive” give examples by may not include every occurrence affected under the heading. “Non-inclusive” shall be interpreted as “including but not limited to:”.

1.5 Specifications Format And Content

A. Specification Format: These Specifications are organized into Divisions and Sections based on Construction Specifications Institute’s (CSI) 48 Division format and MASTERFORMAT numbering system.

B. Specification Content: These Specifications use certain conventions regarding style of language and intended meaning of certain terms, words, and phrases when used in particular situations or circumstances. These conventions are explained as follows:

1. Abbreviated Language: Language used in Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words that are implied, but not stated, shall be interpolated as sense requires. Singular words shall be interpreted as plural and plural words interpreted as singular where applicable as context of Contract Documents indicates.

a. Where omission of such words as “the Contractor”, “shall”, “a”, “an”, “and”, “the”, “all”, and the like are omitted, sentence structure shall be considered to include such words to effect that Specifications are directional in describing Work to be provided by Contractor.
b. Within Contract Documents, singular and plural references shall mean one (1) or more like items of Work as necessary to complete Work, unless otherwise indicated or directed.
c. Term “any” in Contract Documents shall be interpreted as “any and all” whenever more than one (1) item would be applicable for completion of Work; for example, “any other general expenses”.
d. Term “and” in Contract Documents shall be interpreted inclusively as “and/or” whenever only one (1) item would be applicable for completion of Work.
e. Term “or” in Contract Documents shall be interpreted inclusively as “and/or” whenever more than one (1) item would be applicable for completion of Work.

2. Imperative and streamlined language is generally used in Specifications. Requirements expressed in imperative mood are to be performed by Contractor. At certain locations in text, subjective language is used for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by Others when so indicated.

3. Where term “Contractor” is modified in any way, such as, “this Contractor”, “Plumbing Contractor”, “Electrical Contractor”, modified term shall be deemed to refer to Trade Contractor or Subcontractor involved with Work mentioned, but such meaning does not relieve Contractor from his responsibility for all Work, whether or not such Work is sublet.

4. Examples are listed after terms “the following”, “such as”, “for example” and “including” for Contractor’s convenience. Contents of example list are not inclusive of every possible example, and exclusion from example list does not relieve Contractor from his responsibility for all Work. Terms such as “without limit”, “but not limited to” and “non-inclusive” are included at some points but do not mean that examples listed without presence of these terms are all inclusive.

5. Abbreviations are listed on Drawings. Unlisted abbreviations shall be interpreted by Design Professional.

1.6 Overlapping Or Conflicting Requirements

A. Overlapping or conflicting requirements shall be described in writing and submitted to Design Professional for determination but, generally, more restrictive requirement shall apply. Contractor shall submit written descriptions of overlaps or conflicts as soon as they are uncovered.

Part 2 Products

Not used.

Part 3 Execution

Not used.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Contractual and procedural requirements related to independent Inspection and Testing Agencies including:

1. Contractual requirements for retaining Agencies.
2. Contractor's responsibilities for coordinating and cooperating with Agencies.
3. Procedural requirements for Agencies.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Cutting and Patching: Division 01.

C. Inspection and Testing Services are specified in the following locations:

1. Inspection and Testing of Earthwork: Division 01.
2. Inspection and Testing of Cast-In-Place Concrete: Division 01.
3. Inspection and Testing of Asphaltic Concrete: Division 01.
4. Inspection and Testing of Masonry: Division 01.
5. Inspection and Testing of Roofing and Waterproofing: Division 01.
6. Inspection and Testing of Exterior Enclosure: Division 01.

D. Methods and Means Engineering: Division 01.

E. Testing and Balancing of Mechanical Systems: Division 01.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Quality Control Procedures:

1. Test Facility Inspection Reports: As indicated.

2. Field Inspection Reports: No later than one week after inspection or test, unless otherwise indicated.

3. Field Test Reports: As indicated.

C. Certifications: As indicated.

1.4 Definitions

A. Agency: An independent Inspection and Testing Agency qualified for work as indicated.

1.5 Quality Assurance

A. Agency's Qualifications:

1. Agency shall have been in business for a minimum of five years. Agency shall have successfully completed five projects of scope and complexity similar to this Project in last three years. Submit certification.

2. Comply with basic requirements of ASTM E329, "Standard Specification for Agencies Engaged in Construction Inspection and/or Testing".

3. Authorized to operate in the state of North Carolina.

4. Confirm objectivity by disclosing possible conflicts of interest.

5. Maintain adequate equipment to perform required tests that has been periodically calibrated.

6. Employ experienced personnel educated in conducting, supervising and evaluation tests and/or inspections.

1.6 Contractual Requirements

A. Owner will directly retain services of independent Inspection and Testing Agency required in individual Inspection and Testing Sections of Division 01. Individual Inspection and Testing Sections are included in Project Manual for Contractor's coordination with Agency.

1.7 Inspection And Testing Agency's Responsibilities

A. Cooperate with Owner's Representative, Design Professional, and Contractor, and furnish services of qualified personnel after due notice.

B. Perform indicated inspections, sampling and testing of materials and methods of construction:

1. Comply with specified standards.

2. Verify compliance of materials with requirements of Contract Documents.

C. Keep records of inspections.

D. Promptly notify Design Professional, and Contractor of observed irregularities or deficiencies of Work or Products.

E. Submit written report of each field inspection and test. Each report shall include:

1. Date issued.
2. Project title and number.
3. Testing laboratory name, address and telephone number.
4. Name and signature of laboratory or field inspector.
5. Date and time of sampling or inspection.
6. Record of temperature and weather conditions.
7. Date of test.
8. Identification of product and Specification Section.
9. Location of Sample or Test in the Project.
10. Type of inspection or test.
11. Results of tests and compliance with Contract Documents.
12. Interpretation of test results, when requested.

F. When reinspection or retesting at Contractor's expense is required, perform reinspection and retesting in conformance with requirements for original inspection and testing.

G. Submit final report documenting required inspections and correction of any discrepancies noted in the inspections.

1.8 Limitations Of Authority Of Inspection And Testing Agency

A. Agency is not authorized to:

1. Release, revoke, alter or enlarge on requirements of Contract Documents.
2. Approve or accept any portion of Work.
3. Perform Contractor's work.

1.9 Contractor's Responsibilities

A. Cooperate with Agency, and enable access to Work and to manufacturers' operations.

B. Furnish Agency mix design(s) and material Samples proposed to be used which require control by Inspection and Testing Agency.

C. Furnish copies of Product Test Reports as required.

D. Furnish incidental labor and facilities:

1. To enable access to Work to be tested.

2. To facilitate inspection and tests.

3. For storage and curing of test Samples.

E. Notify Agency in advance of operations to allow for Agency assignment of personnel and scheduling of tests. When inspections or tests cannot be performed after such notice, reimburse Owner for Agency personnel and travel expenses incurred.

F. If initial inspections and tests indicate Work does not comply with Contract Documents, pay Construction Manager for such additional inspection and testing services as may be required until Work conforms with Contract Documents.

G. Employ and pay for services of a separate, equally qualified independent Agency to perform additional inspections, testing and sampling for Contractor's convenience.

Part 2 Products

Not used.

Part 3 Execution

3.1 Repair And Protection

A. General: Upon completion of inspection, testing, sample taking and similar services, repair damaged construction, and restore substrates and finishes to eliminate deficiencies, including deficiencies in visual qualities of exposed finishes. Comply with requirements in Cutting and Patching: Division 01.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Inspection and Testing Agency shall perform inspection and testing of earthwork and related construction to ascertain conformance with Contract Documents and as follows:

1. By Soils Engineer:

   a. Inspect subgrade intended for support of structures, slab-on-ground and pavements.
   b. Review equipment and methods used in placement and compaction of fill materials.
   c. Notify Design Professional immediately if footings or slab-on-ground are placed on unfinished soil or frozen ground or when footings and slabs-on-grade are not protected from frost damage.
   d. Notify Design Professional when subgrade with allowable bearing noted is encountered at elevation above bearing elevation indicated.
   e. Notify Design Professional and Contractor if subgrade with required allowable bearing capacity is not encountered at bearing elevation indicated. Foundation shall be adjusted as recommended in writing by Soils Engineer and approved in writing by Design Professional.
   f. Review rock excavation techniques. Monitor extent of rock removal so as to preclude overexcavation. Verify that specified definition of rock is being used. Monitor blasting-induced ground motions.
   g. Monitor settlements and lateral movements of existing adjacent construction.

2. By Soils Technician:

   a. Inspection of filling, backfilling of structures and trenchwork.
   b. Testing work.
   c. Monitoring of temporary drainage, pumping and dewatering systems.
   d. Inspection of installation of perimeter subdrainage system.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Inspection and Testing Services: Division 01, refer to for contractual requirements to retain Agency.

C. Earth Moving: Division 31.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Quality Control Procedures:

1. Field Inspection Reports: As indicated.

2. Field Test Reports: Reports to include the following:

   a. Type and condition of subgrade at foundation bearing.
   b. Level of water table in excavated areas.
   c. Grain size distribution of fill materials (average of three tests.)
   d. Moisture and density test results.
   e. Field density test results with moisture content and relative density of each layer of compacted fill. Include, with field density test results, a plan indicating location of each test.
   f. Notify Design Professional by telephone within one hour of discovery of the following conditions, and follow up telephone notification with written report:

      1) Materials used, existing conditions found, or degree of soil compaction not meeting specified requirements.

      2) Frost and freeze protection requirements for excavation bottoms not being complied with.

C. Certifications: Based on results of inspections and tests performed, certify that Work has been performed in conformance with Contract Documents. Certification shall be signed and sealed by a Professional Engineer trained and specializing in field of geotechnical engineering and licensed in North Carolina.

1.4 Quality Assurance

A. Inspection and testing work shall be by a Soils Engineer, trained and specializing in field of geotechnical engineering.

B. Soils Technician shall have a minimum of five years experience on similar type work.

C. Work of the Soils Technician shall be under direct supervision of Soils Engineer.

D. Inspection and Testing shall be under supervision of Professional Engineer in responsible charge of Inspection and Testing.

E. Referenced Codes and Standards: Comply with the following in accordance with Division 01.

1. ASTM International (ASTM)

C 136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
D 1556	Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
D 1557	Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3)
D 6938	Standard Test Method for In-Place Density and Water Content of Soil and Soil- Aggregate by Nuclear Methods (Shallow Depth)
D 4318	Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

2. U.S. Army Corps of Engineers

EM 1110-2-1906	Modified Providence Vibrated Density Test

Part 2 Products

Not used.

Part 3 Execution

3.1 Repair and Protection

A. Inspect subgrade at each foundation bearing and at all pavement and fill conditions for conformance to specified requirements.

B. Inspect installation of perimeter drainage system for conformance to specified materials and detail requirements.

C. When temporary drainage and dewatering systems are used to keep excavation dry, monitor the systems for adequacy.

D. Inspect materials and methods used for placement and compaction of fills in general earthwork and also in backfilling around structures and in utility trenches.

E. Inspect prepared subgrades under slabs-on-grade and pavements.

3.2 Testing

A. Perform sieve analysis according to ASTM C 136, prior to initiation of and every other week during filling operations, to develop grain-size distribution curves for materials used for subgrade, fill under slabs-on-grade and backfill.

B. Establish moisture-density relation of soils to be used as fill according to ASTM D 1557 by Method A, B, C or D, using method best suited to type of fill material.

C. Perform field density tests according to ASTM D 1556 at each layer of compacted fill at locations adequate to evaluate degree of compaction of all fill areas. There shall be at least one test at each layer for each 1000 square feet with a maximum spacing of 50 feet between test locations.

D. Perform field density tests according to EM 1110-2-1906 at compacted porous fill under slabs-on-grade. There shall be at least one test for each 2000 square feet of slab area.

3.3 Inspection

A. Periodically verify materials below footings are adequate to achieve the design bearing capacity.

B. Periodically verify excavations are extended to proper depth and have reached proper material.

C. Periodically perform classification and testing of controlled fill materials.

D. Continuously verify use of proper materials, densities and lift thicknesses during placement and compaction of controlled fill.

E. Periodically, prior to placement of controlled fill, observe subgrade and verify that site has been prepared properly.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Inspection and Testing Agency shall perform inspection of batch plant concrete, field cast-in-place concrete, concrete formwork, reinforcement, accessories, and concrete placement to verify conformance with Contract Documents.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Inspection and Testing Services: Division 01, refer to for contractual requirements to retain Agency.

C. Concrete Formwork: Division 03.

D. Concrete Reinforcement: Division 03.

E. Concrete Accessories: Division 03.

F. Cast-In-Place Concrete: Division 03.

G. Polished Concrete Finishing: Division 03.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Quality Control Procedures:

1. Field Test Reports to include the following:

a. Specific element(s) being inspected such as floor, roof, wall or column. Designate by floor level, structural bay or other appropriate means.

b. Concrete test reports shall include the following:

1) Specific place of deposit of concrete being tested as to floor, roof, wall or column. Designate by floor level, structural bay or other appropriate means.

2) Specified 28 day strength, unit weight, slump, air content, and water-cement ratio of concrete being tested.

3) Minimum air temperature and average daily air temperature on day of placement.

4) Concrete and subgrade temperatures prior to, during and after placement. Describe methods and procedures used for protecting subgrade and concrete.

5) Volume of concrete represented by test.

6) Results of slump test, air content test and unit weight test.

7) Name of concrete supplier, and time of batching, delivery and placement.

c. Historical reports of concrete strength performance weekly as specified herein.

d. Reports shall clearly indicate compliance/non-compliance of inspected element(s) with respect to Contract Documents. "Non-compliance" reports shall be rectified and superseded by a "compliance" report to satisfaction of Design Professional.

C. Certifications: Separate certification stating that, based on results of inspection and testing performed, cast-in-place concrete work has been constructed in conformance with Contract Documents. Certification shall be signed and sealed by a Professional Engineer trained and specializing in field of structural engineering and registered in North Carolina.

1.4 Quality Assurance

A. Referenced Codes and Standards: Comply with the following in accordance with Division 01.

1. American Concrete Institute (ACI)

311.4R	Guide for Concrete Inspection
318	Building Code Requirements for Structural Concrete

B. Perform inspection work specified under direct supervision of Professional Engineer submitting Certification.

C. Inspection Work indicated shall be performed by a graduate engineer, educated and specializing in field of Structural Engineering.

D. Field and laboratory testing technicians shall be ACI-certified for level of Work being performed.

E. Laboratory Qualifications:

1. Submit copy of report of inspection of facilities made by Construction Materials Reference Laboratory (CMRL) during most recent tour of inspection, with memorandum of remedies of deficiencies reported by inspection.

2. Testing equipment shall be calibrated at NIST or manufacturer’s written recommended intervals by devices of accuracy traceable to either:

a. National Institute of Standards and Technology (NIST).

b. Accepted values of natural physical constants.

Part 2 Products

Not used.

Part 3 Execution

3.1 Batch Plant Inspection

A. Upon submittal of mix designs for approval, test materials sampled from batch plant for compliance with Reference Standards and conformance with materials listed in concrete mix design. Perform the following minimum testing:

1. Cement (ASTM C 150):

    a. Fineness: ASTM C 204.
    b. Compressive Strength (7 day and 28 day): ASTM C 109/109M and ASTM C 917.

2. Aggregate (ASTM C 33, ASTM C 330):

    a. Grading and Fineness: ASTM C 136.
    b. Organic Impurities (fine aggregate only): ASTM C 40.

B. On first day's batching of each Class of concrete and monthly through course of Work, inspect and test materials, batch weights, moisture content, and gradation of fine and coarse aggregate. Sample materials directly from supplier’s stockpiles and test for uniformity as above specified.

3.2 Field Inspection

A. Inspect formwork for ties, finishes and general tightness of joints. Contractor shall design, construct and brace formwork.

B. Inspect concrete reinforcing for quantity, size, type, spacing, splices and placement. Inspect reinforcing using Design Professional approved Shop Drawings.

C. Inspect concrete accessories and inserts for quantity, size, manufacture, type, spacing and placement.

D. Inspect method of placing, vibrating and curing of concrete.

E. Inspect cold-weather protection methods.

F. Inspect grouting under base plates to verify material, method and timing of placement.

3.3 Field And Laboratory Testing

A. Slump Tests: ASTM C 143/143M; one test shall be performed for each sampling for strength tests. Slump shall be considered acceptable if field test is within range of design slump plus or minus 1 inch. For concrete placed by pumping, test shall be performed at pump or truck discharge. Slump measured shall be evaluated for acceptance relative to design slump in accordance with criteria previously specified.

B. Air Content Tests: ASTM C 173/173M; test air-entrained concrete only, one test performed for each sampling for strength tests. Air content shall be considered acceptable if field test is within range of design air content plus or minus 1.5 percent.

C. Unit Weight Tests: ASTM C 138; test each Sample of lightweight concrete taken for strength tests. Unit weight shall be considered acceptable if field test shows a plastic unit weight equal to design unit weight plus or minus 2 pcf.

D. Compression Test Cylinders:

1. Make, transport, cure and test 6 inch diameter by 12 inch long test specimens taken from concrete being cast. Produce test cylinders in accordance with ASTM C 31/31M at rate of four cylinders minimum for each 50 cubic yards or fraction thereof of each class of concrete placed in any one day.

2. Handle newly-made cylinders carefully to avoid damaging green concrete. Store these cylinders in a box at temperature not lower than 60 degrees F during first 24 hours. Construct a suitable box and provide heat if necessary to maintain cylinders at proper temperatures.

3. Place cylinders in laboratory storage, with molds removed, under moist curing conditions and temperature of 65 to 75 degrees F, 24 hours after casting. Maintain these moist curing conditions until specimens are tested.

4. Compressive Strength Tests: Test in accordance with ASTM C 39/39M, one specimen tested at seven days, two specimens tested at 28 days, and one specimen retained in reserve at laboratory for later testing as directed by Design Professional. Include sketch showing nature of fracture of each cylinder. Compliance with 28 day compressive strength requirements specified shall be evaluated in accordance with ACI 318.

5. Each 28 day compression test report shall clearly indicate, as of report date and for class of concrete being reported, the following:

   a. Average of latest three test results.
   b. Lowest average of three consecutive test results recorded to date.
   c. Average of all sets of three consecutive test results.
   d. Percentage of tests falling below specified strength.
   e. Lowest single test result.

E. Verify subgrade, formwork and concrete temperatures for each concrete placement, when winter-concreting procedures are required, as follows:

1. Prior to concrete placement, verify that contact surfaces of subgrade and formwork are maintained at 35 degrees F.

2. Ambient and concrete temperatures shall be recorded at placement and every six hours thereafter for first 24 hours. Thereafter, record concrete temperatures twice per 24 hour period for the following three days.

3. Temperatures shall be taken at multiple locations, including internal, surface, corners and edges. Use expendable thermistors or thermocouples cast in the concrete in addition to surface thermometers as appropriate.

F. Levelness and Flatness of Flatwork: Survey levelness (F_L) and flatness (F_F) of test slabs and floor slabs in accordance with ASTM E 1155. Testing shall be performed at times indicated in Polished Concrete Finishing: Division 03.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Inspection and Testing Agency shall perform inspection and testing of masonry concrete masonry units components to verify conformance with Contract Documents. Services shall include:

1. Inspection of installation of masonry reinforcing and grouting.
2. Testing of face brick for efflorescence.
3. Testing of mortar.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Inspection and Testing Services: Division 01, refer to for contractual requirements to retain Agency.

C. Unit Masonry: Division 04.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Quality Control Procedures:

1. Reports: Two copies of each test report and daily inspection reports as detailed in Inspection and Testing Services: Division 01.
2. Daily Reports: As indicated.

C. Certifications: Within two weeks after completion of Work to be tested, submit certification, signed and sealed by a Professional Engineer trained and specializing in field of structural engineering and licensed in North Carolina, that masonry and related work has been performed in conformance with Contract Documents.

1.4 Quality Assurance

A. Inspection and testing work shall be by an engineer, trained and specializing in field of structural engineering.

B. Inspector: Minimum of ten years inspecting masonry and worked on a minimum of five projects of scope and size of this Project in last three years.

C. Work of inspecting engineer shall be under direct supervision of Professional Engineer.

D. Referenced Codes and Standards: Comply with the following in accordance with Division 01.

1. ASTM International (ASTM)

C 67	Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile
C 140	Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units
C 476	Standard Specification for Grout for Masonry
C 780	Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
C 1019	Standard Test Method for Sampling and Testing Grout
C 1314	Standard Test Method for Compressive Strength of Masonry Prisms

2. American Concrete Institute (ACI)/American Society of Civil Engineers (ASCE)

ACI 530/530.1	Building Code Requirements and Specification for Masonry Structures and Related Commentaries

1.5 Test Procedures

A. Testing of Face Brick: Perform the following tests in accordance with ASTM C 67.

1. Efflorescence.

B. Testing of Concrete Masonry Units: Perform the following preconstruction tests in accordance with ASTM C 140.

1. Compressive Strength.

2. Weight.

3. Dimensions.

C. Mortar Tests: Perform the following preconstruction and construction tests in accordance with ASTM C 780 for each type of mortar mix specified.

1. 28 Day Compressive Strength.

2. Water Retention.

D. Mortar Test: Perform the following test on face brick mortar for efflorescence.

1. Use a test specimen consisting of two face bricks (previously tested successfully for efflorescence) with a layer of proposed mortar between.

2. Allow specimen to stand for seven days, and test for efflorescence in accordance with ASTM C 67.

E. Grout Test: Perform the following preconstruction and construction tests on each different type of grout mix in accordance with ASTM C 1019.

1. Slump Test.

2. 28 Day Compressive Strength.

F. Prism Test: Perform 28 day compressive strength preconstruction test on concrete masonry walls in accordance with ASTM C 1314.

Part 2 Products

Not used.

Part 3 Execution

3.1 Inspection

A. Report deficiencies immediately to Owner's Representative, Construction Manager and Design Professional.

B. Daily Reports: Prepare a detailed report for each day Inspector is on Project Site, describing Work accomplished, number of workers, general progress of Work, any deficiencies which had to be corrected or still require correction and any deficiencies which have been corrected and are approved by Inspector.

C. Construction Inspection

1. Inspect placement of reinforcement, including condition, grade, size, location, spacing and lap splices.

2. Inspect laying, mortaring and grouting of masonry units and elements.

D. Level 1 Special Inspection:

1. Periodically verify proportions of site-prepared mortar; construction of mortar joints; location of reinforcement, connectors, prestressing tendons, and anchorages; prestressing technique; and grade and size of prestressing tendons and anchorages.

2. Periodically verify size and location of structural elements; type, size and location of anchors and anchorage; size, grade and type of reinforcement, protection of masonry during cold or hot weather; and application and measurement of prestressing force. Continuously verify welding of reinforcing bars.

3. Periodically verify grout space is clean; placement of reinforcement and connectors and prestressing tendons and anchorages; proportions of site-prepared grout and prestressing grout for bonded tendons; and construction of mortar joints.

4. Continuously verify grout placement is in compliance with code and construction document provisions; and grouting of prestressing bonded tendons.

5. Continuously observe preparation of any required grout specimens, mortar specimens and/or prisms.

6. Periodically verify compliance with required inspection provisions of the construction documents and the approved submittals.

3.2 Preconstruction Testing

A. Test Samples of face brick, concrete masonry units, mortars and grouts selected for Project prior to start of Construction.

B. Daily Reports: Prepare a detailed report for each day Inspector is on Project Site, describing Work accomplished, number of workers, general progress of Work, any deficiencies which had to be corrected or still require correction and any deficiencies which have been corrected and are approved by Inspector.

3.3 Construction Testing

A. Review and approve design mix(es).

B. Test Samples of each different type of masonry mortar and grout for compressive strength at a rate of one test per 2000 square feet of masonry.

C. Test face brick mortar Samples in accordance with ASTM C 780 and for efflorescence prior to start of Construction and subsequently as follows:

1. Test Samples of mortar used in Sample Panels.

2. Test Samples of mortar periodically during Construction.

3. Test Samples of mortar whenever changes are made in sources of materials.

4. Daily Reports: Prepare a detailed report for each day Inspector is on Project Site, describing Work accomplished, number of workers, general progress of Work, any deficiencies which had to be corrected or still require correction and any deficiencies which have been corrected and are approved in writing by Inspector.

3.4 Deficiencies

A. Report deficiencies immediately to Owner's Representative Construction Manager and Design Professional.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Inspection and Testing Agency shall perform inspection and testing of asphaltic concrete paving to ascertain conformance with Contract Documents.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Inspection and Testing Services: Division 01, refer to for contractual requirements to retain Agency.

C. Inspection and Testing of Earthwork: Division 01.

D. Asphaltic Paving: Division 32.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Samples: As indicated.

C. Quality Control Procedures: Test reports as detailed in Inspection and Testing Services: Division 01, including the following:

1. Field density test results with moisture content and relative density of each Sample. Include, with field density test results, a plan indicating location of each test.

2. Notify Design Professional by telephone within one hour of discovery that materials used, or degree of soil compaction do not conform to indicated requirements. Follow up telephone notification with written report.

3. Test Reports for In-Place Pavement: Contractor shall submit results of tests performed on in-place pavement within thirty (30) days of day's production. Tests shall include those of mix design and attained density.

D. Certifications: Within two weeks after completion of Work to be tested, submit certification, signed and sealed by a Professional Engineer trained and specializing in field of civil engineering and licensed in State of North Carolina, that asphaltic concrete and related work has been performed in conformance with Contract Documents.

1.4 Quality Assurance

A. All Inspection and Testing shall be under supervision of Professional Engineer.

B. Referenced Codes and Standards: Comply with the following in accordance with Division 01.

1. ASTM International (ASTM)

D 6938	Standard Test Method for In-Place Density and Water Content of Soil and Soil- Aggregate by Nuclear Methods (Shallow Depth)

Part 2 Products

Not used.

Part 3 Execution

3.1 Inspection

A. Inspect prepared subgrades under pavements for conformance to specified requirements.

B. Surface Tolerance: Surface shall be finished with final elevation and slope indicated. No point shall be more than 3/4 inch in deviation from elevation indicated. Local irregularities shall not be more than 1/4 inch in any 10 foot length. For irregularities that develop before completion of rolling, correct by loosening surface mixture and removing or adding material as required. If irregularities or defects that cannot be corrected remain after final compaction, affected area will be considered defective work and shall be designated for repair.

3.2 Testing

A. Samples: Test Samples of subbase and base courses shall be submitted by Contractor to determine quality of materials and their conformance to Specification. Submit Samples in time to avoid delaying construction.

B. Density: Density may be measured by nuclear gauge in accordance with ASTM D 6938, or testing of cores cut in pavement, as determined by Inspection and Testing Agency. If test cores are requested, take one 6 inch diameter core per 9,000 square feet or less of day's production, but no less than four cores. Do not compress or distort Samples during cutting, handling, transporting, or storing. Identify Samples and deliver to Inspection and Testing Agency for testing.

1. Compute and report field density of in-place pavement as a percentage of maximum theoretical or Marshall plant mix density obtained during corresponding day's production. At least 96 percent is required for acceptance. If field density does not meet this requirement, instruct Contractor to apply additional compaction, when permitted, to attain required density. If satisfactory density cannot be attained, affected area will be considered defective work, and shall be designated for repair.

C. Test for Depth: After final compaction of base course, drill one 6 inch diameter test hole per 9,000 square feet or less of day's production. Measure thickness of base course. If thickness is 1/2 inch more or less than specified, area will be considered defective work, and shall be designated for repair. Drill additional test holes to determine extent of defective areas.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Inspection and Testing Agency shall perform inspection and testing of structural steel to ascertain conformance with Contract Documents.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Inspection and Testing Services: Division 01, refer to for contractual requirements to retain Agency.

C. Structural Steel Framing: Division 05.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Quality Control Procedures:

1. Field Inspection Reports: As indicated.

2. Field Test Reports: As detailed in Inspection and Testing Services: Division 01.

3. Daily Reports: Prepare a detailed report for each day Inspector is on Project Site, describing Work accomplished, number of workers, general progress of Work, any deficiencies which had to be corrected or still require correction and any deficiencies which have been corrected and are approved in writing by Inspector.

C. Certifications: Within two weeks after completion of Work to be tested, submit certification, signed and sealed by a Professional Engineer trained and specializing in field of structural engineering and licensed in North Carolina, that structural steel and related work has been performed in conformance with Contract Documents.

1.4 Quality Assurance

A. Inspector: Minimum of ten years in inspection of structural steel systems and worked on a minimum of five projects of scope and size of this Project in last three years.

1. Qualifications for welding inspector shall be according to AWS D1.1

B. Referenced Codes and Standards: Comply with the following in accordance with Division 01.

1. American Institute of Steel Construction (AISC)

	Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts

2. ASTM International (ASTM)

A 6/6M	Standard Specification for General Requirements for Rolled Steel Bars, Plates, Shapes, and Sheet Piling
A 325	Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
A 490	Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength

3. American Welding Society (AWS)

D1.1	Structural Welding Code, Steel
D1.3	Structural Welding Code, Sheet Steel

Part 2 Products

Not used.

Part 3 Execution

3.1 Structural Steel Inspection

A. Review approved submittals from steel fabricator.

B. Shop-inspect members for defects, such as cracks, excessive camber, deformation and specified surface preparation, prior to shop painting.

C. Inspect shop painting for coverage and measure Dry Film Thickness (DFT).

D. Perform visual inspection of welds; measure 30 percent of welds.

E. Inspect size and placement of anchor bolts in concrete and masonry.

F. Verify that erected steel frame is surveyed per Specifications.

G. Verify that erector inspects alignment of beams, shelf angles, lintels, and any other similar supporting member.

H. Perform visual inspection of bolted connections. When bolted connections utilize load indicator washers, check a minimum of two bolts per connection with an appropriate feeler gauge. When bolts are tightened by turn-of-the-nut method or when torque control bolts are used, verify that all bolts have been tightened.

3.2 Special Inspection

A. Periodically verify identification markings and manufacturer's certificate of compliance for bolts, nuts and washers.

B. Periodically inspect bearing-type high-strength bolted connections. Continuously inspect slip-critical high-strength bolted connections.

C. Verify identification markings and manufacturer's certified mill test reports for structural steel.

D. Verify identification markings and manufacturer's certificate of compliance for weld filler materials.

E. Continuously inspect complete and partial penetration groove welds; multipass fillet welds; single-pass fillet welds greater than 5/16 inch; reinforcing steel-resisting flexural and axial forces in intermediate and special moment frames, and boundary elements of special reinforced concrete shear walls and shear reinforcement; and shear reinforcement. Periodically inspect single-pass fillet welds less than or equal to 5/16 inch, floor and roof deck welds; weldability of reinforcing steel other than ASTM A 706/706M; and other reinforcing steel.

F. Periodically inspect steel frames for compliance with approved construction documents, including bracing and stiffening details, member locations, and application of joint details at each connection.

3.3 Structural Steel Testing

A. Perform tests as required by Structural Welding Code.

B. Fillet welds for shear connections (15 percent at random) shall be tested by magnetic particle method for final pass only.

C. Ultrasonically test 100 percent of full penetration and partial penetration welds.

D. Edges of material greater than 1 1/2 inches in thickness, that is to be welded, shall be ultrasonically tested for evidence of laminations, inclusions or other discontinuities. Extent to which such defects will be permitted and extent of repair permitted shall be in accordance with ASTM A 6/A 6M.

E. Root layer of multiple pass welds and backside of groove welds made from both sides, after back gouging or chipping, shall be tested by magnetic particle method, or dye penetration method if magnetic particle method is not feasible.

F. Test 100 percent of continuity plate fillet welds by magnetic particle for final pass.

G. Perform equipment calibrations and production tests of high-strength bolt connections as required by AISC Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts.

H. When bolts are tightened by "turn-of-the-nut" method, check by calibrated torque wrench 25 percent of bolts in each shear connection, but not less than two bolts per connection.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Inspection and testing of exterior enclosure to verify conformance with Contract Documents.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Inspection and Testing Services: Division 01.

C. Exterior Enclosure, General: Division 07.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Qualifications: AAMA accreditation data.

C. Quality Control Procedures:

1. Testing Protocols: Submit on testing laboratory letterhead, a detailed list of the testing protocol indicated, including criteria for acceptance prior to testing.

2. Test Reports: Include information required in referenced tests.

3. Inspection Reports: As indicated.

4. Daily Reports: As indicated.

D. Certifications: Certification of Compliance, as indicated.

1.4 Quality Assurance

A. Laboratory and On-site Testing Agency's Qualifications: Agency shall be AAMA accredited.

B. Inspection Agency Qualifications: Agency shall have been in business of inspecting exterior enclosures for a minimum of five (5) years. Individual overseeing work required for this Section shall be a licensed architect or engineer and shall have a minimum of ten (10) years full time equivalent experience with systems similar to those required for this Project.

C. Inspector's Qualifications:

1. Minimum of five (5) years experience in inspecting and testing work and worked on a minimum of five (5) projects of scope and size of this Project in last three (3) years.

2. Not Allowed: Experience involved in Inspection and Testing of structural steel, concrete, soils or similar work is not applicable towards minimum qualifications.

D. Certifications:

1. Preliminary Certification: Prior to indicated Coordination Meeting specified in Exterior Enclosure, General: Division 01, Agency shall submit a certification letter outlining services to be provided by Agency, indicating compliance with this Section. Exterior Enclosure submittals will not be reviewed Design Professional without Preliminary Certification.

2. Final Certification: Immediately prior to Substantial Completion, Agency shall submit a letter certifying that inspection and testing services have been carried out in compliance with this Section and that construction complies with Contract Documents, submittals and manufacturer's written instructions. Substantial Completion will not be processed without Final Certification.

Part 2 Products

Not used.

Part 3 Execution

3.1 Field Testing

A. General:

1. Perform field testing at earliest possible date.

2. Do not cover interior or exterior portions of Work to be field tested until testing is completed and assembly has been approved.

B. AAMA 503, "Voluntary Specification for Field Testing of Storefronts, Curtainwalls and Sloped Glazing Systems".

1. Test shall be performed on indicated field mock-up by applying positive pressure to exterior of system unless Agency and Contractor can document satisfactory methods to seal air paths which would otherwise compromise testing of system, and especially perimeter seals.

2. In additional to initial tests, test one (1) additional Sample Panel matching size of original, selected at random by Agency, at 50 percent and 90 percent completion.

3. Testing and performance values shall be minimums required by referenced test.

4. Air infiltration and water penetration load requirements shall be as listed in Specification Section for each assembly and in Exterior Enclosure, General: Division 07. If value is not given, comply with minimum values contained in referenced test standard.

C. Perform the following test on approximately 10 percent of total lineal footage of horizontal mullions of installed storefront framing and curtainwall:

1. AAMA 501.2 Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems.

2. If any portion of indicated area fails test, additional tests equal in size to original will be tested until no portion of area specified fails test. Additional testing will be at Contractor's expense.

D. Perform destructive and non-destructive testing of installed exterior sealant joints in compliance with ASTM C 1521.

1. Single Line of Sealant: Test at frequency recommended in ASTM C 1521.

2. Double Line of Sealant: Test inner line of sealant prior to installation of outer line at frequency recommended in ASTM C 1521. Test outer line of sealant at 25 percent of the recommended frequency.

3. Water Exposure Test: Provide ten (10) water exposure tests on sealant randomly selected as approved by Design Professional.

3.2 Retesting

A. All retesting shall be at expense of Contractor and shall employ Inspection and Testing Agency who performed original tests.

B. Laboratory testing shall be repeated until compliance is demonstrated.

C. Field testing shall be repeated at original location of failed test until compliance is demonstrated.

D. In addition to retesting of original failed test, one additional test at a new location selected by Design Professional of similar scope as original field test shall be provided.

E. Continue field retesting and adding new field tests until compliance is achieved on first attempt of additional test.

3.3 Inspection

A. Inspector shall:

1. Study requirements of Contract Documents, submittals, manufacturer's written instructions and related materials in order to have an in depth knowledge of Project.

2. Enforce indicated Contract requirements.

3. Attend Preconstruction Meeting required for each type of Work.

4. Inspect and approve in writing substrates prior to start of Work. Submit certification of substrates.

5. Inspect Work for conformance with Contract Documents, submittals and manufacturer's written instructions.

6. Identify potential problem areas and establish method of resolving them.

7. Inspect on Project Site condition of applicable stored materials.

8. Attend Preinstallation Conferences related to exterior enclosure, not including roofs or waterproofing.

9. Provide continuous inspection of construction of mock-ups and field Sample Panels. Submit daily reports.

10. Inspect each area of vapor retarder and air barrier before they are covered by subsequent construction.

11. Provide inspection of every Section of sill flashing below storefronts and base of curtainwall.

12. Provide continuous inspection of testing procedures indicated in this Section. Include observations in test report.

13. Advise Design Professional in matters relating to exterior enclosures, including changes to approved submittals for field conditions and claims for compensation for extra work.

14. Make an inspection immediately prior to Date of Substantial Completion and produce punchlist for Contractor's use.

15. Make Final Inspection when Work is completed.

16. Certify in writing that Work has been performed in conformance with Contract Documents and that inspector has performed required functions.

17. Daily Reports: Prepare a detailed report for each day Inspector is on Project Site, describing Work accomplished, number of workers, general progress of Work, any deficiencies which had to be corrected or still require correction and deficiencies which have been corrected and are approved in writing by Inspector.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Inspection and testing of roofing and waterproofing to verify conformance with Contract Documents.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Inspection and Testing Services: Division 01, refer to for contractual requirements to retain Agency.

C. Sections with Work required to be inspected and tested under this Section include the following:

1. Modified Bituminous Sheet Waterproofing: Division 07.
2. Membrane Roofing (Single Ply): Division 07.
3. Flashing and Sheet Metal: Division 07.
4. Roof Accessories: Division 07.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Quality Control Procedures:

1. Field Inspection Reports: As indicated.
2. Field Test Reports: As detailed in Inspection and Testing Services: Division 01.
3. Daily Reports: As indicated.

C. Certifications:

1. Certification of Substrates: As indicated.
2. Certification of Compliance: As indicated.

1.4 Quality Assurance

A. Inspector: Minimum of ten years in roofing and worked on a minimum of five (5) projects of scope and size of this Project in last three (3) years.

B. Testing Agency: Minimum of ten years experience performing tests similar to those specified.

C. Test Technician: Trained and qualified to administer specified tests with minimum three years experience.

D. Approval: Agency, Inspectors and Technicians shall be approved in writing by Design Professional.

Part 2 Products

Not used.

Part 3 Execution

3.1 Inspection

A. Inspector shall:

1. Study requirements of Contract Documents, submittals and manufacturer's written instructions.
2. Enforce indicated requirements.
3. Attend Preconstruction Meeting required for each type of Work.
4. Inspect and approve in writing substrates prior to start of Work. Submit certification of substrates.
5. Inspect Work for conformance with Contract Documents, submittals and manufacturer's written instructions.
6. Identify potential problem areas and establish method of resolving them.
7. Inspect on Project Site condition of applicable stored materials.
   a. Continuously throughout roofing and waterproofing Work.
8. Notify Design Professional in matters relating to waterproofing, roofing, insulation and sheet metal work, including changes to proposed materials and claims for compensation for extra Work.
9. Make an inspection immediately prior to Date of Substantial Completion and produce punchlist for Contractor's use.
10. Make Final Inspection when Work is completed.
11. Certification of Compliance: Certify in writing that Inspector has performed functions enumerated above and that Work has been performed in accordance with Contract Documents.
12. Daily Reports: Prepare a detailed report for each day Inspector is on Project Site, describing Work accomplished, quantity of workers, general progress of Work, deficiencies corrected or still requiring correction and deficiencies which have been corrected and are approved in writing by Inspector.

3.2 Testing: Waterproofing And Low-Slope Roofing

A. Flood Testing: Waterproofing shall be flood tested by Contractor as specified in individual Specification Sections. Inspector shall observe performance of test, and submit a report of his observations and test

B. Non-Destructive Moisture Testing:

1. Scan the entire roofing and waterproofing area using proven techniques and equipment and experienced operators to locate any wet materials below roof membrane.

2. Contractor's option to use one or more of the following:

a. Infrared Testing: ASTM C 1153.
b. Electric Capacitance Impedance Testing.
c. Nuclear Detection Testing.

3. Where flood testing is required, perform scanning not more than two weeks after flood test.

4. Where flood testing is not required, do not perform scanning until rain of intensity sufficient to penetrate potential leaks has occurred.

C. Pull-Out Testing of Roof Anchors: Initially test five Samples of each type of screw, nail or other anchor used to fasten blocking, insulation, membrane components or roof accessory. Test actual in-place anchors before being covered by subsequent layers as follows:

1. Nails: One (1) test per each 50 lineal feet of blocking or nailers, or fraction thereof.

2. Screws Securing Insulation or Roofing Membrane: One (1) test per 500 screws.

3. Anchors into Concrete Securing Insulation or Roofing Membrane: One (1) test per 250 anchors.

4. Anchors for Insulation or Roofing Membrane Other Than Screws: One (1) test per 250 anchors.

5. All Other Anchors: One (1) test per 500 anchors.

D. Retesting: For each failed test, whether it is an original test or a retest, employ original Inspection and Testing Agency to perform two (2) additional tests of same type at new locations selected at random by Design Professional. Contractor shall pay for cost of retesting.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Engineering and inspection of methods and means of construction to ensure that procedures used are consistent with applicable laws, codes and ordinances, and will prevent damage to Work and adjacent properties due to collapse, overstress, or deformation of any of the parts.

B. Contractor shall retain on staff, or shall separately engage, services of a Professional Engineer licensed by the State of North Carolina to design, inspect and approve methods and means of performing demolition, structural and civil work.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

1.3 Quality Assurance

A. Professional Engineer's Qualifications: Professional Engineer performing Work of this Section shall be registered in State of North Carolina and shall specialize in field of Structural Engineering. Professional Engineer shall carry Errors and Omissions Insurance against Engineer's own acts or omissions in limits of at least $1,000,000/$1,000,000.

1.4 Engineering And Inspection

A. In addition to quality control of Work for Contractor, Professional Engineer shall design, inspect and approve methods and means of:

1. Demolition: Alterations in structural work, and for removal and restoration of structural work.

2. Structure Temporary Loading: Professional Engineer shall advise Owner's Representative and Contractor which areas of structure may be loaded, weight limits and arrangement of such loading throughout Construction Phase.

B. Professional Engineer is not responsible for design of structure and for accuracy of Contract Documents except that Professional Engineer may not approve methods and means which cannot result in Work as designed. Professional Engineer shall not make changes in design. Professional Engineer is responsible for Contractor's failure to conform to Contract Documents.

C. Inspection by Professional Engineer shall not preclude observation by Design Professional, or other inspectors having jurisdiction.

Part 2 Products

Not used.

Part 3 Execution

Not used.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Construction facilities and services required for performance of Work but not a permanent part of finished construction. Included are temporary utilities, temporary construction and support facilities, and security and protection services.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Summary of Work: Division 01.

C. Environmental Protection: Division 01.

D. Project Closeout: Division 01.

E. Earthwork: Division 31.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Quality Control Procedures: Reports of inspections, tests, meter readings and similar procedures performed on temporary utilities.

1.4 Quality Assurance

A. Referenced Codes and Standards: Comply with the following in accordance with Division 01.

1. Applicable Federal, State and Local Codes and Regulations
2. Applicable Health and Safety Regulations
3. Applicable Utility Company Regulations
4. Applicable, Police, Fire and Emergency Rescue Department Regulations
5. Applicable Regulations of the National Fire Protection Association (NFPA 70), National Electrical Manufacturers Association (NEMA), National Electrical Contractors Association (NECA) and Underwriters Laboratories, Inc. (UL)

1.5 Inspection

A. Arrange for authorities having jurisdiction to inspect and test each temporary utility before use. Obtain required certificates and permits.

Part 2 Products

2.1 Temporary Materials

A. Materials may be new or used, but must be adequate in capacity for required usage, and must not violate requirements of applicable codes and standards. Generally, temporary materials shall comply with related Specification Sections for materials to be incorporated into Final Work.

Part 3 Execution

3.1 Temporary Utilities

A. General:

1. Comply with applicable requirements indicated in Earthwork: Division 31, Mechanical: Division 23, and Electrical: Division 26.
2. Temporary utilities shall include water, drainage, electrical power, communications, lighting, and steam where applicable.
3. Maintain and operate systems to assure continuous service.
4. Modify and extend systems as Work progress requires.

3.2 Temporary Electricity And Lighting

A. Arrange with Utility Company, and provide a separate service required for electricity and lighting to include the following:

1. Electrical service shall be adequate for Work of all trades, except field welding, and shall be terminated in fused safety switch and circuit breaker distribution panels.
2. Provide adequate grounded outlets for use of electrical tools, appliances, and temporary work lighting.
3. Provide adequate heavy-duty power sources.
4. Electric service shall remain energized beyond normal working hours as required to provide for night lighting, heating system, and other uses Contractor may require.
5. For welding at Project Site or electrical requirements beyond capacity of temporary system, supply generator, fuel, maintenance, and other incidentals required.

6. Extension cords shall be approved by NFPA 70 and OSHA.

7. Until permanent electrical installation work is adequately completed to make legal connections in order to permit use of permanent heating system, provide proper temporary electrical service and connections to permit such use.

B. Temporary Lighting:

1. Provide temporary lighting required by referenced standards if in excess of requirements below.

2. Provide lighting necessary for construction operations.

3. Provide lighting to interior work areas, exterior staging and storage areas for security purposes to maintain 5 footcandles horizontal at grade or floor level and 3 footcandles on vertical plane.

4. Provide lighting at each landing of each stair or ladder run at level listed above.

5. Permanent building lighting may be utilized during construction.

3.3 Heating, Ventilating And Cooling

A. When heat is required to continue Work prior to permanent enclosure of building, provide enclosures of flameproof material and provide a heat source with fuel of a type not harmful to uncured concrete.

B. Temporary sources of heat shall be direct vented and thermostatically controlled. Use of open flame devices or of solid fuels is not allowed.

C. After enclosure of building, or portions thereof, and when permanent heating and cooling systems, or portions thereof, are sufficiently installed, tested, and operable, they may be used for heating and cooling purposes. For installing finishes, such as acoustical tile, woodwork, and floor tile, maintain 70 degrees F for 24 hours before, during, and for 24 hours after their installation. Maintain minimum 60 degrees F and maximum 80 degrees F.

1. Provide filter with MERV of 8 at each return air grille and remove at the end of construction.

D. Provide forced ventilation by portions of permanent system or by portable units to cure materials, to disperse humidity, and to prevent accumulations of dust, fumes, vapors, or gases. Provide ductwork with temporary filters to prevent broadcasting of dust and debris.

3.4 Temporary Telephone And Internet Service

A. Provide telephone service and internet service for Contractor's, Owner's Representative's and Design Professional's use in Field Office. Contractor shall pay cost of service.

3.5 Temporary Water Supply

A. Provide water service of adequate size as required for temporary fire protection.

B. Provide a main shutoff valve and manifold with hose bibbs.

C. Provide drinking water, paper cups, and waste receptacles for personnel.

D. After installation of permanent water service, provide a temporary tap for construction purposes.

3.6 Sanitary Facilities

A. Provide sanitary facilities according to law at locations approved by Owner's Representative. Provide privacy enclosures, toilet paper and waste receptacles. Provide janitorial services at intervals as follows: weekly and on specific occasions as directed by Owner's Representative.

B. When toilet rooms in new facility are to be used for temporary facilities, provide temporary fixtures. Remove and install new fixtures before Date of Substantial Completion.

C. Enforce use of sanitary facilities. Evidence to the contrary shall require removal, disinfecting, and reconstruction of defaced work.

3.7 Fire Protection

A. Provide fire protection and portable fire extinguishers for Project throughout construction according to law.

3.8 Construction Aids

A. Provide construction aids required for execution of Work, including scaffolds, staging, ladders, stairs, ramps, runways, platforms, railings, hoists, cranes, chutes, and other facilities and equipment.

B. Provide and operate drainage and pumping equipment; maintain excavations and Project Site free of standing water except designated ponds.

3.9 Barriers

A. Provide barriers to prevent unauthorized entry to construction areas to allow for Owner's use of Project Site, and to protect existing facilities and adjacent properties from damage from construction operations and demolition.

B. Protect non-owned vehicles, stored materials, Project Site, and structures from damage.

3.10 Fencing

A. Construction: Provide commercial-grade chain link fence.

B. Provide 6 foot high fence around Construction Site; equip fence with vehicular and pedestrian gates with locks.

3.11 Exterior Enclosures

A. Provide temporary weathertight closure of exterior openings to accommodate acceptable working conditions and protection for products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual Specification Sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.

3.12 Interior Enclosures

A. Provide temporary partitions to separate work areas from Owner-occupied areas to prevent penetration of dust and moisture into Owner-occupied areas, and to prevent damage to existing materials and equipment and as indicated.

B. Construction: Provide steel stud framing and gypsum wallboard with closed joints and sealed edges at intersections with existing surfaces.

C. Paint surfaces exposed to view from Owner-occupied areas.

3.13 Protection Of Installed Work

A. Protect installed Work in accordance with individual Specification Sections.

B. Provide temporary and removable protection for installed products. Control activity in immediate Work area to prevent damage.

C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

D. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects by covering with durable sheet materials.

E. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

F. Prohibit traffic from landscaped areas.

3.14 Project Site Security

A. Owner assumes no responsibility for loss, theft, or damage to Work, tools, equipment, and construction. In the instance of any such loss, theft, or damage, renew, restore, or remedy Work, tools, equipment, and construction in accordance with requirements of Contract Documents at no additional cost.

B. At Contractor discretion, and no additional cost, furnish watchman services, and other means of Project Site Security as deemed necessary.

C. Project Site parked equipment, operable machinery, and hazardous parts of new construction subject to mischief and accidental operation shall be inaccessible, locked, or otherwise made inoperable when left unattended.

3.15 Access Roads And Parking Areas

A. Liability: Owner is not responsible for damage, liability, theft, casualty, or other hazard to automobiles or other vehicles, nor to injury, including death, to occupants of automobiles or other vehicles on Owner's property. Provide signs to this effect in designated parking area.

B. Access Roads: Use existing roads on Project Site for access. Protect roads from damage from extra heavy loading by use of timbers or other approved means.

3.16 Project Identification And Signs

A. Provide project identification sign and temporary information and direction signs as required and approved by Owner’s Representative.

B. No other signs are permitted.

C. Sign faces shall be 3/4 inch exterior-grade, medium-density overlay plywood, unless otherwise indicated.

D. Signs shall conform to code requirements and regulations.

E. Project identification sign shall be 4 feet by 8 feet with the top of the sign at 9 feet above grade. Provide three (3) pressure treated 6 inch by 6 inch wood posts imbedded 4 feet into 2 feet diameter by 5 feet deep concrete footings. Provide four (4) pressure treated 2 inch by 4 inch studs mounted horizontally across posts to support face of sign.

F. Electronic copy of color signage graphics for project identification sign to be provided by design professional.

G. Erect signs at locations directed.

3.17 Field Office

A. Contractor shall provide a Field Office on Project Site where directed for accommodation of Contractor, Owner's Representative, and Design Professional and personnel.

B. Trailer facilities are acceptable if not restricted by zoning or other regulations preventing such use.

C. If trailer unit is not used, submit sketch of Field Office, dimensioned and drawn to scale, for approval by Owner's Representative's approval before proceeding with its construction.

D. Field Office shall contain the following, in addition to Contractor’s requirements:

1. Private, lockable offices, size 150 square feet. 2 office(s) required equipped with the following:

    a. One (1) minimum 9 square foot window per office.
    b. One (1) pivot wall rack with 12 hanging clamps per office.
    c. Minimum 25 lineal feet of 12 inch wide wall shelving per office.
    d. One (1) desk, chair, and waste basket per office.
    e. Two (2) four (4) drawer high, lockable file cabinets per office.

f. One (1) telephone per office.

2. Adequate lighting and receptacles.

3. Heating and air conditioning.

4. Hot and cold running water and operable toilet tied into sanitary sewer. Include a mirror, toilet paper dispenser, paper towel dispenser and wastebasket in toilet room.

5. One (1) desk and chair for use of visiting engineers, and inspection and testing agency personnel to write their reports.

6. Internet service.

7. One (1) large conference room with table and twelve (12) chairs.

8. One (1) plan table.

9. One (1) bottled drinking water cooler with refrigerated compartment.

E. Contractor shall provide all necessary routine maintenance and cleaning services including, but not limited to, replacement of light bulbs, furnishing of toilet paper, paper towels, paper drinking cups, and bottled drinking water, and sweeping of floors and emptying of wastebaskets on a daily basis.

F. Contractor shall provide access to the following:

1. Photocopy machine.

2. Minimum one (1) two-way radio.

3.18 Material Storage Sheds

A. Provide sheds for storage and protection of materials, tools, and other items required to perform Work which requires protection from weather and abuse.

B. When storing on or within building construction, do not exceed load capacity for which structure has been designed.

3.19 Progress Cleaning And Waste Removal

A. Maintain areas free of waste materials, debris, and rubbish. Maintain Project Site in a clean and orderly condition.

B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces prior to enclosing space.

C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

D. Collect and remove waste materials, debris, and rubbish from Project Site weekly and dispose off Project Site.

E. Open free-fall chutes are not acceptable. Terminate closed chutes into appropriate containers with lids.

3.20 Maintenance

A. Maintain facilities in good operating condition until removal. Protect facilities from damage by freezing temperatures, precipitation and similar elements.

B. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation and similar facilities on a 24 hour day basis where required to achieve indicated results and to avoid possibility of damage.

3.21 Work Restrictions

A. Tobacco free site: Tobacco use is not permitted.

3.22 Termination And Removal

A. Remove each temporary facility when the need has ended, or when replaced by authorized use of a permanent facility, but no later than Date of Substantial Completion. Complete or restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

B. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project Identification Signs.

C. Remove temporary paving that is not intended for or acceptable for integration into permanent paving. Where area is intended for landscape development, remove soil and aggregate fill that does not comply with requirements for fill or subsoil in area. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances which may impair growth of plant materials or lawns. Repair or replace street paving, curbs and sidewalks at temporary entrances as required by governing authority.

D. Prior to Date of Substantial Completion, clean and renovate permanent facilities that have been used during Construction Period including, but not limited to, the following:

1. Replace air filters, and clean inside of ductwork and housings.

2. Replace strainers and clean traps.

3. Replace significantly worn parts and parts that have been subject to unusual operating conditions as coordinated with Owner’s Representative.

4. Replace lamps that are burned out or noticeably dimmed by substantial hours of use as coordinated with Owner's Representative.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Requirements for temporary facilities and noise, dust and pollution control.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

1.3 Noise, Dust And Pollution Controls

A. General: Comply with minimum requirements of local noise, dust, and pollution control laws, ordinances, and regulatory agencies applicable to the work, and to more stringent requirements of the Contract Documents, governing limitation of noise and environmental pollution.

1. Comply with Owner's current noise, dust and pollution control plans and procedures.

B. Dust Control: Contractor shall direct all measures required to control generation of dust, and to contain subcontractor-generated dust, inside or outside of the buildings, to the work areas. Use water fog and mist (riot spray or stream) to dampen dusty areas. Contain waste debris disposal operations in enclosures, chutes and covered containers.

1. Ensure that excessive particulate matter emissions, nuisance dust conditions of PM10 (particulate matter with an aerodynamic diameter less than or equal to 10 microns) concentrations not exceed the National Ambient Air Quality Standard of 150 pg./cu.m. on a 24-hour average basis.

2. If the spread of construction generated dust to neighboring property is found to be objectionable, Contractor shall increase efforts to contain construction dust until acceptable conditions are obtained to the satisfaction of Owner.

3. Workers in dusty areas shall be equipped with protection and safety facilities in accordance with requirements of authorities having jurisdiction.

4. Dust and other debris resulting from work with painted materials or hazardous material shall be lawfully disposed of, and all treatment of hazardous material shall conform to requirements of authorities having jurisdiction.

C. Dust Control Practices: Practices to be employed on site on an as-needed basis include, but are not limited to, the following:

1. Install wheel wash stations, with proper provision for runoff of wastewater and debris. Submit proposed locations and methods for approval by Owner's Representative.

2. Spray aggregate piles and excavated materials with water soluble, non-toxic, non-reactive, non-volatile, and non-foaming agents.

3. Institute a procedure for street sweeping on a regular basis.

4. Where necessary and as directed by Owner, attach windscreens of durable fabric mesh of 50 percent porosity to construction fences.

5. Cover active and inactive stockpiles with plastic tarps secured with sandbags or an equivalent method to prevent the cover from being dislodged by the wind.

6. Minimize the free drop height of excavated or aggregate material during batch drop operations such as earthwork with front-end loader, clamshell bucket, or backhoe, to the extent practical.

7. Place properly secured covers on truck cargo areas during transport.

D. Noise Control: Contractor shall endeavor at all times to maintain as low a level of construction noise as practicable in order not to create a disturbance in the neighborhood or Owner's premises.

1. Owner will prepare a noise monitoring plan prior to construction. The plan shall consist of locations where noise monitoring will be performed, type of measurement device, data reporting methods, response and resolution procedures, and method for periodic inspections of equipment mufflers.

2. Contractor shall submit noise measurement reports weekly during construction. Weekly reports shall include noise level measurements taken during the previous week including construction, complaint response, and equipment certification measurements.

3. Any complaints duly registered by Owner of unacceptable noise levels shall be cause for the use of special precautions and methods of operation by the Contractor to reduce noise to acceptable levels, at no additional cost.

4. Any high noise level operations intended to occur during early morning and evening hours or weekends shall be subject to review and approval by Owner prior to proceeding.

E. Noise Levels: Contractor shall be responsible for ensuring that the following criteria are complied with:

1. Truck and equipment mufflers shall be periodically inspected for proper operation.

2. Low-pitch backup alarms shall be used.

3. Sound barriers shall be erected if noise limits exceeding those allowed are anticipated.

4. Daytime, evening and nighttime construction noise levels at noise-sensitive locations shall not exceed 85dBa as identified in the table.

5. The operation of equipment at full-load capacity shall not exceed the maximum noise limits specified.

6. The use of equipment with potentially higher noise levels shall be prohibited within 200 feet of a noise-sensitive location during nighttime hours.

7. To the extent practical, staging of compressors, pumps and similar pieces of equipment that remain stationary throughout the construction period shall be located away from sensitive receptors whenever possible.

Part 2 Products

Not used.

Part 3 Execution

Not used.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Administrative procedures and requirements for selecting, handling, storing, installing and protecting products.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Technical Sections Specifying Products.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Certifications: Certification of Compatibility.

1.4 Definitions

A. “Products” are items purchased for incorporation in the Work, whether purchased for Work or taken from previously purchased stock. Term “product” includes terms “material”, “equipment”, “system”, and terms of similar intent.

B. “Named Products” are items identified by manufacturer’s product name, including make or model designation, indicated in manufacturer’s published product literature.

C. “Foreign Products”, as distinguished from “domestic products”, are items having 50 percent or more of value manufactured outside of United States and its possessions; or produced or supplied by entities more than 50 percent owned by persons who are not citizens of nor living within United States and its possessions.

D. “Materials” are products that are substantially shaped, cut, worked, mixed, finished, refined or otherwise fabricated, processed, or installed to form a part of Work.

E. “Equipment” is a product with operational parts, whether automated or manually operated, that requires service connections, including wiring or piping.

F. “System” is an integrated assembly of materials or equipment which, when combined, form an integral whole to serve a function.

G. “New or like new” are products which comply with the following:

1. Have not been previously installed or operated prior to their installation in the Work.

2. Have been adequately protected so that they are substantially similar to their condition at the time of manufacture.

3. Have not been allowed to deteriorate in way that would affect performance or appearance or in way that results in product of lesser quality than when new.

1.5 Quality Assurance

A. Manufacturer’s Qualifications: Comply with indicated requirements unless otherwise indicated.

1. Experience: Provided products for three (3) projects of scope, schedule and complexity similar to this Project within the last two (2) years as acceptable to Design Professional.

2. Manufacturing: Product shall be manufactured by company marketing product. Products manufactured by third parties for private labeling by marketing company are not acceptable. Accessory products, as approved by Design Professional, may be manufactured by other than company marketing product.

3. Manufacturer’s Designer: Professional engineer licensed in the state in which the project is located, with minimum five (5) years experience designing systems similar to those required for this Work.

4. Manufacturer’s Technical Representative: Individual adequately trained by manufacturer and experienced to be knowledgeable about technical and performance aspects of product as acceptable to Design Professional. If requested by Design Professional, manufacturer shall furnish services of a technical representative from home office, or similar corporate engineering division of manufacturer, to support local sales or other technical representatives who are not adequately trained or knowledgeable.

B. Single Source Requirements: Similar products required for the Work shall be supplied by one (1) manufacturer, even if specified in more than one technical specification section.

C. Installer’s Qualifications:

1. Experience: Minimum five (5) years installing products similar to those required for this Work.

a. Completed three (3) projects of scope, schedule and complexity similar to this Project within last two (2) years as acceptable to Design Professional.

D. Welder’s Qualifications:

1. Welding procedures and qualifications: In accordance with "Structural Welding Code, Steel", AWS D1.1.

2. Welders shall be qualified to perform the type of work required.

1.6 Product Delivery, Handling And Storage

A. Deliver, store and handle products in accordance with manufacturer's written recommendations, using means and methods that prevent damage, deterioration and loss, including theft and as required to maintain products in a new or like new condition.

B. Schedule delivery in accordance with Construction Schedule, to minimize long-term storage at Project Site and to prevent overcrowding of construction spaces.

C. 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.

D. Deliver products to Project Site in manufacturer's original sealed container or other packaging system, complete with legible labels and written instructions for handling, storing, unpacking, protecting and installing.

E. Inspect products upon delivery to ensure compliance with Contract Documents, and to ensure that products are undamaged and properly protected.

F. Store products at Project Site in a manner that facilitates inspection and measurement of quantity and counting of units.

G. Store heavy products away from Project structure in manner that does not endanger supporting construction.

H. Store products subject to damage by elements above ground, under cover in weathertight enclosure, with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer's written instructions.

I. Do not install products that are not new or like new, except where installation of salvaged products are indicated.

J. Remove from Project Site and replace products which are not new or like new due to delivery, handling or storage at no additional cost.

1.7 Project Conditions

A. Environmental Requirements: Maintain environmental conditions and protection from weather as indicated in manufacturer's written instructions. Remove from Project Site products that are not in new or like new condition resulting from failure to maintain environmental requirements with new products at no additional cost.

1.8 Operation, Maintenance, Training And Calibration

A. Submit manuals and furnish services indicated and as required to startup, operate and maintain equipment and systems.

Part 2 Products

2.1 General Product Requirements

A. Provide products that:

1. Comply with Contract Documents.
2. Are undamaged.
3. Are new at the time of installation unless otherwise indicated to be salvaged.
4. Are new or like new at Substantial Completion unless otherwise indicated to be salvaged.
5. Are unused at time of Substantial Completion unless otherwise indicated.

B. Provide products complete with accessories, trim, finish, safety guards, and other devices and details required for a complete installation, and for intended use and effect.

C. Where Work requires testing for assurance of performance, that portion of Work shall not proceed until required testing has been completed and written test report has been approved in writing by Owner's Representative.

D. Do not provide material or equipment for purpose other than for which it is designed or specified.

E. Certification of Compatibility: If indicated, material and equipment manufacturers shall certify in writing that:

1. Other manufacturer's materials or equipment coming into contact with their product are compatible with their product and that intended performance of system in which their product is incorporated is not affected as a result of such contact. Physical breakdown of their product by chemical reaction or otherwise does not occur as a result of such contact.
2. Combination of products by one (1) manufacturer to make up manufacturer's specified system contributes to performance of system as intended, and remains operational, reliable and durable. Manufacturer is source of routine maintenance and replacement parts.

F. Reuse of Salvaged Existing Material: Unless otherwise indicated or otherwise approved in writing, do not provide materials or equipment removed from existing structure.

1. Where salvage or re-use of existing material is indicated or approved, exercise care in removing, handling, storing, and reinstalling to assure proper function and avoid damage in completed Work. Replace salvaged products that have been damaged during execution of the work with new products at no additional cost.

G. Nameplates: Except for required labels and operating data, do not attach or imprint manufacturer's or producer's nameplates or trademarks on exposed surfaces of products exposed to view in occupied spaces or on exterior.

1. Labels: Locate required product labels and stamps on a concealed surface or, where required for observation after installation, on accessible surface that is not conspicuous.

2. Equipment Nameplates: Provide permanent nameplate on each item of service-connected or power-operated equipment. Locate nameplate on easily accessible surface which is inconspicuous in occupied spaces. Nameplate shall include the following information and other essential operating data:

a. Name of product and manufacturer.
b. Model and serial number.
c. Capacity.
d. Speed.
e. Ratings.

H. Contractor's Options:

1. When Contractor is granted option of selecting between two (2) or more product types, make all subsequent product and accessory selections to comply with indicated requirements and selected manufacturer's written instructions.

2. Compatibility: Product selected shall be compatible with products previously selected, even if previously selected products were also options.

2.2 Product Selection Procedures

A. General Requirements:

1. Product selection is governed by Contract Documents and governing regulations.

2. Where products or manufacturers are specified by name, description, or performance accompanied by the term "or equivalent substitution," "or approved substitution," "or approved equal" or similar terms, comply with Product Substitution Procedures: Division 01, to obtain written approval for use of unnamed product.

3. Custom Products:

   a. When products are listed by name and additional requirements are listed, provide custom products, or customization of standard products.
   b. When requirements are listed and manufacturers are indicated, provide custom products or customization of standard products produced by those manufacturers.

4. Multiple product selection requirements may be indicated for a single product. Comply with requirements for all types of product selection indicated.

B. Proprietary Specification Requirements: Where only one product or manufacturer is indicated, provide product indicated, contingent upon meeting indicated requirements. Substitutions will not be considered, unless otherwise indicated.

C. Semi-proprietary Requirements: Where two (2) or more products are indicated, provide one (1) of products indicated, contingent upon meeting indicated requirements.

1. Where one (1) product is listed and other acceptable manufacturers without product names are listed, provide listed product or an equivalent product by one (1) of listed manufacturers.

2. Provide documentation demonstrating that products by listed manufacturer are equivalent in all salient features to listed product.

3. Final decision of equivalency is by Design Professional.

4. Substitutions will be considered.

D. "Basis of Design" Requirements: A specific manufacturer's product accompanied by the words "Basis of Design" establishes characteristics related to type, function, dimension, performance, physical properties, appearance, manufacturers support and service and other salient features.

1. Where other manufacturers are indicated, provide listed product or an equivalent product by one (1) of listed manufacturers, contingent upon meeting indicated requirements and requirements established by named product.

2. Provide documentation demonstrating that products by listed manufacturer are equivalent in all salient features to listed product.

3. Final decision of equivalency is by Design Professional.

4. Substitutions will be considered, unless otherwise indicated.

E. Descriptive Requirements: Where Contract Documents describe a product or assembly, indicating characteristics required, with or without use of a brand or trade name, provide product or assembly that provides characteristics and otherwise complies with Contract requirements.

F. Performance Requirements: Where Contract Documents require compliance with performance requirements, provide products that comply with these requirements, and are recommended in writing by manufacturer for application indicated.

1. Compliance shall be certified by independent testing agencies acceptable to Design Professional.

2. General overall performance of product is implied where product is indicated for a particular application.

3. Submit manufacturer's written recommendations contained in published product literature, or manufacturer's certification of performance.

G. Compliance with Referenced Codes, Standards and Regulations: Where Contract Documents indicate code, standard or regulation, provide product that complies with code, standard, or regulation indicated. Certify compliance by independent testing agencies acceptable to Design Professional.

H. Visual Matching: Where Contract Documents require matching an established sample or existing construction, Design Professional's decision will be final on whether a proposed product matches satisfactorily.

I. Visual Selection: Where indicated, product requirements include the phrase "...as selected from manufacturer's standard colors, patterns, textures..." or similar phrase, provide a product and manufacturer that complies with other specified requirements.

1. Design Professional will select color, pattern and texture from product line selected, including both standard and "premium" items, unless otherwise indicated.

2. Premium items are color, pattern, texture, or finish illustrated in published manufacturers data or advertisement without regard to price, stock availability or other limiting factor.

Part 3 Execution

3.1 Acceptable Installers

A. Installers shall be familiar with products and experienced in their installation. Comply with more stringent requirements of individual Sections for installer qualifications.

3.2 Examination

A. Each installer shall examine substrate onto which product is installed. Inspect for conditions that would reduce quality, performance or durability of product including, but not limited to, dimensional or location tolerances, dampness, dryness, installation not conforming to indicated criteria for substrate and poor workmanship. Do not proceed with installation over unacceptable substrates. Notify Contractor to have substrate repaired. Repair or remove and replace Work installed over unacceptable substrates at no additional cost after substrate is repaired.

3.3 Preparation

A. Protect adjacent Work from damage caused by the Work including, but not limited to, staining, overspray, denting, gouging, and displacement.

B. Prepare substrates and structure onto which subsequent work is installed in order allow for installation that will comply with indicated requirements for finished Work and as required to comply with manufacturer's written instructions.

1. Clean substrates and structure to remove substances deleterious to products in completed Work.

2. Prepare substrates and structure by grinding, sanding, abrasive blasting or otherwise abrading to provide surface texture suitable for subsequent installation.

3. Prepare substrates with primers, bonding agents, barrier coats, or other appropriate method in accordance with manufacturer's written instructions.

4. Prepare substrates with patching, leveling or filling compounds, shims, furring or other appropriate method in accordance with manufacturer's written instructions to bring substrate to condition that allows finished Work to comply with indicated tolerances.

3.4 Passage Of Material And Equipment

A. Establish passage clearances required to deliver and install material and equipment.

B. Where there is insufficient clearance for passage of material and equipment, deliver and protect such equipment before confining construction is installed.

C. If existing structures, equipment and systems must be altered to provide passage of new material and equipment, engage those skilled in respective trade to restore structures, equipment, and systems to their original condition at no additional cost. Do not alter structure, equipment, or systems without written approval of Owner's Representative.

D. In lieu of altering structures to allow passage of material and equipment, provide material and equipment that can be disassembled, brought into building, and reassembled.

E. If exterior windows or doors must be removed to allow passage of materials and equipment into building, store and protect removed Work at Project Site and reinstall as soon as possible. If damage occurs to Work during removal, transit, storage or reinstallation, replace or repair Work to like-new condition at no additional cost.

3.5 Installation

A. Comply with manufacturer's written instructions, and recommendations and requirements of individual Sections in applications indicated. If manufacturer's written instructions indicate differing installation techniques, request clarification from Design Professional. Comply with more stringent requirement unless directed otherwise.

B. Verify and maintain environmental conditions prior to installation, during installation, during curing periods and up to time of Substantial Completion.

C. Anchor each product in place accurately located and aligned with other Work.

D. Coordinate installation with other Work to allow for proper installation and sequencing of each underlying product.

3.6 Field Quality Control

A. Furnish services of manufacturer's Technical Representative on Project Site to observe crucial installation steps as required by individual Specification Sections or as required to comply with manufacturer's Warranty or other indicated criteria.

3.7 Adjusting

A. Adjust installed products for proper operation and fit.

3.8 Cleaning

A. Clean surfaces of products to new or like new condition at Date of Substantial Completion.

3.9 Protection

A. Provide temporary protection to maintain products in new or like new condition and to maintain environmental conditions. Remove from Project Site products that have not been adequately protected and replace with new products at no additional cost.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Work of an independent Testing and Balancing Agency. Testing and Balancing Agency shall test and balance mechanical systems as indicated, and make submittals as described in this Section.

1. Inspect Work pertaining to cooling and heating systems, and submit a written report to Owner's Representative, identifying Work that has not been installed in accordance with Contract Documents. Inspection shall be conducted every two (2) weeks for a period of eight (8) weeks prior to start of balancing. Inspection shall address systems to be tested and balanced.

B. Conduct thermal performance testing of cooling towers.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Instrumentation and Control for HVAC: Division 23.

C. Sequences of Operation for HVAC Controls: Division 23.

D. Preparation for Testing and Balancing of HVAC Systems: Division 23, refer to for responsibilities of Mechanical Installer with regard to Testing and Balancing Work.

E. Metal Ducts: Division 23.

F. Testing, Adjusting and Balancing for HVAC: Division 23.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Quality Control Procedures:

1. Inspection Reports: Every two (2) weeks prior to and weekly during testing and balancing.

2. Testing and Balancing Procedures: Written step-by-step procedures to be used for testing and balancing of each system thirty (30) days before starting Work. Step-by-step procedures shall include specific reference to components and sequence of testing, adjusting, and balancing. Include estimated start and completion dates for testing and balancing each system. As an example:

    a. Adjust speed of supply and return fans "X" and "Y" for required speed, revolutions per minute (rpm).
    b. Confirm fan flowrate and dynamic head as conforming to submitted fan curve.
    c. Set and mark manual damper settings for balanced flow.
    d. Adjust directional vanes on registers, grilles, and diffusers for proper spread and blow.
    e. By balancing airflow at each air terminal for Constant Volume (CV) systems and adjusting thermostats at each Variable Air Volume (VAV) air terminal, establish design flowrate at fan and confirm fan head. Take readings at terminals on longest run. Examine VAV control system to ensure that the proper connections have been made in order to test and confirm, for example, design airflow rates and pressure drops.
    f. At design flowrate:

        1) Measure inlet static pressure to each air terminal. Report deficiencies where static pressure is less than that required.

        2) Modulate thermostat at each reheat coil to ensure response and measure discharge air temperature at design room conditions.

3. List of test instruments and calibration dates to be used for each test.

C. Testing and Balancing (TAB) Reports: Including preliminary and final balance data sheets, DOP tests, sound tests, laboratory fume hood system testing and balancing, verification of direction of airflow, and thermal performance test of cooling towers.

1. Three (3) copies of written reports, during course of construction, of potential or developing problems and delays relating to Work being provided, where such problems may adversely affect proper TAB of equipment or systems.

2. Written reports for review upon completion of each major phase of TAB Work.

3. Reports of delayed TAB Work promptly after execution of those services.

4. Final TAB Report in accordance with requirements specified in this Section, modified and expanded to be compatible with requirements of installed system.

5. Form of Final Reports:

    a. Each final reporting form must bear signature of person who recorded data, and the seal and signature of TAB supervisor of reporting organization.
    b. When more than one (1) certified organization performs TAB services, firm having managerial responsibility shall make submittals.
    c. Identify instruments of all types that were used, and last date of calibration of each.

D. Certifications:

1. Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB) Certification.

2. Test Instrument Agency.

1.4 Quality Assurance

A. Testing and Balancing Agency shall be certified by Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB) or Testing, Adjusting and Balancing Bureau (TABB).

B. TAB Work performed by Testing and Balancing Agency shall be under direct supervision of a Professional Mechanical Engineer registered in State of Project, who is experienced in testing and balancing of mechanical systems, and who is a full-time employee of Testing and Balancing Agency. Technicians performing TAB Work must be properly trained, experienced and full-time employees of Testing and Balancing Agency.

C. Testing and Balancing Agency shall be approved by Owner's Representative.

D. Within 30 days after Award of Contract, transmit the following to Owner's Representative:

1. Name of organization proposed to perform TAB Work.

2. Proof of having balanced and tested at least five (5) projects of similar size and scope if requested.

E. Comply with applicable procedures and standards of certification-sponsoring association, unless more stringent requirements are specified in this Section; either:

1. Current issue of "National Standards for Testing and Balancing Heating, Ventilating and Air Conditioning Systems" published by AABC.

2. Current issue of "Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems" published by NEBB.

3. Calibrate and maintain test instruments in accordance with requirements of referenced standards. Calibrate instruments used in performance of TAB Work within six (6) months preceding date of usage. Calibration histories for each instrument shall be included with TAB Report.

4. Accuracy of measurements shall comply with more stringent of requirements of standards or tolerances indicated.

F. Balancing Tolerances:

1. Air Systems: Balance all equipment, air outlets and air intakes in accordance with air quantities indicated with permissible tolerances as follows:

a. Supply, Return and Exhaust Fans: Minus 5 percent to plus 10 percent.

b. Supply, Return, Exhaust, and Transfer to Individual Room: Minus 5 percent to plus 10 percent.
c. Individual Outlet, Intake or Transfer for Room with Multiple Outlets, Intakes or Transfer: Plus or minus 10 percent.

2. Hydronic Systems: Balance all equipment in accordance with capacities and flow quantities indicated with a permissible tolerance of minus 5 percent to plus 10 percent.

G. If, during progress of the construction or during balancing, Testing and Balancing Agency encounters any condition that will not allow balancing to be performed within above balancing tolerances, facts shall be reported immediately to Design Professional with written recommendations for corrective action. If feasible, report such conditions and written recommendations prior to submission of Balancing Reports. Work shall then proceed in accordance with response by Design Professional.

H. Referenced Codes and Standards: Comply with the following in accordance with Division 01.

1. American National Standards Institute/American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ANSI/ASHRAE)

111	Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems

2. Air-Conditioning and Refrigeration Institute (ARI)

640	Performance Rating of Commercial and Industrial Humidifiers

3. Associated Air Balance Council (AABC)

National Standards for Total System Balance

4. Cooling Technology Institute (CTI)

ATC-105	Acceptable Test Code for Water-Cooling Towers
FSP-36	Preparation and Procedures for an Official CTI Thermal Performance Test

5. National Environmental Balancing Bureau (NEBB)

Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems

1.5 Coordination And Cooperation

A. Installing Contractor responsible for Work under Mechanical: Division 23 provides services described in Testing, Adjusting and Balancing for HVAC: Division 23 and as indicated on Drawings.

B. Enlist aid of Installing Contractor or equipment suppliers, at no additional cost, whenever such aid is required for timely and proper performance of TAB Work.

C. Cooperate with Installing Contractor to effect smooth coordination of TAB Work with Construction Schedule.

1.6 Procedures

A. Report and review the requirements of the TAB Work with Design Professional before starting any field TAB Work.

B. Visit Project Site monthly, or more frequently, during installation of Work. When potential or developing problems be discovered relating to materials, equipment or methods being used in Work, and where such problems may adversely affect TAB Work, immediately report these findings in writing to Design Professional with written recommendations for correction.

C. Provide present operating status report of altered systems before demolition/alteration/new work is started.

1.7 Warranty And Contract Closeout

A. Warranty:

1. Provide a National Certification Guarantee from the AABC or the NEBB, applicable for the TAB Work performed under this Contract.

2. After completion of the Work specified under this Section, provide an extended warranty encompassing one (1) full heating season and one (1) full cooling season, during which time any balancing device which had been adjusted earlier as part of this Work shall be rechecked and reset when such additional Work is deemed necessary by Owner's Representative or Design Professional.

B. Contract Closeout:

1. Submit reports for:

   a. Air distribution systems balancing, including status report of existing conditions prior to start of demolition/alteration/new work.
   b. Water systems balancing, including status report of existing conditions prior to start of demolition, alteration or new work.
   c. Performance of Automatic Temperature Control System.

2. Submit National Certification Guarantee from AABC or NEBB.

Part 2 Products

2.1 Test Equipment

A. Furnish test instruments, materials, and equipment required for testing.

B. Test and calibrate instruments installed in systems to be tested and those portable instruments to be used for testing.

Part 3 Execution

3.1 General

A. Adjust, test, and confirm design flowrates, pressure drops, pressures, temperatures, and heat transfer performance for mechanical systems, including, but not limited to, chilled water system, condenser water system, hot water heating system, supply air, return air, outdoor air, transfer air, relief air, makeup air and exhaust air systems, including all associated pumps, chillers, boilers, cooling towers, coils, fans, dampers, diffusers, Airflow Measuring Devices (AMD), terminal devices, valves and accessories.

B. Perform in two (2) phases, preliminary and final testing and balancing. Initiate preliminary testing and balancing immediately after mechanical installer's certification of system performance, for example, before controls, ceilings and walls are completed. Confirm that source devices, including fans, pumps and converters are operating within 10 percent of their scheduled values. Preliminary phase shall be followed by a submitted written report of system shortcomings which prohibit final balancing. Following preliminary testing and balancing, if balancing or control devices are not operating correctly, report these conditions to Contractor who shall direct Work to make required corrections so that balancing can continue. Send a copy of report to Owner's Representative, Design Professional and Contractor.

C. Perform Work, using methods and test forms published by AABC National Standards for Total System Balance, or using equivalent NEBB methods and forms, except as modified in this Section.

D. Attend coordination meetings described in Testing, Adjusting and Balancing for HVAC: Division 23.

E. Do not start final testing and balancing until each system has been certified by Mechanical Installer to be complete, as required in Testing, Adjusting and Balancing for HVAC: Division 23.

F. Using controls and devices installed, test and balance air conditioning systems with maximum attainable internal load, including lights and equipment, or simulated maximum load using automatic temperature controls, whichever is closest to design operating conditions.

G. Perform final testing and balancing of air handling systems with finished ceilings and partitions in place, and doors closed.

H. Have on Project Site AABC or NEBB standards referred to in this Section, and make them available to Mechanical installer and Owner's Representative.

I. Design Professional may witness final testing and balancing of all systems. Testing and Balancing Agency shall notify Design Professional ten (10) working days prior to each system being tested or balanced.

J. Testing and Balancing Agency shall repair or replace finished products damaged by personnel employed by Testing and Balancing Agency as a result of testing, balancing and inspection work. Repair or replace finished products damaged in providing access to areas or in providing support for testing and balancing work.

K. In general, rate of transfer air in spaces shall be constant between maximum and minimum airflow setpoints for control of room relative pressure. Rate of transfer air is indicated on Drawings. Verify that transfer air rate is in conformance with indicated values, and recommend required corrective action if transfer air rate difference is greater than 10 percent between maximum and minimum airflow setpoints. Report deviations from Contract Documents required to accomplish design transfer air rates to Design Professional.

3.2 Instrumentation Calibration

A. Submit written certification of accuracy of instruments used by Testing and Balancing Agency. Show date and method of calibration. Instruments shall have been calibrated within six (6) months prior to estimated commencement date of testing and balancing work.

B. Verify the accuracy of permanently-installed flow-measuring primary elements and their read-out instruments, thermometers, sensors, and pressure gauges furnished by Mechanical Installer. Verification may be by calculation and calibration of primary element and read-out instrument, or by an independent measurement of flow, temperature or pressure of flow, of same flowing medium using calibrated instruments. Submit a report of accuracy of calibrations.

3.3 Balancing Procedures And Related Work

A. Balancing shall achieve design air and hydronic flowrates, within specified tolerances at terminal points, including air outlets, inlets, transfer air quantities and coil flowrates. Flowrates at fans and pumps shall be within indicated tolerances from flows indicated on Drawings, specified or scheduled. Where supply and return air fans of air handling units are of variable air volume (VAV) operation type, adjust both fans for similar control ranges. Transfer airflow direction shall be in accordance with Drawings in all modes of operation and flow shall be measured, where possible, rather than mathematically derived from supply, return and exhaust flows.

B. Verify that all controls and final control elements, including valves, louvers, dampers, heat pumps, and terminal boxes, operate as they are intended and in sequence specified. Report all device failures in preliminary reports submitted every week.

C. Where variable or initial fixed sheaves have been provided, determine correct fan rpm, and advise mechanical installer of correct fan rpm and required fixed-sheave diameter. Final fixed sheaves shall be sized such that, upon final balancing, balancing devices at fan and in highest pressure drop duct run are open. Do not "choke" excess fan capacity to achieve final system balance; instead, decrease fan speed (rpm) as required. Check and verify fan speed (rpm) following installation of fixed sheaves.

D. Fan systems with filters shall be balanced to design cubic feet per minute (cfm) with simulated dirty filter condition. The dirty filter pressure drop shall be as indicated on Equipment Schedules. Variable-frequency motor drives shall not be at 100 percent when filters are in clean condition.

E. Permanently-installed flow-measuring elements may be used to accomplish balancing after accuracy has been verified with certified calibrated instruments. Record and report readouts of these instruments for all flows, even if not required for testing and balancing results.

F. Adjust and mark solid-state variable-speed pump/fan controls for proper setting to produce design water/airflow rates.

G. Protect read-out instruments from damage, and return them in good working order to Mechanical Installer.

H. Only direct-flow measurements are acceptable. Do not use indirect calculations, such as a heat balance or pressure drop, unless authorized by Owner's Representative and/or Design Professional.

I. Balance air system minimum and maximum damper positions for correct operation at all operating conditions.

J. Balance air systems in all modes of operation, including unoccupied, occupied non-production, occupied in-production, warm-up, economizer, equipment failure modes.

K. Provide required openings for duct traverses. Seal test holes in ducts with snap-in plugs. Tape is not acceptable. Repair insulation where damaged. Mark insulation or exterior of duct where readings were taken.

L. Space Pressurization: Relative differential pressures between spaces are critical. Transfer air quantities and directions of flow between rooms are indicated on Contract Documents for all spaces where relative space pressure differentials are required. If not indicated otherwise, pressure differential shall be in range of 0.05 inch w.g. As systems are balanced, determine actual transfer air quantities from supply, return, and exhaust air readings, and include with balancing report. Show room numbers and actual transfer air quantities to and from each room. Adjust supply/exhaust air quantities so that each space achieves proper relative pressure in both occupied and unoccupied modes. Before changing the supply or exhaust air quantities, obtain approval from Design Professional on whether supply or exhaust should

be changed. Measure and record relative pressure differentials in balancing report, and identify and report any deviations to Design Professional.

M. Record test data for each motor, fan, pump, air system, heat exchanger, boiler, cooling tower, chiller, and condenser. Apply temperature, barometric and other correction factors for non-standard conditions and record in report.

3.4 Tests And Records

A. Submit a separate test report for each air and hydronic system containing actual temperatures, pressure drops and flowrates at all terminal devices, including terminal boxes, diffusers, fume hoods and coils, and compare totals to flow measurements taken at source, including fans and pumps and to design parameters. Include a separate report summarizing all test results obtained from space pressurization tests performed.

B. In addition, record test data where applicable on the following test forms defined in Chapter 26 of AABC National Standards for Total System Balance or equivalent NEBB forms. Modify forms as necessary to report information requested in this Section.

1. Air Moving Equipment Test Sheet: Form No. 82030.
2. Exhaust Fan Data Sheet: Form No. 82031.
3. Fan and Motor Pulley: Form No. 82034.
4. Duct Traverse Readings: Form No. 82035.
5. Duct Traverse Zone Totals: Form No. 82036.
6. Air Distribution Test Sheet: Form No. 82040.
7. Terminal Units: Form No. 82041.
8. Pump Data Sheet: Form No. 82060.
9. Cooling Tower: Form No. 82070.
10. Chillers: Form No. 82080.
11. Air-Cooled Condenser: Form No. 82081.
12. Primary Heat Exchanger: Form No. 82090.
13. Cooling Coil Data: Form No. 82100.
14. Heating Coil Data: Form No. 82101.
15. Sound Level Report: Form No. 82300.
16. Octave Band Chart: Form No. 82301.

C. In addition to tests and records for foregoing equipment, tests, and records are required for the following equipment:

1. Heat transfer and reheat coils, including nameplate data and, for both design and actual conditions, the following:

   a. Inlet and outlet air temperature and, for cooling, both wet and dry bulb temperatures on 2 foot vertical and horizontal centers at air handlers.
   b. Air pressure drop.
   c. Air face velocity on 2 foot vertical and horizontal centers at air handlers.
   d. Chilled water, hot water pressure, in and out.
   e. Chilled water, hot water pressure drop.
   f. Outside air temperature.
   g. Entering and leaving coil fluid temperatures and flow.
   h. Entering pressure.
   i. Calculate air BTU/hr versus liquid BTU/hr.

2. Heat exchangers, including nameplate data, and both design and actual inlet and outlet water temperature and pressure drop at full flow through unit.

3. Air filters and air handling units, including air pressure drop across filters and entire unit.

D. In addition to data required on AABC or NEBB forms, the following additional information is required for all scheduled equipment:

1. Motors: Type, amps per phase, frame number, serial number, motor horsepower, and calculated driven equipment brake horsepower and efficiency at final conditions.

2. Fans: Blade design type such as Air Foil (AF), Backwardly Inclined (BI), Forward Curved (FC), Single Width Single Inlet (SWSI) or Double Width Double Inlet (DWDI), class and number of blades.

3. Pumps:

   a. Design Data: Impeller size, motor hp, rpm, net positive suction head (NPSH) required at design flow, and total dynamic head (TDH) at zero flow.
   b. Test Data: Suction and discharge pressures at full flow (not throttled to obtain rated flow), and zero flow.

4. Hydronic Systems: Flowrate in each significant branch, position of each balancing valve, and flowrate to each unit, including each cell of cooling tower.

5. Constant Volume Terminal Boxes: Test and record volume and pressure into and out of constant-volume air terminal boxes for all modes of operation. Recalibrate factory setting of volume on box if it differs from Design Documents.

6. VAV Terminal Boxes: Test inlet pressure to Variable Air Volume (VAV) terminal boxes, and confirm performance, minimum/maximum airflow, response to thermostat or static pressure sensor, and minimum closure airflow.

7. Fan and Pump Systems: For systems controlled by static pressure, assure by test and recording that devices, including high-limit controls are calibrated to perform in accordance with Contract Documents, and provide design static pressure at most distant location. Furnish and coordinate static pressure setpoint of controls, as applicable, with the installation of BMS System. Fans and pumps that are driven by variable-frequency drives shall be tested over their operating range. Conduct vibration tests on VFD-driven equipment over their entire operating range.

8. Air Change Rates: Calculate actual air change rate for each room based on actual supply, return, and exhaust air quantities.

9. Deviation: Calculate, for each room, percent deviation between actual supply, return, and exhaust air quantities and supply, return, and exhaust air quantities indicated on Drawings.

3.5 Testing And Balancing Reports

A. Submit preliminary and final testing and balancing reports for approval.

B. Arrange recorded data by system, using the appropriate designations as established in Contract Documents. Submit signed, bound, and indexed copies of both preliminary and final reports to Owner's Representative and Design Professional.

C. Where actual measurements recorded for final balance show deviation of more than 5 percent from design balancing point, and deviation cannot be corrected by balancing with installed layout and elements, note this deviation in final report with written recommendations for corrective action.

D. In those cases where recorded data can be reasonably interpreted to be inaccurate, inconsistent or erroneous, Owner's Representative may request additional testing and balancing. Testing and Balancing Agency shall, at no additional cost, perform such retesting and rebalancing as directed by, and in presence of Owner's Representative.

E. Where, in opinion of Testing and Balancing Agency, there is excessive vibration, movement, or noise from any piece of equipment, ductwork, or piping, note these conditions in final report with written recommendations for corrective action.

3.6 Verification Of Direction Of Airflow

A. Where airflow diagrams indicate transfer air into or out of a room, verify that direction of transfer air is correct by generating smoke with a hand-held aspirating smoke generator in one (1) room and observing smoke's direction of travel to adjacent rooms. Conduct this test for each room where airflow diagrams indicate transfer air into or out of a room.

B. After successful completion of testing, submit a written report on rooms to Construction Manager, Owner's Representative and Design Professional.

3.7 Ductwork Leak Test Witnessing

A. Testing and Balancing Agency shall witness ductwork leak testing conducted by Mechanical Installer under Metal Ducts: Division 23. Advance notice of three (3) working days will be provided. Ductwork may be tested in sections and must be tested within ten (10) working days of installation.

B. Testing and Balancing Agency shall inspect ductwork installation and ductwork leak testing setup to ensure compliance with Metal Ducts: Division 23, and shall verify Mechanical Installer's instrument readings and sign Mechanical Installer’s test documentation.

3.8 Thermal Performance Testing Of Cooling Towers

A. Cooling tower(s) shall be tested in accordance with Cooling Technology Institute (CTI) Test Code ATC-105: Acceptance Test Code for Water-Cooling Towers. Test shall be performed by a licensed CTI Thermal Testing Agency. Testing and Balancing Agency shall hire this agency and coordinate all related work.

B. Test procedure shall follow requirements of CTI Bulletin FSP-136: Preparation and Procedures for an Official CTI Thermal Performance Test.

C. Testing and Balancing Agency shall coordinate with Mechanical Installer and Thermal Testing Agency for proper locations of test instruments and wells/taps for test instruments required for test.

D. Testing and Balancing Agency shall be responsible for coordinating proper timing for this test to satisfy outdoor ambient condition requirements required by test code. Inform Owner’s Representative seven (7) days before date of test.

E. All results and calculations shall be compiled in an orderly manner and shall be submitted to Owner’s Representative.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Contractor shall engage services of a Surveyor to establish all grades, lines and levels, and as follows:

1. Each separate Contractor shall be responsible for layout of their own Work from grades, lines and levels established by Contractor.

2. Contractor shall engage services of a Surveyor to perform surveys for measurement and payment based on Unit Costs of all Work performed under Project Earthwork: Division 31 including, but not limited to, earthwork, paving, Project Site utilities and landscaping.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Application for Payment: Division 01.

C. Unit Prices: Division 01.

D. Project Closeout: Division 01.

E. Project Record Documents: Division 01.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Surveyor Data: Name, Address, and Telephone Number of Surveyor, prior to starting survey work.

C. Certifications:

1. Documentation certifying accuracy of survey work, upon request.

2. Documentation signed and sealed by Surveyor stating that elevations and locations of all improvements are or are not in conformance with Contract Documents.

D. Record Documents: In accordance with Division 01.

1.4 Quality Control

A. Surveyor: Licensed in State of North Carolina and acceptable to Design Professional.

1.5 Project Record Documents

A. Maintain complete, accurate log of control and survey work as it progresses.

B. Record on Project Record Documents all pertinent information in accordance with Division 01.

C. On completion of foundation walls and major Project Site improvements, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and Project Sitework.

D. Submit Project Record Documents as specified.

Part 2 Products

Not used.

Part 3 Execution

3.1 Inspection

A. Verify locations of survey control points prior to starting Work. Promptly notify Owner's Representative and Design Professional of discrepancies discovered.

3.2 Survey Reference Points

A. Protect survey control points prior to starting Project Site work; preserve permanent reference points during construction. Make no changes without prior written notice to Owner's Representative and Design Professional.

B. Promptly report to Owner's Representative and Design Professional destruction of any reference point or relocation required because of changes in grades or other reasons. Replace dislocated survey control points based on original survey control.

3.3 Survey Requirements

A. Use instruments to establish a minimum of two (2) permanent benchmarks on Project Site. Reference benchmarks to data established by survey control points. Record benchmark locations with horizontal and vertical data for Project Record Documents. Reference these benchmarks to finished floor lines and grades. Provide accurate alignment and level of Work, and correct slope and curvatures as required.

B. Periodically verify layouts and elevations by same means. No extra charges will be allowed for differences between dimensions and elevations indicated and actual measurements. Advise Owner's Representative and Design Professional of any differences. Do not provide filler pieces or closures without approval of Design Professional.

C. Prepare Project Record Documents of grading, layout and Project Site utility plan showing final installation of all Project Site improvements and utilities, including stormwater, sanitary, water, gas and electric lines for permanent record.

3.4 Surveys For Measurement And Payment

A. Perform surveys to determine quantities of Unit Price Work, including control surveys to establish measurement reference lines. Notify Owner's Representative and Design Professional prior to starting Work.

B. Contractor's Engineer shall sign Surveyor's field notes or keep duplicate field notes, and shall calculate and certify quantities for payment purposes.

3.5 Settlement Survey

A. Prior to start of construction operations, fix elevation targets to surrounding buildings. Targets shall be located minimum at each corner of building and maximum 100 feet on center.

B. Perform surveys to determine elevation of targets in relation to benchmarks which shall not be disturbed by construction.

C. During excavation operations, perform surveys weekly to determine elevation of targets. Report results to Owner’s Representative and Design Professional in writing. If settlement over 1/4 inch has occurred, notify Contractor and Owner’s Representative and Design Professional immediately.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Cutting and patching required to complete Work, including:

1. Make Work parts come together properly.
2. Uncover portions of Work to provide for installation of ill-timed work.
3. Related excavation and backfill.
4. Remove and replace defective work.
5. Remove Samples of installed Work for testing as indicated.
6. Provide penetrations for installation of piping, ductwork and electrical conduit.
7. Prepare existing surfaces indicated to be coated in Finished Work with paint, sealers, high-performance coatings and similar finishes which do not conceal surface irregularities.
8. Repair surfaces indicated to remain in Finished Work which are damaged in process of demolition.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Firestopping: Division 07, refer to for regulations related to firestopping and smoke penetration.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Demolition Procedures and Operational Sequences: For review and acceptance by Contractor and Design Professional.

C. Calculations: For shoring if structural elements are to be altered, removed or redesigned.

Part 2 Products

2.1 Materials

A. Provide materials that match materials being cut or patched and are recommended by manufacturer of overlying materials if applicable. If matching materials are not available, provide new materials with installed performance matching or exceeding cut or patched material. Comply with Specifications and Standards for each material involved.

Part 3 Execution

3.1 Examination

A. Examine existing conditions, including Work subject to damage or movement during cutting and patching.

B. Report unsatisfactory conditions to Design Professional. Do not proceed until directed.

3.2 Preparation

A. Provide temporary support as required to maintain structural integrity of Work.

B. Provide materials and methods to protect other Work from damage, including exposure to elements.

C. Prepare existing surfaces indicated to be coated in Finished Work with paint, sealers, high-performance coatings and similar finishes which do not conceal surface irregularities as required to allow finish surface to comply with indicated requirements and as required to deliver a finished surface comparable to a system applied to new or like new substrates.

1. Remove existing finishes or surface defects which are loose or will adversely affected the overlying material.

2. Patch rough or irregular surfaces to provide a smooth substrate.

3. Sand or abrade and prime or otherwise prepare existing to maximize bond of overlying materials.

3.3 Protection

A. Do not interfere with use of adjacent building areas.

B. Prevent movement or settlement of structure(s). Provide and place bracing or shoring as required.

C. Provide, erect and maintain barricades, lighting, and guardrails as required by applicable regulatory advisory to protect occupants of building, public and workers.

D. Maintain legal egress from building at all times. If demolition work encroaches on a required exit, provide an enclosed fire rated passageway to such exit. Keep required exits unencumbered at all times, and artificially lighted.

E. Maintain legal fire lanes and access to fire hydrants. If Work encroaches on fire lanes or encompasses hydrants, provide new fire lanes and hydrants as required.

3.4 Performance

A. Do not cut or alter Work of another Contractor without written consent of Owner's Representative.

B. Do not cut structural steel, structural concrete or load-bearing unit masonry without written approval of Design Professional.

C. Execute cutting and demolition by methods which shall prevent damage to Work of other Sections, and provide proper surfaces to receive installation of repairs.

D. Perform excavating and backfilling by methods which will prevent settlement or damage to Work of other Sections. Maintain excavations free of water.

E. Where cutting and patching of materials provided under this Contract is required, employ original installer or fabricator to perform cutting and patching of:

1. Structural steel and concrete.
2. Weather-exposed elements.
3. Moisture or corrosion resistant elements.
4. Sight-exposed finished surfaces.

F. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances and finishes.

G. Firestop through penetrations and construction gaps created by cutting and patching in compliance with Division 07.

H. Restore Work to remain, or be reused, which has been cut or removed. Provide new products to make complete Work in accordance with Contract Documents.

I. Refinish entire surface to provide an even finish to match adjacent surfaces. Refinish surfaces to nearest intersection. For assembly, refinish entire unit.

3.5 Removal Of Debris

A. Dispose of unusable material and debris resulting from Work in a legal dumpsite off of Project Site, and leave areas clean and ready for succeeding Work of other Sections.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Procedural requirements for executing, assembling and submitting warranties, bonds and service and maintenance contracts as follows:

1. Compile specified warranties, bonds, and service and maintenance contracts.

2. Review to verify compliance with Contract Documents. Co-execute Documents when specified.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Contract Conditions.

C. General and Supplementary Conditions of the Contract.

D. Project Closeout: Division 01.

E. Individual Specification Sections requiring warranties, bonds and service/maintenance contracts.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Closeout Submittals:

1. Warranties, Bonds and Service and Maintenance Contracts: Two (2) sets of original signed copies executed by respective Manufacturers, Suppliers, and Subcontractors as follows:

a. Contents: Neatly type, in orderly sequence, the following information for each item:

1) Product or work item.

2) Subcontractor, supplier and manufacturer's name, address and telephone number.

3) Date of beginning and duration time of warranty, bond, or service and maintenance contract.

4) Proper procedure in case of failure.

5) Instances which might affect validity of warranty, bond or service and maintenance contract.

b. Bind each set in 8 1/2 inches by 11 inches commercial quality, 3-ring, D-type binders with durable and cleanable plastic covers. Identify each binder with typed or printed titles “Warranties and Bonds”, “Service and Maintenance Contracts” with title of Project, Location, Date and Owner. No hand lettering.

1.4 Time Of Submittals

A. For equipment or component parts of equipment placed into service during progress of construction, submit Documents within ten (10) days after Final Inspection and Final Acceptance.

B. Make other submittals within ten (10) days after Date of Substantial Completion prior to Final Request for Payment.

C. For items of Work, where acceptance is delayed materially beyond Date of Substantial Completion, provide updated submittal within ten (10) days after Final Acceptance, listing Date of Final Acceptance as start of Warranty Period.

Part 2 Products

Not used.

Part 3 Execution

Not used.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Procedures to minimize the amount of waste generated by the Project and to recycle a portion of the waste for recycling.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Construction Waste Management Plan: Submit not later than 30 days after Notice to Proceed or start of construction activities, whichever is earliest.

C. Construction Waste Documentation: Tabulating total waste material, quantities diverted and means by which it is diverted, and statement that requirements have been met.

1.4 Performance Requirements

A. Institute procedures which will reduce by 50 percent the volume of waste sent to landfills as compared to a similar typical project, unless a higher percentage is indicated on the Construction Waste Management Plan.

B. Contractor shall be responsible for ensuring that debris will be disposed of at appropriately designated licensed solid waste disposal facilities, as defined by MGL Chapter 111, Section 150A.

1.5 Quality Assurance

A. Manager: Designate an on-site person responsible for instructing workers and overseeing and documenting results of the Waste Management Plan for the Project.

B. Waste Management Plan: Include the following:

1. Analysis of the proposed Project Site waste to be generated, including types and rough quantities.

2. Landfill Options: The name of the landfills where trash and building debris will be disposed of, the applicable landfill tipping fees, and the projected cost of disposing of all Project waste in the landfills.

3. Landfill Certification: Contractor's statement of verification that landfills proposed for use are licensed for types of waste to be deposited and have sufficient capacity to receive waste from this Project.

4. Alternatives to Landfilling: A list of each material proposed to be salvaged or recycled during the course of the Project. Include the following and any additional items proposed:

    a. Cardboard.
    b. Wood.
    c. Reusable pallet wood, plywood and OSB.
    d. Beverage containers.
    e. Plastic.
    f. Land clearing debris.
    g. Concrete.
    h. Bricks and masonry.
    i. Asphalt.
    j. Metals from framing, banding, stud trim, ductwork, piping, rebar, roofing, other trim, steel, iron, galvanized sheet steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze.
    k. Mechanical and electrical equipment.
    l. Building components which can be removed relatively intact from existing construction.
    m. Gypsum Wallboard.
    n. Carpet.
    o. Roofing.
    p. Glass.
    q. Paper.
    r. Insulation.
    s. Ceiling tiles returned to manufacturer.

5. Meetings: A description of the regular meetings to be held to address waste management.

6. Materials Handling Procedures: A description of the means by which any waste materials identified above will be protected from contamination, and a description of the means to be employed in recycling the above materials consistent with requirements for acceptance by designated facilities.

7. Transportation: A description of the means of transportation of the recyclable materials (whether materials will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler and removed from the site) and destination of materials.

8. Summary Report: Prior to Substantial Completion, the Contractor shall submit a written Waste Management Report summarizing the types and quantities of materials recycled and disposed of under the Waste Management Plan. Also include the name and location of disposal facilities.

9. Distribution: Distribute copies of the Waste Management Plan to the Project Site Foreman, each Subcontractor, Owner and Design Professional.

C. Instruction: Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the Project.

D. Referenced Standards: Comply with the following in accordance with Division 01.

1. Sustainability Requirements.

E. Maintain records of hauling tickets and receipts provided by recipients of salvaged or recycled material.

F. Preconstruction Sustainability Meeting: Discuss Waste Management Plan at Preconstruction Sustainability Meeting specified in Sustainability Requirements: Division 01.

1.6 Delivery, Handling And Storage

A. Packing:

1. Pack materials for shipment to site in re-usable containers.

2. Use packing materials manufactured with 100 percent post-recycled content.

Part 2 Products

Not used.

Part 3 Execution

3.1 Preparation

A. Protection: Protect adjacent surfaces from staining, deterioration or damage.

B. Separation Facilities: Provide and label a specific area to facilitate separation of materials for recycling, salvage, reuse, and return. Recycling and waste bin areas are to be kept neat and clean and clearly marked in order to avoid contamination of materials.

3.2 Waste Management Plan Implementation

A. Manager: Contractor shall designate an on-site person responsible for instructing workers and overseeing and documenting results of Waste Management Plan for Project.

B. Distribution: Contractor shall distribute copies of Waste Management Plan to Job Site Foreman, each Subcontractor, Owner and Design Professional.

C. Instruction: Contractor shall provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at appropriate stages of Project.

D. Separation Facilities: Contractor shall lay out and label a specific area to facilitate separation of materials for recycling, salvage, reuse, and return. Recycling and waste bin areas are to be kept neat and clean and clearly marked in order to avoid contamination of materials. Location shall be acceptable to Owner and Design Professional.

E. Hazardous Wastes: Any unforeseen hazardous wastes shall be separated, stored, and disposed of according to local regulations and as directed by Owner.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Final cleaning of Work required before Project Closeout, including the following:

1. Minor repairs and touch up of marred surfaces and broken glass.

2. Disposal and hauling of remaining construction debris.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Project Closeout: Division 01.

C. Additional cleaning is specified in individual Specification Sections.

D. Mechanical: Division 23.

E. Electrical: Division 26.

1.3 Performance Requirements

A. Comply with Green Seal™ Environmental Standard for Cleaning Services, GS-42, as follows:

1. Floor Care procedures shall commence on a room-by-room basis as final flooring is installed.

2. All areas shall be cleaned once in accordance with Cleaning Procedure Requirements as a requirement for Substantial Completion.

Part 2 Products

2.1 Materials

A. Use only cleaning materials recommended in writing by manufacturer of surface to be cleaned.

1. Materials shall comply with Green Seal™ Environmental Standard for General-Purpose, Bathroom, Glass, and Carpet Cleaners Used for Industrial and Institutional Purposes.

B. If there is no written recommendation for cleaning a material, then, prior to cleaning, Contractor shall contact manufacturer of material to obtain written recommendations for cleaning. Proceed with cleaning only after obtaining written recommendations from manufacturer.

C. Use cleaning materials only on surfaces recommended in writing by cleaning material manufacturer.

Part 3 Execution

3.1 Cleaning

A. Immediately before Design Professional's observation of Work for Substantial Completion, clean sight-exposed surfaces, and leave Project Site clean and ready for Occupancy. Clean ledges and other horizontal or near horizontal surfaces, which may not be sight-exposed but are contiguous to finished spaces.

B. Employ experienced workers or professional cleaners for final cleaning.

C. Remove grease, dust, dirt, stains, labels, fingerprints, and other foreign materials from sight-exposed interior and exterior finished surfaces. Polished surfaces shall have shine finish.

D. Broom clean paved surfaces. Rake clean other surfaces of grounds.

E. Thoroughly clean all interior and exterior glass prior to Substantial Completion.

F. Clean mechanical equipment and ductwork, and replace filters as indicated in Mechanical: Division 23.

G. Clean electrical work, including lighting fixtures, as indicated in Electrical: Division 26.

H. Maintain Project Site clean until Work or portion thereof is accepted by Certificate of Substantial Completion. If minor work is required after Date of Substantial Completion, coordinate with Owner's Representative and clean affected areas afterwards.

3.2 Minor Repairs And Touch Up

A. Repair, patch, and touch up marred surfaces to specified finish to match adjacent surfaces. Replace damaged glass with specified materials.

3.3 Disposal And Hauling

A. Remaining construction debris and waste materials shall be collected and transported off of Project Site, and disposed of in accordance with applicable local, state and federal laws.

B. Debris and waste materials shall not be allowed to blow or spill into any public or private property during transporting.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Administrative and procedural requirements for Project Closeout.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Application for Payment: Division 01.

C. Final Cleaning: Division 01.

D. Project Record Documents: Division 01.

E. Operation and Maintenance Data: Division 01.

F. Warranties and Bonds: Division 01.

1.3 Submittals (Closeout)

A. Submit per the requirements of Division 01 when Work is complete.

B. Quality Control Procedures:

1. Keys and Keying Schedule: In accordance with Door Hardware: Division 08.

C. Certifications:

1. Evidence of Compliance: With requirements of governing authorities as indicated.
2. Substantial Completion Notification: As indicated.
3. Final Completion Notification: As indicated.
4. Certificate of Occupancy: As indicated.
5. Certificates and Reports of Inspections, Tests and Approvals: As indicated and for elevators, mechanical work, electrical work, and other Work requiring Certificate of Inspection by governing authority.
6. Evidence of Payment and Release of Liens: In accordance with requirements of Contract Conditions.

7. Final Application for Payment: in accordance with Section Application for Payment: Division 01.

8. Consent of Surety: As indicated.

D. Closeout Submittals:

1. Project Record Documents: In accordance with Division 01.

2. Operation and Maintenance Manuals: In accordance with Division 01.

3. Warranties and Bonds: In accordance with Division 01.

4. Spare Parts and Maintenance Materials: As indicated.

5. Final Adjustments of Accounts: As indicated.

1.4 Substantial Completion

A. Submit written notice when Work or a designated portion thereof, is substantially complete. Include a list of all items that require completion or correction.

B. Within a reasonable time after receipt of such notice, an inspection will be made to determine status of completion.

C. If Work is not considered substantially complete, Contractor will be notified in writing, citing reasons.

D. Remedy deficiencies in Work, and send written notice of Substantial Completion of item noted as requiring correction or completion to achieve Substantial Completion status.

E. Work will be observed again and, if not considered substantially complete, Contractor will be notified as indicated.

F. When determined that Work is substantially complete, Design Professional will:

1. Prepare a Certificate of Substantial Completion on AIA Form G704, accompanied by Contractor's list of items to be completed or corrected, as verified and amended by Owner's Representative.

2. Submit Certificate to Owner’s Representative for written acceptance of responsibilities assigned to them in the Certificate.

G. Prepare Application for Payment after Date of Substantial Completion, and complete administrative and submittal requirements per Application for Payment: Division 01.

1.5 Final Observation

A. When Work is considered complete, submit written certification that:

1. Contract Documents have been reviewed.

2. Work has been inspected by Contractor and has been completed in compliance with Contract Documents.

3. Equipment and systems have been tested in presence of Owner's Representative and Design Professional and are operational.

4. Work is ready for final observation.

B. Inspection by Design Professional will be made to verify status of completion with reasonable promptness after receipt of such certification.

C. If Work is not considered complete, Contractor will be notified in writing, listing incomplete or defective Work.

D. Take immediate action to remedy stated deficiencies, and, after correcting deficiencies, send a written certification that Work is complete. This certification shall itemize each deficiency noted and a statement of action taken to remedy or complete Work.

E. Work will be observed again and, if not considered substantially complete, Contractor will be notified as indicated.

F. When Work is acceptable under Contract Documents, make closeout submittals.

1.6 Additional Observation Fees

A. Should Design Professional perform more than one (1) observation at Substantial or Final Completion due to failure of Work to comply with claims of status of completion made by Contractor:

1. Owner shall compensate Design Professional for such additional services.

2. Owner will deduct amount of such compensation from Final Payment to Contractor.

1.7 Spare Parts And Maintenance Materials

A. Furnish spare parts and maintenance materials as indicated under various Sections of Specifications.

B. Package and label parts and materials as directed, and store in area of building where directed by Owner's Representative.

1.8 Final Adjustments Of Accounts

A. Submit a final statement of accounting.

B. Statement shall reflect all adjustments to Contract Sum:

1. Original Contract Sum.

2. Additions and deductions resulting from:

a. Previous Change Orders.

b. Change Orders caused by substitutions, including deductions for review.
c. Allowances.
d. Unit Prices.
e. Deductions for uncorrected Work.
f. Deductions for reinspection payments.
g. Other adjustments.

3. Total Contract Sum, as adjusted.

4. Previous payments received.

5. Sum remaining due.

C. Contractor will prepare a Final Change Order, reflecting approved adjustments to Contract Sum which were not previously made by Change Orders.

1.9 Final Application For Payment

A. Submit Final Application for Payment in accordance with procedures and requirements indicated.

Part 2 Products

Not used.

Part 3 Execution

Not used.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Procedural requirements for compiling and submitting operation and maintenance data.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Inspection and Testing Services: Division 01, refer to for testing and balancing reports.

C. Material and Equipment: Division 01.

D. Project Closeout: Division 01, refer to for Contract Closeout Procedures.

E. Project Record Documents: Division 01.

F. Warranties and Bonds: Division 01.

G. Individual Specification Sections: Specific requirements for operation and maintenance data.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit documents within ten (10) days after acceptance.

C. Closeout Submittals:

1. Preliminary Draft of Operation and Maintenance Manuals: Submit before start of Work.

2. Final Operation and Maintenance Manuals: Submit completed volumes fourteen (14) days prior to Final Inspection. Submittal will be reviewed and returned after Final Observation with Design Professional's comments. Revise content of all Document Sets as required prior to Final Submission.

3. Revised Final Operation and Maintenance Manuals: Submit revised final volumes in final form prior to Final Application for Payment.

1.4 Quality Assurance

A. Prepare written instructions and data by personnel experienced in maintenance and operation of described products.

1.5 Format

A. Prepare data in form of an instructional manual – 2 hard copies and one digital PDF format.

B. Binders: Commercial quality, 8 1/2 inches by 11 inches three-ring, D-type binders with durable covers. When multiple binders are used, correlate data into related consistent groupings.

C. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project, Location, Date, Owner and subject matter of contents.

D. Provide tabbed flyleaf indexed for each separate product and system, with typed description of product and major component parts of equipment.

E. Text: Manufacturer's printed data or type written data.

F. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

G. Contents: Prepare a Table of Contents for each volume, with each product or system description identified, in three (3) parts as follows:

1. Part 1: Directory, listing names, addresses, and telephone numbers of Design Professional, Contractor, Subcontractors, and major equipment suppliers.

2. Part 2: Operation and maintenance instructions, arranged by system and subdivided by Specification Section. For each category, identify names, addresses and telephone numbers of Subcontractors and Suppliers. Identify the following:

    a. Significant design criteria.
    b. List of equipment.
    c. Parts list for each component.
    d. Operating instructions.
    e. Maintenance equipment for equipment and systems.
    f. Maintenance instructions for finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.

3. Part 3: Project Documents and Certificates, including the following:

    a. Shop Drawings and Product Data.
    b. Air and water balance reports.
    c. Certificates.
    d. Photocopies of warranties.

1.6 Data

A. For Each Product or System: List names, addresses and telephone numbers of Subcontractors and Suppliers, including local source of supplies and replacement parts.

B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.

C. Drawings: Supplement Product Data to illustrate relations of component parts of equipment or system to show control and flow diagrams. Do not use Project Record Documents as Maintenance Drawings.

D. Type Text: As required to supplement Product Data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's written instructions.

E. Warranties, Bonds and Service and Maintenance Contracts: As specified in Warranties and Bonds: Division 01.

1.7 Manual For Materials And Finishes

A. Building Products, Applied Materials, and Finishes: Include Product Data, with catalog number, size, composition, and color and texture designations. Provide information for re-ordering custom-manufactured products.

B. Instructions for Care and Maintenance: Include manufacturer's written recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and written recommended schedule for cleaning and maintenance.

C. Moisture Protection and Weather-Exposed Products: Include Product Data listing applicable reference standards, chemical composition, and details of installation. Provide written recommendations for inspections, maintenance and repair.

D. Additional Requirements: As specified in individual Specification Sections.

1.8 Manual For Equipment And Systems

A. Each Item of Equipment and Each System: Include description of unit or system, and component parts. Identify function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and model number of replaceable parts.

B. Panelboard Circuit Directories: Provide electrical service characteristics, controls and communications; typed or by label machine.

C. Include color-coded wiring diagrams as installed.

D. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shutdown and emergency instructions. Include summer, winter, and any special operating instructions.

E. Maintenance Requirements: Include routine procedures and guide for disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

F. Troubleshooting: Include step-by-step chart listing common problems with appropriate repairs.

G. In addition, include:

1. Servicing and lubrication schedule, and list of lubricants required.
2. Manufacturer's printed operation and maintenance instructions.
3. Sequences of operation by controls manufacturer.
4. Original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
5. Control diagrams by controls manufacturer as installed.
6. Contractor's Coordination Drawings, with color-coded piping diagrams as installed.
7. Charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
8. List of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
9. Testing and balancing reports as specified.

H. Additional Requirements: As specified in individual Specification Sections.

I. Where complexity of machinery is such that regular maintenance by a specialty service company is normal, or may be required by law, give notice thereof to Owner in writing.

1.9 Instruction Of Owner's Personnel

A. Before Final Inspection, instruct Owner's designated personnel in operation, adjustment, and maintenance of products, equipment and systems, at agreed-upon times.

1. Training shall be provided by factory trained personnel, and shall consist of two (2) separate eight (8) hour sessions.
2. Sessions shall be coordinated with Owner's designated personnel and conducted at times agreed to in order to ensure availability of all personnel requiring such training.

B. For equipment requiring seasonal operation, instruct Owner's designated personnel in system operations for other seasons, within six (6) months of first instructions.

C. Use Operation and Maintenance Manuals as basis for instruction. Review contents of manual with Owner's designated personnel in detail to explain all aspects of operation and maintenance.

D. Prepare and insert additional data in Operation and Maintenance Manuals when need for such data becomes apparent during instruction.

Part 2 Products

Not used.

Part 3 Execution

Not used.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Administrative and procedural requirements for recording selections, changes, and Work concealed by subsequent construction.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Methods and Means Engineering: Division 01.

C. Project Meetings: Division 01.

D. Progress Reports: Division 01.

E. Project Closeout: Division 01.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Submit preceding or coincidental with final Application for Payment.

C. If review of Record Documents reveals non-compliance with Contract Documents, correct deficiencies and resubmit.

D. Accompany this final submittal with transmittal letter containing data including: project title and number, Contractor's name and address, title and number of each Record Document, certification that each Document as submitted is complete and accurate, and signature of Contractor or Contractor's Authorized Representative.

E. Closeout Submittals:

1. Record Construction Drawings: One (1) of digital AutoCAD file indicating notations indicated above.

2. Record Project Manual: One (1) digital copy bound in 3-ring, D-type binders.

3. Record Shop Drawings: One (1) digital copy of Shop Drawings.

4. Record Product Data: One (1) digital copy organized by CSI format bound in 3-ring, D-type binders.

5. Record Samples: As indicated.

6. Miscellaneous Records: One (1) digital copy organized by type of record and chronologically bound in 3-ring, D-type binders.

7. Specifications and Addenda: As indicated.

1.4 Maintenance Of Documents

A. Maintain, at Project Site, one (1) copy of Record Documents, including Drawings, Specifications, Addenda, Change Orders and other modifications, Shop Drawings, Product Data and Samples.

B. In addition, maintain one (1) copy of Field Orders or written instructions, Field Test Records, Inspection and Testing Reports, Progress Reports, and Meeting Minutes.

C. Provide files and racks for storage of Documents.

D. File Documents and Samples in accordance with Data Filing Format of Construction Specifications Institute (CSI).

E. Maintain Documents in a clean, dry, legible condition and in good order. Do not use Record Documents for construction purposes.

F. Make Documents available at all times for inspection.

G. Review Documents at Progress Meetings.

1.5 Recording

A. Label each Document and binder with Project Record, Project Name, Project Location and Owner, in neat large letters. No hand lettering.

B. Record information concurrently with construction progress.

C. Do not conceal any Work until required information is recorded.

D. Record Construction Drawings and Shop Drawings: Maintain a clean, undamaged set of blue- or black-line whiteprints of Drawings and Shop Drawings. Mark set to show actual installation where installation varies from Work as originally indicated. Mark whichever Drawing is most capable of indicating conditions fully and accurately; where Shop Drawings are used, record a cross-reference at corresponding location on Drawings. Give particular attention to concealed elements that would be difficult to measure and record at a later date.

1. Mark Record Sets with red indelible pen; use other colors to distinguish between variations in separate categories of Work.

2. Note depths of various elements of foundation in relation to finish first floor datum.

3. Note horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.

4. Note location of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of structure.

5. Note field changes of dimensions and details.

6. Note changes made by written Supplemental Instructions or by Change Order.

7. Note details not on original Drawings.

8. Organize Record Drawings sheets into manageable sets, bind with durable paper cover sheets, and print suitable titles, dates and other identification on cover of each set.

9. Shop Drawings: Maintain as Record Documents. Legibly annotate any changes made after review.

E. Record Project Manual: Maintain one (1) complete copy of Project Manual, including addenda, and one (1) copy of other written construction documents, such as Change Orders and modifications issued in printed form during construction. Mark these Documents to show substantial variations in actual Work performed in comparison with text of Specifications and modifications. Give particular attention to substitutions, selection of options and similar information on elements that are concealed or cannot otherwise be readily discerned later by direct observation. Note related Record Drawing information and Product Data.

F. Record Product Data: Maintain one (1) copy of each Product Data submittal. Mark these Documents to indicate variations in actual Work performed in comparison with information submitted. Include variations in products delivered to Project Site, and from manufacturers' written installation instructions and recommendations. Give particular attention to concealed products and portions of Work which cannot otherwise be readily discerned later by direct observation. Note related Change Orders and mark-up of Record Drawings and Specifications.

G. Record Samples: Immediately prior to Date or Dates of Substantial Completion, meet at Project Site with Design Professional and Owner's personnel to determine which of submitted Samples that have been maintained during progress of Work are to be transmitted to Owner for record purposes. Comply with delivery to Owner's Sample Storage Area.

H. Miscellaneous Records: Refer to other Specification Sections for requirements of miscellaneous record keeping and submittals in connection with actual performance of Work. Immediately prior to Date or Dates of Substantial Completion, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for continued use and reference. Submit to Design Professional for Owner's Records.

I. Specifications and Addenda: Legibly mark each Section to record:

1. Manufacturer, trade name, catalog number, and supplier of each Product and item of equipment actually installed.

2. Changes made by written Supplemental Instructions or by Change Order.

Part 2 Products

Not used.

Part 3 Execution

Not used.

END

Section 018120 Construction Indoor Air Quality (IAQ) Management

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Requirements for minimum Indoor Air Quality (IAQ) performance standards during Construction Period.

B. Sustainable Design Intent: Comply with project requirements intended to achieve a Certified Rating, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. HVAC: Division 23.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Quality Control Procedures:

1. Construction Indoor Air Quality Management Plan: Description of proposed construction indoor air quality management plan for review by Design Professional.

1.4 Performance Requirements

A. Comply with minimum requirements of ASHRAE 62.1-2004, Ventilation for Acceptable Indoor Air Quality and approved Addenda.

1. Coordinate with requirements of HVAC: Division 23.

B. Prevent exposure of building systems to environmental tobacco smoke during construction. At a minimum, take the following measures:

1. Do not allow smoking in enclosed portions of Project Site.

2. Do not allow smoking adjacent to fresh air intakes for the building.

C. Comply with minimum requirements of Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guidelines for Occupied Buildings under Construction.

1.5 Construction Indoor Air Quality Management Plan

A. Construction Indoor Air Quality Management Plan: With the completed Form of Bidder's Proposal, Contractor shall submit a preliminary Construction IAQ Management Plan.

1. Within seven (7) calendar days after receipt of Notice to Proceed, Contractor shall submit to Owner a finalized Construction IAQ Management Plan.

2. Proposed Plan shall comply with HVAC: Division 23 requirements.

3. Proposed Plan shall include, but not be limited to, the following:

   a. Protection of ventilation system components during construction.
   b. Cleaning and replacing contaminated ventilation system components after construction.
   c. Temporary ventilation.
   d. Protection of absorptive materials from moisture damage when stored on site and after installation.
   e. Sequence of finish installation plan.

B. Coordinate Construction IAQ Management Plan with Owner's current IAQ management plans and procedures.

Part 2 Products

Not used.

Part 3 Execution

3.1 Construction Indoor Air Quality Management Plan Implementation

A. IAQ Manager: Contractor shall designate an on site person responsible for instructing workers and overseeing and documenting results of the Construction IAQ Management Plan for the Project.

B. Distribution: Contractor shall distribute copies of the Construction IAQ Management Plan to the Project Site Foreman, each Subcontractor, Owner and Design Professional.

C. Instruction: Contractor shall provide on-site instruction of appropriate procedures and methods to be used by all parties at the appropriate stages of the Project.

D. Coordinate Construction IAQ Management Plan with Project Closeout and Final Cleaning as indicated in other Division 01 Sections.

E. For use of permanent heating, cooling, and ventilating systems during construction period as specified in Division 01 Section "Construction Facilities," 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 immediately prior to occupancy.

3.2 Building Flush-Out

A. Comply with one of the following requirements:

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 degrees F and a relative humidity no higher than 60 percent.

2. If occupancy is desired prior to flush-out completion, the space may be occupied following delivery of a minimum of 3500 cu. ft. of outdoor air per sq. ft. of floor area to the space. Once a space is occupied, it shall be ventilated at a minimum rate of 0.30 cfm per sq. ft. of outside air or the design minimum outside air rate determined in EQ Prerequisite 1, whichever is greater. During each day of the flush-out period, ventilation shall begin a minimum of three hours prior to occupancy and continue during occupancy. These conditions shall be maintained until a total of 14000 cu. ft./sq. ft. of outside air has been delivered to the space.

END

Part 1 General

1.1 Related Documents

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

B. Section 220800 – Commissioning of Plumbing Systems.

C. Section 230800 – Commissioning of Mechanical Systems.

D. Section 230901 – Commissioning of Integrated Automation Systems.

E. Section 260800 – Commissioning of Electrical Systems.

F. Commissioning Plan.

1.2 Description Of Work

A. An independent third party Commissioning Agent has been retained to lead the project participants through the commissioning process. The section below is provided for informational purposes and to inform the contractor of the extent of the commissioning process and the involvement required. The Commissioning Agent is RMF Engineering, Inc.

B. The purpose of the construction phase commissioning is to provide the Owner and Operators of the facility with a high level of assurance that each commissioned system has been installed in the prescribed manner and operates within the performance guidelines set forth in the design intent. The Commissioning Agent shall provide the Owner with an unbiased, objective view of the system's installation, operation, and performance. This commissioning process shall not take away or reduce the responsibility of the System Design Professional(s) or installing contractors to provide a finished product. Commissioning is intended to enhance the quality of system start-up and aid in the orderly transfer of systems to beneficial use by the owner. The Commissioning Agent will be a member of the construction team, cooperating and coordinating all commissioning activities with the Owner, Design Professionals, Construction Manager or General Contractor, Subcontractors, Manufacturers and Equipment Suppliers.

1.3 Definitions

A. Commissioning Agent: The Commissioning Agent is a third party consulting company interested in providing quality control to the project and quality assurance to the Owner. The Commissioning Agent provides a non-biased perspective of issues. The goal of the Commissioning Agent is to discover equipment and system issues early and resolve them quickly for an overall smooth construction process and to keep costs down for both the Owner and Contractor(s).

B. Commissioning Team: The Commissioning Team is a group of individuals selected by each company to represent that company for direct involvement in the commissioning activities during the construction phase of the project. A minimum of one individual must be included to represent every company. Companies include but are not limited to; Commissioning Agent, Owner, Architect, System Design Engineer, Construction Manager or General Contractor, and all Sub-Contracting Companies.

C. System Design Professional(s): The System Design Professional(s) are the designers and design firm representatives for the mechanical, electrical, plumbing, telecommunications and other systems outside of the scope of the Architect. Typically, the System Design Professional(s) do not include structural and civil design representatives unless structural or civil systems are specifically included within, or are associated with the systems being commissioned.

D. Contractor(s): The term Contractor(s) utilized herein refers to the primary contracting party responsible for the specific item being referenced. Contractor(s) may refer to one or more of the general contractors, construction managers, sub-contractors and/or venders whom are responsible for the construction or other provisions regarding any of the systems to be commissioned as outlined within Specification 019113 Section 1.5 - Systems To Be Included In Commissioning. Contracting parties outside of the scope of the systems being commissioned are not included.

E. Subcontractors: The term Subcontractors utilized herein refers to the any and all subcontracting companies or venders whom are responsible for the construction or other provisions regarding any of the systems to be commissioned as outlined within Specification 019113 Section 1.5 - Systems To Be Included In Commissioning. Subcontracting parties outside of the scope of the systems being commissioned are not included.

1.4 Roles And Responsibilities

A. Owner:

1. The commissioning roles and responsibilities of the Owner are outlined within the Commissioning Plan. The Owner is not contractually obligated to complete any tasks defined within the Commissioning Plan. Rather, the roles and responsibilities defined within the Commissioning Plan are in the best interest of the Owner and are highly recommended for the successful completion of Commissioning.

2. If the Owner's Project Requirements have been outlined and documented, the Owner shall provide a copy of this document to the Commissioning Agent. This document shall set the goals towards which each of the commissioning tools implemented will drive the final product.

3. The Owner shall be required to review many Commissioning Forms prior to their completion. The Owner must verify that the forms are constructed and being utilized in the most effective way for their own benefit. Commissioning documentation should only provide information which will be useful to the Owner and their Operations and Maintenance throughout the construction process and in the future.

B. Commissioning Agent:

1. Schedule the Construction Phase Commissioning Kick-Off meeting within 90 days of the award of the contract, at some convenient location and at a time suitable to the Contractor and System Design Professional(s). This meeting shall be for the purpose of reviewing the complete commissioning program and establishing tentative schedules for system orientation and inspections, O&M submittals, training sessions, system flushing and testing, job completion, test, adjust and balance (TAB) work, and verification and functional performance testing.

2. Prepare the Commissioning Plan after the Commissioning Kick-Off meeting. Include list of all contractors for commissioning events by name, firm and trade specialty.

3. Provide Pre-Functional Checklists for the purposes of verifying proper installation. Checklists shall be based upon submitted documentation and updates to the Construction Documents.

4. The Commissioning Agent shall conduct approximately 4 Commissioning Meetings throughout the construction phase. Meetings shall be held more frequently as Commissioning Activities increase. Meetings are typically held monthly until systems are prepared for verification testing. The Commissioning Agent shall prepare minutes for every Commissioning Meeting and distribute copies to all attendees and other interested parties.

5. The Commissioning Agent shall conduct periodic inspections of work in progress and shall generate and distribute a report for each inspection. All issues and discrepancies found during these inspections shall be listed on a Commissioning Issues Log, maintained by the Commissioning Agent.

6. Submit detailed installation checklists entitled Pre-Functional Checklists. These checklists shall be developed by the Commissioning Agent specific to the project and shall be required to be completed by the installing contractors. The Commissioning Agent is required only to spot-check these checklists upon completion of the installations.

7. Submit detailed Functional Performance Test procedures for review and acceptance by the Commissioning Team. These tests are specifically custom designed by the Commissioning Agent for verifying each system operates per the design intent and meets both the Basis of Design (BOD) and the Owner's Project Requirements (OPR.)

8. Provide and install calibrated data loggers to monitor and record data as required by the Functional Performance Tests.

9. Upon receipt of notification from the System Design Professional(s) that the mechanical systems have been completed and are operational, the Commissioning Agent shall proceed to verify on a random basis the TAB report and operation of the control systems in accordance with the Commissioning Specification. The Commissioning Agent shall recommend acceptance of the Final Test, Adjustment and Balance Report.

10. Oversee Functional Performance Testing which shall be performed by the installing contractors. All issues and discrepancies found during Functional Performance Testing shall be listed on the Commissioning Issues Log, maintained by the Commissioning Agent.

11. The Commissioning Agent shall not perform any site visits for the purpose of witnessing Functional Performance Testing until the installing contractor has verified that the system is ready for Functional Performance Testing and made proper notice to the Commissioning Agent with appropriate lead time.

12. Witness repeated conducting of Functional Performance Tests if deficiencies are found during the original testing. The Commissioning Agent will invoice the Owner for additional time required for any retesting, and the Owner at his discretion may deduct this cost from the CM’s Application for Payment. It is the Contractors' responsibility to properly de-bug systems and verify successful system performance prior to inviting the Commissioning Agent to witness the test.

13. Prepare the Final Commissioning Report. Submit completed Functional Performance Tests as part of Final Report to the owner. Recommend acceptance of the Final Product, by the Owner, based upon the results of Commissioning.

C. Construction Manager / General Contractor:

1. Read, understand and follow the Commissioning Plan as a guideline for the Commissioning Process implemented into this construction project.

2. Include commissioning requirements in the mechanical subcontracts, electrical subcontracts, and all other subcontracts relating to the systems to be commissioned as outlined within Specification 019113 Section 1.5 - Systems To Be Included In Commissioning. Ensure full cooperation of all contracting, manufacturing and testing parties required to participate in commissioning.

3. Include cost for commissioning requirements in the contract price. Include specific line items within the Schedule of Values according to Specification 019113 Section 2.2 – Schedule of Values.

4. Provide copies of the Project Schedule to the Commissioning Agent as outlined within Specification 019113 Section 2.1 – Project Schedule. Update the overall project schedule to reflect all Commissioning Activities. Ensure cooperation by subcontractors in coordinating the inclusion of subcontractor activities related to commissioning into the overall Project schedule.

5. Provide all submittals to the Commissioning Agent as outlined within Specification 019113 Section 2.3 – Submittals.

6. Ensure acceptable representation, with the means and authority to prepare and coordinate execution of the entire commissioning program as described in the contract documents.

7. Provide a representative to regularly attend every Commissioning Meeting. Ensure all Subcontractors also provide a representative at each Commissioning Meeting. These representatives are to remain the same individual throughout the construction project unless termination with the representing company occurs or their replacement is approved by the Owner and Commissioning Agent.

8. Coordinate all scheduled commissioning activities with the Commissioning Agent. The Contractor(s) must apprise the Commissioning Agent of various construction activities. These activities include but are not limited to: System Start-up, Completion of Pre-Functional Checklists, readiness for Functional Performance Testing, and System Completion.

9. Remedy all contractual deficiencies as outlined within the Commissioning Issues Log. The Commissioning Agent shall issue an updated deficiency log throughout construction based upon site visits, Pre-Functional Checklist completion, Commissioning Meeting topics and Functional Performance Test results.

10. Maintain a master copy of all PFC's. There are several methods for keeping these documents organized which is the responsibility of the Construction Manager/General Contractor. Reference the Commissioning Plan for examples of methods previously utilized to keep these documents organized. The Construction Manager/General Contractor must verify all PFC's and FPT's are complete. Sign all completed PFC’s and FPT’s prior to inviting the Commissioning Agent to witness and sign-off on these documents.

11. Evaluate performance deficiencies identified in the completed FPT's for non-conformance with contract documents. Remedy all contractual deficiencies identified in through Functional Performance Testing and other verification tests.

12. The Commissioning Agent shall not have any direct authority to order construction changes or make any project alterations without the written approval of the Owner or System Design Professional. Any changes or project alterations made by a Contractor(s) without such written approval shall be the responsibility of that Contractor(s).

D. Subcontractors:

1. Subcontractor responsibilities are outlined within respective Commissioning Specification Sections.
    a. Plumbing Subcontractor responsibilities are outlined in Section 220800 – Commissioning of Plumbing Systems.
    b. Mechanical Subcontractor responsibilities are outlined in Section 230800 – Commissioning of Mechanical Systems.
    c. Controls Subcontractor responsibilities are outlined in Section 230901 – Commissioning of Integrated Automation Systems.
    d. Electrical Subcontractor responsibilities are outlined in Section 260800 – Commissioning of Electrical Systems.
    e. All Subcontractors are additionally responsible for all requirements outlined within this Specification Section 019113 – Commissioning General Requirements.

2. Provide a representative at each Commissioning Meeting. These representatives are to remain the same individual throughout the construction project unless termination with the representing company occurs or their replacement is approved by the Owner and Commissioning Agent.

3. All Subcontractors must follow the same procedure for the completion of Pre-Functional Checklists as organized by the Construction Manager/General Contractor.

4. The Commissioning Agent shall not have any direct authority to order construction changes or make any project alterations without the written approval of the Owner or System Design Professional. Any changes or project alterations made by any Contractor(s) without such written approval shall be the responsibility of that Contractor(s).

1.5 Systems To Be Included In Commissioning

A. For the systems listed, all requirements specified within the Commissioning Specifications Sections 019113, 220800, 230800, 230901, and 260800 shall apply including but not limited to:

1. All system related documentation shall be tracked within forms provided by the Commissioning Agent.

2. All required equipment and component submittals shall be copied to the Commissioning Agent per Specification 019113 Section 2.3 – Submittals.

3. All system related documentation shall be copied by the Contractor and provided to the Commissioning Agent for inclusion into the Commissioning Record Documents.

4. All systems shall be inspected by the Commissioning Agent while under construction and all issues discovered by the Commissioning Agent shall be corrected or otherwise addressed by the contractor.

5. All systems shall have Pre-Functional Checklists and Functional Performance Tests provided by the Commissioning Agent and completed by the Contractor(s) as per Specification 019113 Sections 2.4 – Pre-Functional Checklists and 2.6 – Functional Performance Tests.

B. The following systems, equipment and components shall be commissioned:

System

Domestic Hot Water Generation System

Plumbing Pumping Systems

Lighting/Daylighting Control System

HVAC Systems

Electrical Distribution Systems

Building Automation System Integration

Renewable Energy Systems

1.6 Coordination

A. General coordination is required by the Owner, Architect, System Design Professional(s), Contractor(s) and the Commissioning Agent to maintain an efficient commissioning process.

B. The Architect, System Design Professional(s) and Contractor(s) shall submit to the Commissioning Agent a copy of all construction documents, addenda, change orders, overall project schedule, and any approved submittals, shop drawings, value engineering proposals and training plan related to commissioned systems.

C. The Commissioning Agent's primary responsibility is to the Owner, and as such, shall regularly apprise the Contractor and the Owner of progress, pending problems and/or disputes, and shall provide regular status updates on progress with each system.

D. The Contractor(s) must apprise the Commissioning Agent of various construction activities. These activities include: System Start-up, Completion of Pre-Functional Checklists, readiness for Functional Performance Testing, and System Completion.

1.7 Schedule

A. Commissioning of systems shall proceed per the criteria established in the specific sections that follow, with activities to be performed on a timely basis. Site visits which are specifically scheduled for the purpose of demonstrating system functionality shall be coordinated by the Contractor(s) such that all required parties are present during the visit. The Contractor(s) shall be responsible for demonstrating system functionality during these scheduled periods.

B. All Commissioning activities which require the presence of the Commissioning Agent shall be scheduled such that the Commissioning Agent is made aware of the required site visit with a minimum of two weeks (14 days) notice.

C. Upon the discovery of deficient items during inspection or testing, the Contractor(s) shall be notified via distribution of an updated Commissioning Issues Log. Additional visits to the site for re-inspection or re-testing shall be scheduled as required. Prior to these additional visits, related deficiencies shall be rectified by the responsible party. The Contractor(s) shall be responsible for ensuring that all required corrective actions are performed in a timely manner in order to maintain the project schedule.

D. Contractor schedules and scheduling is the responsibility of the Contractor(s).

E. Prior to substantial completion, all Functional Performance Tests must be successfully completed and documented by the Commissioning Agent, such that each tested system has proven full and efficient functionality.

1.8 Related Work Specified Elsewhere

A. Commissioning requires support from the contractors. The commissioning process does not relieve any contractors from their obligations to complete all portions of work in a satisfactory manner prior to commissioning any system.

B. Refer to Sections 220800, 230800, 230901, and 260800 for contractor responsibilities relative to the commissioning process.

Part 2 Products

2.1 Project Schedule

A. Contractor(s) shall submit two copies of a complete project schedule to the Commissioning Agent. The Contractor(s) must submit the schedule no later than two weeks after the Commissioning Kick-Off Meeting.

B. Contractor(s) shall be required to incorporate all Commissioning Activities into the overall project schedule.

2.2 Schedule Of Values

A. The Contractor(s) shall include within the Schedule of Values, specific line items to reflect Commissioning progress. For each system to be commissioned as outlined in Specification 019113 Section 1.5 – Systems to be Included in Commissioning, a line item shall be listed in the Schedule of Values for the following:

1. Pre-Functional Checklist
2. System Start-Up
3. Functional Performance Test
4. Equipment/System Training

B. The Contractor(s) shall submit two copies of the Schedule of Values to the Commissioning Agent for review. The Commissioning Agent shall review and comment on line items relevant to commissioning and systems to be commissioned. Any comments by the Commissioning Agent will be forwarded to the System Design Professional(s) for review and inclusion.

2.3 Submittals

A. Contractor(s) shall submit two copies of all equipment and component submittals to the Commissioning Agent for each of the Systems to Be Commissioned as outlined within this specification section.

B. Manufacturer's Product Data: The Contractor(s) shall provide to the Commissioning Agent all product data as required within each individual specification section.

C. Coordination Drawings: The Contractor(s) shall provide to the Commissioning Agent all Coordination Drawings as required within each individual specification section.

D. Manufacturer's Installation Instructions: The Contractor(s) shall provide to the Commissioning Agent a minimum of one copy of installation instructions for every piece of equipment and accessory included as part of a commissioned system.

E. Manufacturer's Controls Calibration Instructions: The Contractor(s) shall provide to the Commissioning Agent a minimum of one copy of calibration instructions for each type of control device to be installed. Submit only control device calibration instructions for devices which have been approved by the System Design Professional(s).

2.4 Pre-Functional Checklists

A. Pre-Functional Checklists (PFC's) are not included within the scope of Commissioning and are not a requirement of the Contractor(s).

B. Pre-Functional Checklists (PFC) shall be issued by the Commissioning Agent to the Commissioning Team. Each member of the Commissioning Team representing a project contractor shall receive a minimum of one copy of every PFC issued by the Commissioning Agent. The PFC's shall consist of a series of installation checklist items, required to be completed by the installing contractors. Each PFC is customized for each type of equipment or system component.

C. A series of checklist items must be completed for every single piece of equipment and system component included within the systems being commissioned as outlined in Specification 019113 Section 1.5 – Systems To Be Included In Commissioning.

D. It is the contractor's responsibility to estimate the extent and depth of the PFC requirements, based upon the level of involvement required to install each individual piece of equipment or system component. Each contractor shall be responsible for providing a cost associated with Pre-Functional Checklists based upon this extent and depth.

1. The number of checklist items for each piece of equipment or system component shall range from approximately 10 checklist items up to approximately 30 checklist items with respect to the level of involvement required by the contractors. For example, a PFC of only 10 checklist items would represent a piece of equipment which requires only to be connected to an inlet and outlet pipe such as a strainer or other pipe accessory. A PFC of 30 checklist items is more involved and requires in depth installation and adjustment by multiple contractors, such as a Variable Volume Terminal Reheat Box.

2. All checklist items on a PFC are static installation requirements. Proper storage and installation methods may be included within the PFC checklists. Operational checklist items and test, adjustment and balance items shall NOT be included. PFC's may include checklist items requiring submittals to be completed which indicate operational characteristics have been verified. These submittals shall only be included within a PFC if they are a requirement of the contract documents.

3. Equipment PFC's shall list for comparison the manufacturer's data of the equipment as per the design, approved submittal and the installed equipment. These items are initially blank on the forms provided to the contractors by the Commissioning Agent. The Contractors are responsible for obtaining this information and filling in these blanks.

    a. Design: The manufacturer's data shall be filled in by the contractor according to the design criteria outlined within the design specifications or equipment schedules.
    b. Submitted: The manufacturer's data shall be filled in by the contractor according to the product submittal, submitted by the contractor and approved of by the design representative
    c. Installed: The manufacturer's data shall be filled in by the contractor according to the actual piece of equipment installed in the field nameplate data.

4. The contractor shall remain responsible for completing all manufacturer's data. PFC manufacturer's data are not considered checklist items and are not included in the range of installation checklist items defined in Specification 019113 Section 2.4 – Pre-Functional Checklists, Sub-section D-1 above (06150-2.4-D-1.).

5. PFC's shall not require an extension of the project schedule. PFC's require no additional installation work above and beyond the scope of the contract documents. PFC checklist items shall be checked-off as equipment is being installed according to the project schedule. PFC's shall be completed in conjunction with the completion of equipment installations.

E. PFC's are multi-discipline and therefore must be partially completed by multiple contractors. The division of each PFC is the contractor's responsibility. Division of project work is determined by the CM and subcontractors and is not within the jurisdiction of the Commissioning Agent. Therefore, the division of work outlined within each PFC is generalized and has not taken into account the true scope of each individual sub-contracting company. Each contractor must review every PFC to determine their own obligation to the installation checklist items described therein.

F. PFC's shall include full calibration documentation of all field calibrated devices as required by the specifications of equipment or controls.

G. In the event, the Commissioning Agent has omitted a piece of equipment or system component from its applicable PFC form, which is included within the systems to be commissioned. The sub-contractor shall remain responsible for completing a column of checklist items within the appropriate PFC form for that particular piece of equipment or system component. The contractor may bring the omitted item to the attention of the Commissioning Team or Commissioning Agent, whom may in turn provide an additional form for the omitted item. The contractor shall otherwise copy an existing blank PFC form and alter the equipment or system component designation at the top of one column of checklist items to represent the omitted item. The contractor shall then complete the column of checklist items and include the form within the master PFC.

H. The CM shall be responsible for maintaining a master PFC for each PFC provided by the Commissioning Agent. The master PFC shall be completed in black fine-point ink unless kept electronically via PDF. All marks must be permanent and legible. Each PFC checklist item shall be verified by the responsible contractor and checked-off on the master copy of the respective PFC. Sub-contractors may utilize their personal copies of each PFC's in the field to verify installations and then transfer all checks, notes an initials to the master PFC. Otherwise, sub-contractors my check-off items directly on the master PFC, while in the field. Contractors shall not assemble pages from multiple copies of a PFC, which have been completed by multiple sub-contractors, to create a single PFC representing the master PFC.

I. Each PFC checklist item shall be checked by the responsible contractor. The specific individual person who checks off any single item on a PFC shall legibly scribe their personal three-letter initials in the space provided adjacent to the item checkbox. Upon completion of any contractor's portion of checklist items, the responsible manager or field superintendent for that company shall sign their full signature in all required places indicated on the PFC. The day's date shall be scribed next to the signature. Typically, the only signature space shall be on the title page of each PFC.

J. The CM shall be responsible to verify any general contracting items, for which the sub-contractors are not responsible. The CM shall be responsible for determining these checklist items within each PFC and completing them in kind.

K. The CM shall be responsible to verify all sub-contractors complete each checklist item for which they are responsible. The CM may complete any outstanding checklist items which have not been completed by the sub-contractors, understanding that by checking and initialing any blank item, the CM accepts responsibility for the truthful state of that installation item.

L. Checklist items within a PFC shall not require any additional work or installation above and beyond that which is called for in the project construction documents or manufacturer's installation requirements. Items above and beyond the scope outlined within the construction documents or manufacturer's installation requirements may be brought to the attention of the Commissioning Team or Commissioning Agent and will likely be removed from the PFC checklist requirements.

M. Prior to proceeding with any particular system Functional Performance Test, all PFC's associated with equipment or system components which fall under the scope of that particular system, shall be 100% complete and approved by the Commissioning Agent.

N. The Commissioning Agent shall require the following for the approval of each Pre-Functional Checklist: Each checklist item shall be checked or noted otherwise. Each checklist item shall bear a three-letter initial next to it if an initial space is provided. Each piece of manufacturer's data shall be complete and accurate. Each device calibration checklist shall be complete. Every space on each PFC which requires a signature shall bear the appropriate signature. All marks shall be black and legible according to the Owner or Commissioning Agent.

2.5 Start-Up And Test Reports

A. Contractor(s) shall submit copies of all start-up reports for systems to be commissioned, test reports and any additional reports relating to work performed by subcontractors and manufacturers as required by the project specifications. Reports shall be submitted with the appropriate Pre-Functional Checklists. Reports shall include but are not limited to: equipment start-up, weld tests, pressure tests, system flushing, system cleaning, chemical treatment, equipment repair, feeder tests, grounding tests, electrical equipment tests, gauge calibration, etc.

2.6 Functional Performance Tests

A. Functional Performance Tests (FPT's) are not included within the scope of Commissioning and are not a requirement of the Contractor(s).

B. Functional Performance Tests (FPT's) shall be issued by the Commissioning Agent to the Commissioning Team. Each member of the Commissioning Team representing a project contractor shall receive a minimum of one copy of every FPT issued by the Commissioning Agent. Each system FPT shall consist of a multitude of operational procedures which shall encompass all operational procedures for which that system is required to be capable of performing per the contract documents. Each FPT is customized for each system according to the specifications, contract drawings and equipment submittals.

C. A Functional Performance Test must be completed for each of the systems to be commissioned as outlined in Specification 019113 Section 1.5 – Systems To Be Included In Commissioning.

D. It is the contractor's responsibility to estimate the extent and depth of the FTP requirements, based upon the level of involvement required to perform each individual sequence of operations. Each contractor shall be responsible for providing a cost associated with Functional Performance Testing based upon this extent and depth.

1. Functional Performance Tests shall be composed of a very detailed series of step-by-step procedures required to be performed by the installing contractors in order to prove the sequence of operations has been properly met according to the construction documents.

2. FPT's shall include functional test procedures for each operational piece of equipment within a system. Each piece of equipment shall be individually tested for correct operation and load capabilities according to the contract documents. These shall be tested by both the remote BAS control system as well as any localized controls. Local controls may range from a fully programmable control panel down to a simple disconnect switch. Equipment which has been adjusted by the TAB contractor shall be tested against the information provided by the TAB Contractor within the TAB Report. Certain parameters may be required for Functional Performance Testing which are not fully encompassed within the Test, Adjustment and Balance scope if these parameters are essential for verifying equipment operational characteristics or performance.

3. Every sequence of operation shall be tested as identified within the contract documents. Various sequence requirements are outlined within the project specifications and several requirements are outlined within the contract drawings. Sequences tested shall verify equipment integration and overall system performance. Items identified during system testing include correct order of operations and system efficiencies. System sequence of operations testing shall test every sequence of operations for every case-scenario possible. Each sequence of operations shall be tested for each piece of redundant equipment. Each sequence of operations which has a reverse process shall be tested through the reverse process. Sequence of operations test shall encompass all controls devices as well as all major equipment.

4. Each auxiliary system requirement shall be tested as identified within the contract documents. Various auxiliary requirements are outlined within the project specifications and several requirements are outlined within the contract drawings. Auxiliaries tested shall verify system alarms, notifications and operation of auxiliary equipment. Equipment failures shall be tested to verify system response. Sub-systems to large systems which have not been functionally tested elsewhere shall be tested, such as a refrigerant pump-out system to a chilled water system.

E. The contractor must account for performing each Functional Performance Test two (2) times:

1. Upon receipt of each Functional Performance Test, the contractor shall be responsible for reviewing all steps and procedures within, to verify each test is congruent to the applicable system as installed. The contractor is responsible for updating the Commissioning Team and Commissioning Agent of any and all changes within the project which may have an effect on the sequence of operations of any system as it is tested by Functional Performance Test. It is important that the Final Functional Performance Tests, performed in the field and witnessed by the Commissioning Agent are in-fact finalized drafts which encompass all changes made to the systems.

2. The contractor shall be responsible for performing all steps within a Functional Performance Test prior to issuing a formal request for the Commissioning Agent to witness functional testing. The contractor shall utilize the Functional Performance Tests as received from the Commissioning Agent to internally verify all sequences are fully operational. Upon successful completion of each Functional Performance Test, the contractor may request the presence of the Commissioning Agent to witness the test. The Commissioning Agent shall then witness each test in its entirety.

F. Redundant Equipment: A Functional Performance Test shall be provided to test every piece of redundant equipment. The contractor shall be responsible for testing every unit to verify correct operation. All redundant equipment shall not necessarily be retested and witnessed by the Commissioning Agent. The Commissioning Agent will select a certain percentage of redundant equipment to be tested. These units shall be chosen at random by the Commissioning Agent, during functional testing. A failure of a certain percentage (typically 10%) or greater of the redundant equipment tested shall indicate improper installation and performance and shall result in system failure. Terminal Reheat Boxes are an example of redundant equipment which are typically tested by random sampling.

2.7 Tab Verification

A. The Test, Adjustment and Balance Report is to be spot-checked by the Commissioning Agent. The TAB Contractor shall be required to repeat measurements selected at random by the Commissioning Agent to confirm the accuracy of the submitted report. See Specification 230800 – Commissioning of Mechanical Systems for detailed TAB Contractor requirements. TAB Verifications shall be included within the scope of the Functional Performance Testing. Repeated measurements shall be taken using the original instruments utilized by the TAB Contractor.

2.8 Test Equipment

A. All industry standard test equipment required for performing the specified tests shall be indicated by the Commissioning Agent within the testing protocol documents and provided by the contractors. Any proprietary vendor specific test equipment shall be provided by that vendor or manufacturer.

B. Any portable or hand-held setup / calibration devices required to initialize the control system shall be made available by the control vendor (at no cost) to the Commissioning Agent.

C. The instrumentation provided by the contractor shall meet the following standards:

1. Be of sufficient quality and accuracy to test and/or measure system performance within the tolerances required.
2. Be calibrated at the manufacturer’s recommended intervals with calibration tags permanently affixed to the instrument
3. Be maintained in good repair and operating condition throughout the duration of use on this project.
4. Be immediately replaced if dropped and/or damaged in any way during use on this project.

Part 3 Execution

3.1 Commissioning Plan And Schedule

A. The Contractor(s) shall submit to the Commissioning Agent a copy of the overall project schedule. The Contractor(s) shall be responsible for submitting updated copies of this schedule to the Commissioning Agent.

B. The Commissioning Schedule will be reviewed with the Owner, the System Design Professional(s) and Construction Manager or General Contractor for integration into the overall project construction schedule. All commissioning tasks as well as critical milestone dates will be tracked on the master project schedule.

C. The Construction Manager/General Contractor and Contractor(s) shall be responsible for providing periodic updates to the commissioning tasks within the master schedule, identifying areas where commissioning is falling behind schedule.

D. After the pre-construction meeting, a Commissioning Kick-Off Meeting will be held and attended by all Contractor(s) involved in the commissioning process. A commissioning plan will be distributed at this meeting to the Construction Manager or General Contractor, System Design Professional(s), and prime contractors outlining the specific commissioning process for this project and the names and contact information, to be determined at this meeting, of all commissioning team members. A final plan will be issued soon after the meeting listing all team contact information.

3.2 Construction Observation

A. The Architect and System Design Professional(s) shall make standard construction inspection site visits as required by their respective contracts with the Owner.

B. Construction observation by the Commissioning Agent is required as part of the commissioning and coordination process. A specific number of scheduled site visits will be provided during construction and prior to Functional Performance Testing. Functional Performance Testing shall not be for the purposes of installation inspection and shall be scheduled separately.

3.3 Test And Balance

A. See Specification 230800 Section 1.5 – Roles and Responsibilities for the requirements of the Test, Adjustment and Balance Contractor as related to Commissioning.

3.4 Pre-Functional Checklists And Functional Performance Test Procedures

A. Pre-functional checklists and functional performance testing will be provided by the Commissioning Agent after equipment submittal and start-up information is provided by the contractors to the Commissioning Agent. The contractors shall use only PFC and FPT forms provided by the Commissioning Agent. PFC and FPT forms are required to be completed by the Contractor(s) and approved by the Commissioning Agent.

3.5 Pre-Functional Checklists - Observation

A. The pre-functional test forms shall be completed by the installing contractor, manufacturer's, and all others with related involvement with the commissioned equipment. The test forms shall be signed verifying completion by the Construction Manager or General Contractor and all related contractors and sub-contractors. The Commissioning Agent shall spot check forms to verify completion. If the spot check reveals discrepancies, the contractors will be required to redo the forms. The Commissioning Agent again spot check the forms and will invoice the Owner for additional time required for any retesting required due to failed PFC's, and the Owner at his discretion may deduct this cost from the Construction Manager or General Contractor's Application for Payment. It is the contractor's responsibility to properly install equipment and components and verify such prior to inviting the Commissioning Agent to spot check these installations.

B. Checklists shall be completely comprehensive and to the extent necessary to enable the Commissioning Agent to assure the Owner and System Design Professional(s) that the systems are installed correctly.

3.6 Functional Performance Testing - Observation

A. The functional performance testing shall be performed by the installing contractor. The Commissioning Agent shall direct and witness final testing. The Contractor(s) shall initiate the tests provided by the Commissioning Agent, debug the systems, and verify compliance prior to requesting the tests be witnessed by the Commissioning Agent. The Commissioning Agent, upon witness of any system functional deficiency shall require complete retesting. The Commissioning Agent will invoice the Owner for additional time required for any retesting required due to failed FPT's, and the Owner at his discretion may deduct this cost from the CM's Application for Payment. It is the contractor's responsibility to properly de-bug systems and verify successful system performance prior to inviting the Commissioning Agent to witness the test.

B. Tests shall be completed comprehensively and to the extent necessary to enable the Commissioning Agent to assure the Owner and System Design Professional(s) that the systems do perform per the design intent.

3.7 Exclusions

A. Responsibility for construction means and methods: The Commissioning Agent is not responsible for construction means, methods, job safety, or any construction management functions on the job site.

B. Hands-on work by the Commissioning Agent: The contractors shall provide all services requiring tools or the use of tools to start-up, test, adjust, or otherwise bring equipment and systems into a fully operational state. The Commissioning Agent shall coordinate and observe these procedures (and may make minor adjustments), but shall not perform construction or technician services other than verification of testing, adjusting, balancing, and control functions.

3.8 Prerequisites To Substantial Completion

A. All commissioning of mechanical, and electrical systems must be complete prior to Substantial Completion. Exceptions to this are the planned control system training performed after occupancy and any required seasonal or approved deferred testing. Prerequisites include for all systems, but are not limited to:

1. Completed and signed start-up and pre-functional checklist documentation.
2. Submission of final approved TAB report.
3. Completion of all functional testing.
4. Required training of Owner personnel completed and approved.
5. Submission of the approved O&M manuals.
6. All identified deficiencies have been corrected or are approved by the Owner for substantial completion.

B. The Owner's Project Manager will determine the date of Functional Completion after reviewing the Commissioning Agent's recommendation for Substantial Completion.

C. Commissioning activities are non-compensable and cannot be a cause for delay claims. Failure of the contractors to complete all work, including commissioning activities, in a timely manner resulting in overall project delays shall be the fault of the contractor.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Demolition of existing structure(s) as indicated including removal of foundations, floor slabs, buried tanks and service lines and as follows:

1. Owner will identify and remove equipment, furniture and furnishings from building(s) prior to demolition.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Methods and Means Engineering: Division 01.

C. Environmental Protection: Division 01.

D. Existing hazardous Material and Removal information: Division 00.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Quality Control Procedures: Demolition procedures and operational sequence for review and acceptance by Owner.

1.4 Quality Assurance

A. Cooperate with Work of other Sections, Owner's personnel, public and private Utility Authorities and others authorized to shut off valves, switches, and make disconnections.

B. Explosives may not be used. Torch cutting, if required, must have prior written consent of Owner and shall be performed according to NFPA Publications No. 51 and 51B, including a fire watch for at least two (2) hours after last torch is extinguished.

C. Perform demolition work in accordance with applicable local and state regulations and ordinances, and with American National Standard Safety Requirements for Demolition.

D. Services of an Inspection and Testing Agency are required. Perform demolition under provisions of Methods and Means Engineering: Division 01.

1.5 Protection

A. Do not interfere with use of adjacent buildings. Maintain free and safe passage to and from said buildings and adjacent rights-of-way.

1. Provide survey of adjacent buildings noting all existing cracks and deficiencies.

B. Prevent movement or settlement of adjacent structure(s), services, sidewalks, driveways and trees. Promptly repair damage at no additional cost.

C. Provide, erect, and maintain street barricades as required to protect general public, workers, and adjoining property.

1.6 Existing Services

A. Arrange and pay for removing utility services. Disconnect and stub off. Notify the affected utility company in advance and obtain approval before starting this Work.

B. Place markers to indicate location of disconnected services. Identify service lines and capping locations on Project Record Documents.

1.7 Maintenance Traffic

A. Conduct operations with minimum interference to public or private roadways.

1.8 Hazardous Material Removal

A. Remove hazardous material prior to proceeding with demolition. See Section 003126.

Part 2 Products

2.1 Materials

A. Unless otherwise indicated, maintain possession of materials being demolished. Immediately remove from Project Site.

Part 3 Execution

3.1 Phases Of Demolition

A. Perform Work in phases described under Summary of Work: Division 01.

B. Perform Work in accordance with approved Construction Schedule.

3.2 Environmental Protection

A. Maintain applicable temporary controls as specified under Environmental Protection: Division 01.

3.3 Demolition

A. Obtain permission from adjacent property Owner when, for example, swinging cranes may have to traverse their property.

B. Remove tanks and service piping from Project Site.

C. Backfill areas excavated caused as a result of demolition.

D. Rough grade areas affected by demolition and leave level maintaining grades and contours of Project Site.

E. Remove utilities and appurtenances indicated on Drawings completely, unless otherwise instructed by Owner's Representative.

F. Manholes and valve boxes shall be entirely removed regardless of depth.

G. Pavement: Saw-cut pavement to be removed. Pavement shall be removed and prevent damaging areas not included to be demolished.

H. Concrete Curbs: Saw-cut curbs to be removed. Curbs shall be removed and prevent damaging areas not included to be demolished.

I. Concrete Foundations: Demolish and remove concrete foundations for equipment and buildings scheduled for demolition. Foundations shall be removed and prevent damaging areas not included to be demolished.

J. Fencing: Remove and salvage fencing fabric including intermediate framing members and support posts scheduled for removal on plan. Contractor shall store fence fabric and framing members and support posts as directed by Owner's Representative. Fence framing posts and concrete foundations shall be removed and disposed off of Project Site.

3.4 Repair

A. General: Repair demolition performed in excess of that required.

B. Repair damage to adjacent structure(s) caused as result of this Work.

   1. Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.

C. Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.

3.5 Removal Of Debris

A. Dispose of debris resulting from Work at legal off of Project Site disposal areas. Leave Work areas ready for Work of other Sections.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Materials (with exception of metal deck materials), design criteria and tolerance requirements for cast-in-place concrete formwork.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Inspection and Testing Services: Division 01.

C. Inspection and Testing of Cast-In-Place Concrete: Division 01.

D. Cast-In-Place Concrete: Division 03.

E. Structural Steel Framing: Division 05.

F. Metal Fabrications: Division 05.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Shop Drawings:

1. Detail Drawings: Showing locations and details of construction joints, curbs, shelves, haunches, slab depressions, sleeves and openings. Coordinate with Shop Drawings of reinforcing steel.

C. Sustainability Submittals: Provide the following in accordance with Sustainability Requirements: Division 01.

1. Materials Sustainability Documentation Form.

2. Product data indicating VOC content and chemical composition.

1.4 Design Criteria

A. Contractor shall design, construct, and brace formwork and temporary falsework to safely support concrete fluid pressures, wind and other construction loadings.

B. Requirements indicated are considered minimum acceptable and are not intended to eliminate, lessen, or restrict in any manner Contractor's work.

C. Formwork and falsework shall conform to Guide to Formwork for Concrete (ACI 347), except as indicated. Design and construct formwork and temporary bracing to resist wind, construction and other loads as required for stability and as required by Code.

D. Forms shall be substantially built and of sufficient strength and rigidity to produce finished concrete of precise size, shape, and location shown without exceeding specified tolerances. Assembly shall permit removal in proper sequence without damage to concrete.

1.5 Quality Assurance

A. Referenced Codes and Standards: Comply with the following in accordance with Division 01.

1. American Concrete Institute (ACI)

117	Standard Tolerances for Concrete Construction and Materials
301	Specification for Structural Concrete for Buildings
318	Building Code Requirements for Structural Concrete
347	Guide to Formwork for Concrete

2. National Institute of Standards and Technology (NIST)

PS-1	Construction and Industrial Plywood

B. Independent Inspection and Testing: Services of an Independent Inspection and Testing Agency are required in conjunction with the Work of this Section. Agency will inspect formwork, for example, for tightness, level, alignment and camber. Cooperate with and facilitate the Work of the Agency. Refer to Division 01.

Part 2 Products

2.1 Wood Form Materials

A. Type 1, Standard Wood Formwork: Standard plywood forms of B-B concrete form panels, Class I and II, exterior per U.S. Product Standard PS-1, not less than 5/8 inch thick, or approved equal. Type 1 formwork may be used for surfaces concealed in Finished Work and shall not be used for exposed surfaces.

B. Type 2, High Density Wood Formwork: High Density, concrete form overlay, per U.S. Product Standard PS-1, edge sealed, having one (1) or both faces overlaid with cellulose fiber sheets. These forms shall produce smooth, flat concrete surfaces free of wood grain marks, offsets, fins, bulges or depressions, with grinding used only to remove fins or irregularities at butted form joints. Type 2 formwork may be used for surfaces exposed in Finished Work.

C. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized and spaced as required and of sufficient strength and character to maintain formwork in place while placing concrete and curing.

2.2 Prefabricated Forms

A. Steel Type: Gauge as required by Project conditions. Well-matched, tight fitting, and adequately stiffened to support plastic weight of concrete within deflection and appearance requirements of finished concrete surfaces indicated.

B. Fibrous Glass Reinforced Resin Type: Matched, tight fitting, and stiffened to support plastic weight of concrete within deflection and appearance requirements of finished concrete surfaces indicated.

C. Formwork shall produce smooth finished concrete surfaces without normally resorting to patching. Grinding shall be limited to remove fins or irregularities at butted form joints. Finished concrete surfaces shall be smooth, even, uniformly dense, free of offsets, bulges, depressions, and form marks, and within tolerances indicated.

2.3 Form Ties

A. Tie strength shall be as required to resist hydraulic pressure of plastic concrete. Minimum working strength of each tie shall be 3,000 pounds.

B. Ties shall be adjustable so as to permit complete tightening of forms.

C. After removal of protruding part of tie, no metal shall be closer than 1 inch from face of concrete. That part of tie which is to be removed shall be at least 1/2 inch diameter or, if smaller, shall be provided with a wood, plastic, or metal cone placed tightly against inside of forms.

D. Ties below grade shall incorporate a water seal washer.

2.4 Form Release Agent

A. Material: Colorless, nonstaining, nonemulsifiable type, compatible with materials to be subsequently applied, and Volatile Organic Compounds (VOCs) compliant.

B. Materials of the following manufacturers are acceptable. No substitutions.

1. The Euclid Chemical Company.
2. W. R. Grace and Company.
3. W. R. Meadows, Inc.
4. Sonneborn Building Products.

2.5 Accessories

A. Forms for chamfers: Rigid foam, plastic, wood or metal, of maximum possible length.

B. Chamfer Strips: 3/4 inch by 3/4 inch or 1 inch by 1 inch size; maximum possible lengths.

Part 3 Execution

3.1 General Installation Requirements

A. General: Erect, shore, brace and maintain formwork as required to:

1. Comply with ACI 301 and 117.

2. Support plastic concrete pressures, loads from concrete placement operations, other construction loadings and superimposed gravity and lateral loads.

3. Comply with tolerance requirements for size, shape, alignment, elevation, surface irregularities and position.

B. Examine documents to determine nature of construction. Coordinate with Work specified in other Sections for proper placement of embedded items.

C. Formed Surfaces: Erect, shore, brace and maintain formwork as required to comply with the following classes of formed surfaces at locations indicated:

1. Class C: At permanently exposed formed concrete surface at loading docks and exposed on interior of building in mechanical, electrical and utility spaces.

2. Class D: At permanently concealed formed concrete surfaces.

D. Construct forms for openings in concrete. Before concrete is placed, check elements to be built in forms for completeness, size, and location. Coordinate with Work required by other Sections relative to size and location of openings.

E. Formwork shall be reused only a number of times which shall ensure that concrete surfaces produced does not show lack of uniformity from one (1) like area to another. Remove metal fasteners. For exposed concrete surfaces, do not reuse wood formwork more than two (2) times or use formwork that has been patched.

F. Provide access panels at bottom of vertical formwork to facilitate cleaning and inspection prior to placing of concrete.

G. Provide chamfer strips on external corners of all concrete exposed to view in Finished Work.

H. Support and protect shores at ground level to prevent movement due to frozen or partially frozen soil, wet soil, or soil which allows settlement. Watch shores during concreting operations and provide adjustment for settlement or distortion.

I. Set edge forms and intermediate screed strips to support screeds, or strike off templates, so that proper surface elevations and concrete thicknesses are achieved.

J. Construction joint locations other than those indicated shall not be permitted without written approval of Design Professional.

K. Construct joints in formwork to prevent leakage of cement and water and to minimize fins. Joints shall be uniformly and continuously backed.

3.2 Allowable Tolerances

A. Set formwork and screeds to produce flatwork within finish tolerances specified in Cast-In-Place Concrete: Division 03.

B. Set formwork to produce concrete which is true to dimensions and elevations indicated to within tolerances listed in ACI 117 and ACI 347, except as modified by Contract Documents.

1. Limit formed surface irregularities in any 5 foot span as follows:

   a. Class C: 1/2 inch.
   b. Class D: 3/4 inch.

2. Edges of concrete members along elevator shafts shall be true to plane locations shown, within 1/4 inch at any point along any edge and at any elevation.

3. Footings, Variation in Plan Dimensions: Minus 1 inch**,** plus 2 inches**.**

4. Reduction in Depth: 5 percent maximum.

5. Eccentricity: 2 percent of footing dimension but 2 inches maximum.

6. Variation from plumb, in lines and surfaces of pedestals and walls: 1/4 inch per 10 feet but not more than 1/2 inch.

7. Variations of linear building lines from established position in plan and related position of columns, walls, and partitions:

   a. In any bay or 20 foot span: Maximum 1/2 inch.
   b. In 40 feet or more: 1/2 inch.

8. Variations in cross-sectional dimensions of pedestals and in thickness of slabs and walls:

   a. Minus 1/4 inch.
   b. Plus 1/2 inch.

9. Concrete work that is used as connection point for Work specified in other Sections shall be coordinated with tolerance requirements of Work of those Sections.

3.3 Field Quality Control

A. Prior to concrete placement, inspect and check completed formwork, shoring, and bracing to ensure that Work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and parts are secure.

B. Inform Inspection and Testing Agency when formwork is complete and has been cleaned, to allow for inspection. Do not place concrete until form is inspected by Inspection and Testing Agency. Inspection of formwork shall not relieve Contractor from his responsibility to provide safe and tight forms.

C. Allow Inspection and Testing Agency to inspect each section of formwork prior to reuse.

3.4 Cleaning

A. Clean forms as erection proceeds, to remove foreign matter. Remove cuttings, shavings, and debris from within forms. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.

B. During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out completed forms, unless formwork and concrete construction proceed within heated enclosure. Use compressed air or other means to remove foreign matter.

3.5 Removal Of Forms

A. Do not remove forms until concrete has attained sufficient strength to support its own weight and construction loads to be placed thereon. Repair or replace any work damaged due to improper or early removal of forms.

B. When mean daily temperature falls below 40 degrees F leave forms or selected portions thereof in place, if required, in order to protect concrete from freezing temperatures.

C. Do not strip pedestal forms and wall forms until concrete has been in place for the following minimum periods of time.

1. When average air temperature is 60 degrees F or higher: 24 hours.

2. When average air temperature is below 60 degrees F: 48 hours.

D. Average temperature is defined as average of local weather bureau maximum temperature during the day and minimum temperature for night or the morning immediately following, whichever is lower. Average for more than one (1) day shall be the average of the daily values as computed above. If artificial heat and protection is provided, use average temperature of air directly above and below concrete in such environment at a point midway between representative heaters as average temperature for determining proper stripping time.

E. Leave forms in place for longer periods than above listed minimums when required, because of adverse weather conditions, lack of adequate artificial heat and protection, construction loads, or condition of concrete.

3.6 Waste Management

A. Remove recyclable or reusable debris in accordance with Construction Waste Management: Division 01.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Material, accessories and placement requirements for reinforcement of concrete and masonry.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Inspection and Testing Services: Division 01.

C. Inspection and Testing of Cast-In-Place Concrete: Division 01.

D. Unit Masonry: Division 04.

E. Mechanical and Electrical: Refer to for grounding, equipment pads and curbs.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Shop Drawings: Reinforcing Shop Drawings shall conform to requirements of ACI 315, ACI SP-66 and the following:

1. Show bar and welded wire fabric reinforcing.
2. Show reinforcement so it can be cut, bent and placed from information shown.
3. Show locations and lengths of bar and welded wire fabric splices. Coordinate splice locations with construction joint locations. Show dowels on Drawings of Work that is to be placed first.
4. For concrete flatwork, show construction joint locations, openings, sleeves, depressions and other significant features. Coordinate with equipment pads and curbs specified in Mechanical and Electrical Divisions and as indicated. Coordinate with existing structures based on field check of actual conditions and dimensions.
5. Show elevations of concrete walls with top and bottom elevations, openings, ledges, haunches and beam pockets. Draw wall elevations at a minimum scale of 1/4 inch equals 1 foot 0 inches.
6. Show details, at a minimum scale of 1 inch equals 1 foot 0 inches, for heavily reinforced, layered and congested areas. Identify bar placement sequence.

C. Product Data: Manufacturers information for each reinforcing accessory.

D. Certifications: Certified mill test reports for bars and welded wire fabric.

E. Sustainability Submittals: Provide the following in accordance with Sustainability Requirements: Division 01.

1. Materials Sustainability Documentation Form.

2. Product data, certification letter, and costs for materials with recycled content.

3. Product data and costs for regional materials.

4. Product data for indicating VOC content.

1.4 Quality Assurance

A. Referenced Codes and Standards: Comply with the following in accordance with Division 01.

1. American Concrete Institute (ACI)

315	Details and Detailing of Concrete Reinforcement
318	Building Code Requirements for Structural Concrete
SP-66	ACI Detailing Manual

2. American Welding Society (AWS)

D1.4	Structural Welding Code, Reinforcing Steel

3. Concrete Reinforcing Steel Institute (CRSI)

P1	Placing Reinforcing Bars
	Manual of Standard Practice

B. Independent Inspection and Testing: Services of an Independent Inspection and Testing Agency are required in conjunction with the Work of this Section. Cooperate with and facilitate Work of Agency. Refer to Division 01.

1.5 Delivery, Handling And Storage

A. Store reinforcing steel in a neat and orderly manner in suitable racks and off the ground.

B. Before placing, clean off ice, rust scale, or other bond-reducing coatings.

C. Repair damaged epoxy coating according to ASTM D 3963/D 3963M prior to concrete placement.

Part 2 Products

2.1 Materials

A. Provide recycled content materials in accordance with Sustainability Requirements: Division 01.

B. Source: Extract material or salvage and manufacture within 500 miles of the project site.

C. Reinforcing Bars: Comply with ASTM A 615/A 615M Grade 60, except for bars to be welded, unless otherwise approved in writing by Design Professional.

1. Bend Test Requirements: Based on ACI 318.

2. Free from excessive rust and coatings which shall reduce bond.

3. Bars to be Welded: ASTM A 706/A 706M.

D. Welded Wire Fabric: ASTM A 185, plain, sheet mesh.

E. Accessories:

1. Bolsters, chairs, spacers and other accessories for proper placement of reinforcing shall comply with CRSI “Manual of Standard Practice”.

2. Reinforcing supports, chairs, and elements in contact with concrete surfaces to be exposed in finished work shall be stainless steel CRSI Type E, or shall be encased with hard durable performed plastic tips for length of 3/4 inch minimum measured perpendicular to plane of surface, or may be entirely of plastic. Accessories shall not mar, discolor, or be visible on hardened concrete surfaces nor create any planes of weakness in concrete.

3. Supports in contact with epoxy-coated bars shall be coated with dielectric material for a minimum of 2 inches from point of contact. Bars used as support shall be epoxy coated.

4. Bar Supports: Able to support a static load of 250 pounds at any point without permanent deformation.

5. Rebar Supports: Manufactured with 100 percent recycled plastic.

a. International Plastics Corporation, Nicholasville, KY, telephone 606/887-2877.

6. Tie Wire: Annealed. Tie epoxy-coated bars with nylon, epoxy or plastic-coated tie wire.

7. Support reinforcement in slabs-on-ground on concrete brick.

8. Support reinforcement in concrete slabs on metal deck using steel supports designed for this purpose.

2.2 Fabrication

A. Fabricate in accordance with CRSI “Manual of Standard Practice”.

B. Cut and bend reinforcing steel cold to exact lengths and shapes in accordance with approved Shop Drawings.

C. Reinforcing bar embedments and lap splice length shall be in accordance with ACI 318.

D. Where continuous bars are indicated, run bars continuously around corners. Lap at splices and hook at discontinuous ends.

Part 3 Execution

3.1 General

A. Ensure that reinforcement is in compliance with Contract Documents within tolerances specified. Check reinforcement before and during placing of concrete.

B. Provide approved bar supports, spacers, and other placing accessories so that reinforcing is not displaced during construction or casting of concrete beyond tolerances specified.

C. At reinforcing above waterproofing membranes and vapor retarders, use supports which do not penetrate or damage sheet or membrane.

D. Reinforce metal pan stair fill with 4 by 4 W1.4 by W1.4 W.W.F.

E. Coordinate connections to building grounding system, including connections at column footing and foundation wall rebar.

3.2 Placing Of Reinforcement

A. Perform concrete reinforcing work in accordance with CRSI P1, unless otherwise indicated.

B. Place, securely tie, and support bar and fabric reinforcement to prevent displacement by construction traffic prior to or during casting of concrete. Do not allow top bars to sag below tolerances specified. Wire dowels securely in place before embedding in concrete. Concrete cover as specified by ACI or as indicated shall be uniformly maintained. Immediately correct displacement of reinforcing, and provide additional supports to prevent recurrence. Tolerances for position of reinforcing shall be:

1. Plus or minus 1/4 inch for concrete members having depth of 24 inches or less.

2. Plus or minus 1/2 inch for concrete members having depth of more than 24 inches.

C. Lapped ends of bars may be placed in contact and wired or may be separated in accordance with ACI to permit embedment of entire surface of each bar in concrete in accordance with ACI requirements. Stagger splices in adjacent bars.

D. Lap welded wire fabric a minimum of one (1) full panel and tie securely.

E. Tie reinforcing with wire and bend wire back beyond general plane of reinforcing.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Concrete accessories including:

1. Expansion joint filler.
2. Vapor retarder and accessories.
3. Waterstops.
4. Weepholes.

B. Products Installed but Not Supplied Under this Section:

1. Anchor Rods.
2. Sleeves.
3. Inserts.
4. Masonry anchors and ties.
5. Exterior enclosure system anchors.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Inspection and Testing Services: Division 01.

C. Inspection and Testing of Cast-In-Place Concrete: Division 01.

D. Unit Masonry: Division 04.

E. Metal Fabrications: Division 05.

F. Modified Bituminous Sheet Waterproofing: Division 07.

G. Joint Sealants: Division 07.

H. Mechanical and Electrical: Refer to for equipment.

1.3 Submittals

A. Submit per requirements of Division 01.

B. Product Data: Manufacturer's Product Data.

C. Certifications: Waterproofing manufacturer's certification that waterstop is acceptable.

D. Sustainability Submittals: Provide the following in accordance with Sustainability Requirements: Division 01.

1. Materials Sustainability Documentation Form.

2. Product data, certification letter, and costs for materials with recycled content.

3. Product data and costs for regional materials.

4. Product data indicating VOC content.

1.4 Quality Assurance

A. Referenced Codes and Standards: Comply with the following in accordance with Division 01.

1. American Concrete Institute (ACI)

117	Standard Tolerances for Concrete Construction and Materials
318	Building Code Requirements for Structural Concrete

B. Independent Inspection and Testing: Services of an Independent Inspection and Testing Agency are required in conjunction with the Work of this Section. Cooperate with and facilitate Work of Agency. Refer to Division 01.

Part 2 Products

2.1 Expansion Joint Filler

A. Non-extruding, nonstaining filler of sponge rubber, conforming to ASTM D 1752, Type I for interior applications.

B. Resilient, pre-compressed, self-expanding cork, conforming to ASTM D 1752, Type III for exterior applications.

2.2 Vapor Retarder And Accessory Systems

A. Provide products of the following contingent upon meeting indicated requirements. Equivalent products of other manufacturer's will be evaluated as substitutions in accordance with requirements of Division 01.

B. Reinforced plastic sheet complying with ASTM E 1745, Class A.

1. Griffolyn Type T-65G or T-105 vapor barrier manufactured by Griffolyn Division of Reef Industries, Houston, Texas.

2. Premoulded Membrane with Plasmatic Core by W.R. Meadows.

C. Accessories: Seam tape, mastic and penetration boots recommended in writing by manufacturer.

2.3 Waterstops

A. Construction Joint Waterstops:

1. Multi-composite type consisting of penta-bentonite or other hydrophilic material laminated to high-density polyethylene (H.D.P.E.) and polypropylene. Waterstop shall be certified in writing as acceptable to waterproofing manufacturer. Refer to Division 07. Provide one (1) of the following:

a. “Superstop” by Tremco Sealants and Waterproofing.
b. “Waterstop RX” by CETCO Building Materials.
c. “Swellstop”, “LockStop” or “Hydrotite” by Greenstreak.

2.4 Weepholes

A. 4 inch diameter concrete or PVC drain tile.

2.5 Control And Expansion Joint Sealant

A. Joint Sealants: Refer to Joint Sealants: Division 07.

Part 3 Execution

3.1 General Installation Requirements

A. Install products furnished under this Section and products furnished under other Sections, where these products are to be cast into concrete.

1. Install in accordance with manufacturer’s written instructions.

2. Install products furnished as Work of other Sections in compliance with requirements indicated.

B. Embedded items shall conform to requirements of ACI 318, Chapter 6.

C. Inserts and sleeves furnished under other Sections: Coordinate with, and place prior to placing of reinforcing steel.

D. Anchor rods furnished under other Sections: Set anchor rods with line and transit and secure with template(s) and braced to prevent displacement.

E. Tolerances:

1. Comply with ACI 117.

2. For products furnished as Work of other Sections within tolerance requirements of that Work.

F. Embed no pipes other than electrical conduit in structural concrete. Install steel sleeves for pipes passing through concrete. Obtain written approval from Design Professional for variation from the following requirements, unless otherwise indicated. Make request in writing accompanied by suitable sketch.

1. No conduit coating, except galvanizing or equivalent.

2. Do not cut or displace reinforcement.

3. Do not place conduit between concrete surfaces and reinforcement.

4. Restrict outside diameter of conduit to 1/4 of slab thickness. Keep conduit within middle half of slab thickness.

5. Place nearly parallel conduits apart at least six (6) times outside diameter of conduit being used.

3.2 Vapor Retarder

A. Install vapor retarder under interior slabs-on-ground, as indicated, in accordance with manufacturer's written recommendations and ASTM E 1643 to provide a continuous sheet under slabs-on-ground.

B. Unroll vapor retarder with the longest dimension parallel to the direction of the pour.

C. Lap joints minimum 6 inches and seal.

D. Lap over footings and seal to foundation walls.

E. Seal penetrations through vapor retarder using boots, mastic and tape.

F. No penetrations of the vapor retarder are allowed except for reinforcing steel and permanent utilities.

G. At construction joints, extend vapor retarder past edge form minimum 12 inches to allow for sealing to vapor retarder under adjacent pour. Seal stake holes after removing edge forms.

H. Do not disturb or damage vapor retarder while placing concrete reinforcing. If damage occurs, repair areas before placing concrete. Use vapor retarder material, lapped over damaged areas minimum 6 inches and seal.

3.3 Waterstops

A. Install construction joint waterstops in accordance with manufacturer's written instructions to form a continuous watertight diaphragm.

B. Adequately support and protect waterstops to prevent displacement when concrete is being placed.

3.4 Weepholes

A. Install at base of exterior retaining walls at not more than 10 feet on center. Screen and provide minimum of 8 cubic feet of porous fill behind.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Requirements for concrete cast-in-place at Project Site, as well as requirements for concrete cast at fabricator's plant for precast concrete.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Pipe and Tube Railings: Division 05.

C. Modified Bituminous Sheet Waterproofing: Division 07.

D. Earth Moving: Division 31.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Product Data:

1. Concrete Mix Designs: Each individual mix design submittal shall be clearly labeled as to Class of concrete and proposed location(s), time(s) and method(s) of placement. Each mix design shall be submitted using sheets similar in content to those included with this Specification Section. Each separate mix submittal shall include the following:

   a. Documentation in accordance with ACI 301, establishing conformance with average compressive strength requirements.
   b. Cement mill test certificate.
   c. Cement/Aggregate reactivity certification, as indicated.
   d. Aggregate gradations and test reports.
   e. Lightweight aggregate certification as indicated.
   f. Splitting Tensile Strength data.
   g. Chloride test report substantiating chloride ion content per ASTM C 1218.
   h. Admixture compatibility certification, as indicated.
   i. Percentage of each type of pozzolan admixtures.

2. Manufacturer's Data: For information only submit two (2) copies of manufacturer's published data with application and written installation instructions for proprietary materials.

C. Quality Control Procedures:

1. Grout Test Results: Grout test data substantiating conformance with ASTM C 1107.

2. Curing Procedures: Drawings and other information required to fully define locations and materials of proposed concrete flatwork curing procedures. Submit cold and hot weather protection and procedures. If curing compound is proposed to be used, include in submittal required certification.

D. Sustainability Submittals: Provide the following in accordance with Sustainability Requirements: Division 01.

1. Materials Sustainability Documentation Form.

2. Product data, certification letter, and costs for materials with recycled content.

3. Product data and costs for regional materials.

4. Product data indicating VOC content.

1.4 Quality Assurance

A. Contractor's Responsibilities:

1. Contractor shall be responsible for methods of construction, and for strength, slump, consistency, finish, and general quality of the concrete. Statements in this Section relative to methods, quality and inspection and testing by Inspection and Testing Agency shall be construed as minimum acceptable, and shall not relieve Contractor of responsibility.

2. Provide suitable wood or metal boxes to store newly made cylinders. Provide boxes with sufficient space for storage and maintain within the boxes a temperature between 60 degrees F and 80 degrees F during first 24 hours after cylinders are made.

3. Notify Inspection and Testing Agency not less than 24 hours in advance of any concrete operation involving more than 2 cubic yards.

B. Referenced Codes and Standards: Comply with the following in accordance with Division 01.

1. American Concrete Institute (ACI)

117	Standard Tolerances for Concrete Construction and Materials
211.1	Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
211.2	Standard Practice for Selecting Proportions for Structural Lightweight Concrete
212.2R	Guide for Use of Admixtures in Concrete
214	Recommended Practice for Evaluation of Strength Test Results of Concrete
229R	Controlled Low-Strength Materials

301	Specifications for Structural Concrete for Buildings
304R	Guide for Measuring, Mixing, Transporting and Placing Concrete
304.2R	Placing Concrete by Pumping Methods
305R	Hot Weather Concreting
306R	Cold Weather Concreting
308	Standard Practice for Curing Concrete
309	Standard Practice for Consolidation of Concrete
318	Building Code Requirements for Structural Concrete
SP-15	Field Reference Manual: Specifications for Structural Concrete for Buildings With Selected ACI and ASTM Reference

2. National Ready Mixed Concrete Association (NRMCA)

   Quality Control Manual

3. Truck Mixer Manufacturers Bureau (TMMB)

   Truck Mixer, Agitator and Front Discharge Concrete Carrier Standards

C. Perform cast-in-place concrete work in accordance with ACI 318 and ACI 301, unless otherwise indicated.

D. ACI SP-15, Field Reference Manual shall be kept in field office during concrete construction.

E. Sources of supply of cement and aggregate shall not be changed during the course of Work without prior written approval of Design Professional. Material from any new source shall be subject to a complete new set of preliminary test, with expenses borne by Contractor.

F. Pre-Concrete Conference: At least fifteen (15) days prior to start of concrete construction, Contractor shall hold a meeting to review proposed concrete mix designs and to finalize the procedures for producing proper concrete construction.

1. Meeting shall be attended by responsible representatives of every party who is concerned with concrete work including, but not limited to, the following:

   a. Contractor's Superintendent.
   b. Concrete Inspection and Testing Agency.
   c. Concrete Subcontractor.
   d. Ready-mix Concrete Supplier.
   e. Admixture Manufacturer(s).
   f. Concrete Pumping Equipment Operator.
   g. Owner's Representative.

2. Meeting shall be scheduled such that Design Professional will be present at conference. Contractor shall notify Design Professional at least five (5) days prior to scheduled date.

3. Minutes of meeting shall be recorded, typed and distributed by Contractor to parties concerned within five (5) days of meeting and prior to placement of concrete.

G. Independent Inspection and Testing Agency: Services of an Independent Inspection and Testing Agency are required in conjunction with Work of this Section. Cooperate with, and facilitate the work of Inspection and Testing Agency. Refer to Division 01.

1.5 Corrective Actions

A. If, in opinion of Design Professional, reports of Inspection and Testing Agency, or field observations, indicate that concrete was placed contrary to requirements of Contract Documents, Design Professional may order additional measurements and or tests on portion(s) of structure affected.

B. Portions of Work that, in the opinion of Design Professional, do not conform to Contract requirements based on appearance or any other aesthetic reason shall be considered deficient.

C. Work found deficient shall, as directed by Design Professional, be repaired or removed and replaced, at no additional cost.

D. Contractor shall reimburse Owner for direct salary costs multiplied by a factor of 3.0, and other expenses, incurred by Design Professional for any work required to investigate and correct concrete construction of questionable quality. Contractor shall also pay additional inspection and testing costs incurred by Inspection and Testing Agency relative to investigating and testing concrete work determined to be of questionable quality.

1.6 Mix Design Performance Criteria

A. Provide concrete mix design(s) that comply with design and performance criteria indicated.

B. Concrete shall be homogeneous, with strength, appearance and durability required for various parts of Work.

C. Concrete shall be composed of Portland cement, fine aggregate, coarse aggregate, water, and admixtures as required, and shall be so proportioned and mixed as to produce concrete having the properties indicated in Building and Site Concrete Materials Schedule and as required.

D. Concrete Supplier shall submit a certification stating that no alkali reactivity is produced with proposed combination of materials when tested in accordance with ASTM C 227, or a pozzolan, proven by ASTM C 441 to be effective in preventing excessive expansion due to alkali-aggregate reaction, shall be included in mix.

E. Structural Lightweight Concrete:

1. Maximum Air-Dry Weight and Splitting Tensile Strength: As indicated in Concrete Materials Schedule.

2. Air-Dry and Plastic Unit Weights: Determined in accordance with ASTM C 567 and submitted as part of the mix design submittal to confirm specified air-dry unit weight and to establish a plastic unit weight to be used in field control.

3. Lightweight aggregate manufacturer shall produce and provide splitting tensile strength test data as part of mix design submittal, substantiating conformance with specified values in mixes with similar materials.

4. Mix design(s) shall be reviewed by lightweight aggregate manufacturer. Aggregate manufacturer shall certify that proposed mix design(s) are appropriate considering properties of aggregate, concrete supplier's procedures for storage and handling of aggregate, intended method of concrete placement and procedures indicated for quality control.

Part 2 Products

2.1 Materials, General

A. Provide recycled content materials in accordance with Sustainability Action Plan specified in Sustainability Requirements: Division 01 and as indicated below.

B. Provide regional materials in accordance with Sustainability Action Plan specified in Sustainability Requirements: Division 01 and as indicated below.

C. Use admixtures and compounds that comply with the VOC limits specified in Sustainability Requirements: Division 01.

2.2 Portland Cement

A. ASTM C 150, Type I, II, or III. Blended Hydraulic Cements (ASTM C 595 and C 1157) shall not be used. Do not use air-entraining cement.

2.3 Aggregates

A. Source: Extract material or salvage within 500 miles of Project Site.

B. General: ASTM C 33. Fine and coarse aggregates shall have hard, angular, uncoated, durable particles and shall be free of deleterious substances and injurious amounts of mica, clay and organic matter.

C. Fine Aggregate: Natural sand or stone screenings. Maximum silt content shall be 2 percent, organic impurities Plate No. 2 maximum when tested as per ASTM C 40. Fineness Modulus shall be 2.75 plus or minus 0.20.

D. Coarse Aggregate: Crushed stone or gravel, size and weathering class as indicated in Concrete Materials Schedule.

E. Graduation of aggregate for flatwork concrete shall be such that no less than 8 percent and no more than 22 percent is retained on any sieve above No. 100.

F. Lightweight Aggregate: Expanded shale, clay or slate, size as indicated in the Concrete Materials Schedule, manufactured by the rotary kiln method, conforming to ASTM C 330. Aggregate shall be free of impurities that damage finish, cause aggregate to separate at concrete surface, or other deleterious effects. Handle, store and predampen lightweight aggregate as per manufacturer's written recommendations before mixing with cement.

2.4 Chemical Admixtures

A. General: Where more than one (1) admixture is used, admixtures shall be compatible. Products of the following manufacturers are acceptable for use. No substitutions.

1. W. R. Grace.
2. Sika Chemical Corporation.
3. BASF Construction Chemicals.
4. The Euclid Chemical Company.
5. L & M Construction Chemicals.

B. Air-Entraining Admixtures: ASTM C 260.

C. Accelerating and Water-Reducing Accelerating Admixtures: ASTM C 494, Type C or E.

D. Water-Reducing Admixtures: ASTM C 494, Type A.

E. Water-Reducing Retarding Admixtures: ASTM C 494, Type D.

F. High-Range Water-Reducing Admixtures (Superplasticizer): ASTM C 494, Type F or G or ASTM C 1017, Type 1 or 2.

G. Prohibited Admixtures: Calcium chloride and admixtures containing more than 0.05 percent chloride ion are not acceptable.

H. Certification: Admixtures proposed for each Class of concrete shall be produced by a single manufacturer. Written conformance of compatibility of admixtures in each mix design shall be submitted from admixture manufacturer as part of mix design.

2.5 Water

A. Water for mixing and curing concrete shall be clean, potable, free of oils, acids, alkali, chlorides, fluorides, nitrates, organic materials, or other substances, in amounts deleterious to concrete. Wash water shall not be reused as mix water.

2.6 Pozzolan Admixtures

A. Fly Ash: ASTM C 618, Class C or F. No additives or contaminants derived from fly ash precipitation process, which are detrimental to concrete (such as soda ash and ammonia), shall be allowed. Fly ash producer shall have a minimum of five (5) years experience in production of acceptable fly ash and shall practice an effective quality control program to guard against contamination of fly ash. Provide a maximum of 25 percent fly ash. Products of the following manufacturers are acceptable, subject to the review of manufacturer's certification of applicability: Equivalent products of other manufacturers will be evaluated as substitutions in accordance with requirements of Division 01.

1. Member, American Coal Ash Association, Syracuse, NY; telephone 315/428-2400.
2. Boral Material Technologies, San Antonio, TX, telephone 210/349-4069.
3. Hanson Aggregates South Central Region, Dallas, TX, telephone 800/441-0005.
4. Mineral Solutions, Eagan, MN, telephone 800/437-5980.
5. The SEFA Group, West Columbia, SC, telephone 800/884-7332.
6. VFL Technology, Dagsboro, DE, telephone 302-934-8025.

B. Ground Granulated Blast Furnace Slag: ASTM C 989 Grade 100 or 120 when tested in combination with Portland Cement indicated in the mix design(s) submitted. Slag producer shall have a minimum of five (5) years experience in the production of acceptable slag and shall practice an effective quality control program to guard against contamination. Provide a maximum of 50 percent slag.

2.7 Curing Materials

A. Insulating blankets, reinforced waterproof kraft paper, or polyethylene film per ASTM C 171 shall keep concrete continuously moist and is suitable for prevailing weather conditions.

B. Curing Compounds: Curing compounds may be used only if approved in writing by Design Professional. Curing compounds proposed for use shall comply with ASTM C 309. Manufacturer of material shall certify to appropriateness of material and application procedures, given weather conditions, concrete mix, finishes and materials indicated to be subsequently applied. A technically qualified representative of material manufacturer shall be available at Project Site when material is first used and as required throughout the course of Work to assure materials proper application.

1. Provide zero or low VOC type curing compounds.

C. Concrete Curing Compounds, Low-VOC Type: Products of the following manufacturers are acceptable, subject to the review of manufacturers certification of applicability: No substitutions.

1. SealTight Green Line Products by W. R. Meadows, Hampshire, IL, telephone 800/342-5976.

2. Master Cure 100 and 200 by ChemRex, Inc., Shakopee, MN, telephone 800/243-6739.

2.8 Bonding Material

A. Bonding Compounds: Polyvinyl acetate type, Rewettable: “Euco Weld” by Euclid Chemical or “Weldcrete” by The Larsen Co. Use only in areas not subject to moisture. Equivalent products of other manufacturers will be evaluated as substitutions in accordance with requirements of Division 01.

2.9 Repair Materials

A. If concrete repair is required, materials used shall be as recommended in writing by manufacturer for intended use and are subject to written approval of Design Professional.

B. Products of the following manufacturers are acceptable, subject to the review of manufacturers certification of applicability: No substitutions.

1. The Euclid Chemical Company.
2. L&M Construction Chemicals, Inc.
3. W. R. Grace.
4. Sika Chemical Corporation.

2.10 Nonshrink Grout

A. Non-metallic, non-shrink, 7600 psi grout conforming to ASTM C 1107, “Standard Specification for Packaged Dry, Hydraulic-Cement Grout”.

B. Products of indicated manufacturers are acceptable. No substitutions.

1. The Euclid Chemical Company.
2. L&M Construction Chemicals, Inc.
3. Master Builders, Inc.
4. U.S. Grout.

2.11 Evaporation Retarder

A. Products of indicated manufacturers are acceptable. No substitutions.

1. The Euclid Chemical Company.
2. L&M Construction Chemicals, Inc.
3. Master Builders, Inc.

Part 3 Execution

3.1 General

A. Examination: Examine concrete substrates prepared by Work of other Contracts. Do not proceed with Work until substrates are acceptable for proper execution of Work of this Section.

B. Coordinate Work with Work of other Sections affected. See Division 01 for Work regarding chases, openings and inserts.

C. Do not place horizontal joints in walls, except as indicated, without specific written approval by Design Professional.

3.2 Concrete Proportioning

A. At least three (3) weeks before first scheduled concrete placement, submit proposed design mixes to Design Professional. Submit a separate design mix for each Class of concrete (each required or anticipated change in mix materials). Include trial mixture results with water/cement ratio vs. strength curves or record of past experience with complete standard deviation analysis. When record of past experience is used to establish standard deviation, include information on mix materials of mixes used for substantiating tests. Concrete placed prior to mix design approval is subject to additional testing as required by Design Professional.

B. Proportions for concrete mixes shall be determined in accordance with ACI 301. No deviations from approved mixes will be permitted without prior written approval of Design Professional.

C. Concrete shall be of such consistency and composition that it can be worked into corners and angles of forms and around reinforcement without permitting materials to segregate or for free water to collect on surface.

D. Concrete shall be proportioned utilizing a high-range water-reducer (superplasticizer).

1. Concrete for the following Work need not be proportioned utilizing a high-range water-reducer (superplasticizer):

    a. Footing concrete.
    b. Site concrete work; for example, curbs, sidewalks, pads, paving.

E. Control moisture content of stockpiled materials by protecting them from weather, spraying and draining as necessary. Adjust batch weights as necessary to compensate for variations in moisture content of aggregate. Maintain a uniform moisture content in fine aggregate not in excess of 6 percent.

F. Fly Ash: Use a maximum of 150 pounds per cubic yard. Fly ash shall not exceed 20 percent of total cementitious materials.

G. Slag: Use a maximum of 300 pounds per cubic yard. Slag shall not exceed 40 percent of total cementitious materials.

3.3 Mixing

A. General: Provide mixing equipment capable of combining aggregates, cement, water, and admixture into a uniform mass that can be conveyed and placed without segregation of components. Size of each batch shall not exceed rated capacity of equipment.

B. A technically-qualified representative of high-range water-reducing admixture (superplasticizer) manufacturer shall be present during initial stages of concrete production to assist Contractor and ready-mix producer to achieve optimum benefits of concrete under prevailing Project Site conditions.

C. Ready-Mixed Concrete: Batch, mix and transport equipment complying with recommendations of the NRMCA and in accordance with "Specifications for Ready-Mixed Concrete", ASTM C 94 except as modified herein. Nonagitating equipment shall not be used to transport concrete.

3.4 Preparation For Conveying And Placing

A. Before placing concrete, remove soil, debris, ice, frost, snow, and free water from forms and from conveying and placing equipment. Moisten subgrades and porous formwork sufficiently to avoid drawing cement grout from concrete placed thereon.

B. Equipment: Type and size to provide material, at point of deposit, of indicated consistency and capable of being handled and conveyed from mixer to place of final deposit without delay, segregation, or intrusion of foreign matter.

C. Pumping: Comply with ACI 304.2R. Provide sufficient standby equipment to ensure continuous placement up to a properly located construction joint.

3.5 Placing Concrete

A. Place concrete within 1 1/2 hours after introduction of water to mix or after introduction of cement to the aggregates. In hot weather, shorten this time as required to minimize stiffening of concrete prior to placement.

B. Ensure reinforcement, inserts, embedded parts, formed expansion and contraction joints, and waterstops are not disturbed during concrete placement.

C. Free fall shall not exceed 10 feet for concrete with high-range water-reducing admixture and 5 feet for other concrete so as to avoid segregation. Free fall on metal deck shall not exceed 2 feet.

D. Provide side access in forms where required. Use adjustable hoppers and chutes so as to limit the horizontal flow of concrete after deposition to not greater than 10 feet.

E. Prepare previously placed concrete (except for slab-on-ground) by cleaning and applying bonding compound. Apply bonding compound in accordance with manufacturer's written recommendations.

F. Joints:

1. Construction joints shall not be further apart than 80 feet in any direction.

2. Expansion joints in exterior work shall not be further apart than 80 feet.

3. Control joints shall be as indicated, not to exceed 20 foot.

G. Slabs-On-Ground:

1. Begin Work for slabs-on-ground only after slab subgrade, virgin soil, porous fill, and controlled fill have been compacted and tested, and underslab utilities have been placed and tested.

2. Vapor Retarder: Refer to Concrete Accessories: Division 03.

3. Provide control and expansion joints as indicated. Do not make changes in details or location without prior written approval by Design Professional.

4. Place slab in strips, and form panels at control joints, allowing at least 48 hours between placement of adjacent strips.

H. In locations where new concrete is doweled to existing work, drill holes in existing concrete and insert steel dowels as indicated.

3.6 Vibrating

A. Conform to ACI 309.

B. Consolidate concrete with mechanical vibrators of internal type. For difficult placements (for example, heavily-reinforced sections), provide supplemental external form vibration only with written approval of Design Professional.

C. Vibrate each layer of concrete, except upper portion of topmost layer. Extend vibrator into preceding layer to ensure thorough integration.

D. Insert vibrators into concrete at regular intervals and operate for 5 to 15 seconds at each insertion.

E. Do not use vibrators to transport concrete horizontally.

3.7 Protection

A. Protect Work against excessive loading and other construction activities. Protect constructed Work from degrading environmental effects of ice, rain, snow, excessive heat, and freezing temperatures.

B. Where walls, and slabs-on-ground are exposed to elements pending completion of Work, brace and protect concrete against wind forces and other weathering.

3.8 Curing

A. Concrete work other than flatwork shall be cured in accordance with provisions of ACI 308, unless otherwise indicated.

B. Flatwork Curing: Moist cure interior and exterior concrete slabs, sidewalks, paving, ramps, and steps by use of materials specified.

1. Curing materials for general use shall be light in color. Use dark (heat absorbing) colors if temperature is below 50 degrees F.

2. Commence moist curing as soon as finishes will not be marred. Do not postpone curing until next morning.

3. Keep concrete continuously moist for at least seven (7) days at temperature above 50 degrees F after placement. Concrete may require periodic spray. After temporary heat is removed, (in cold weather), cover concrete with insulating blankets or other material that will retain moisture and protect against frost.

3.9 Cold-Weather Concrete Work

A. Except as otherwise indicated, follow procedures outlined in ACI 306.

B. Do not place concrete on frosted or frozen ground.

C. Use cold weather concreting procedures when mean temperature falls below 50 degrees F. Concrete placed shall be of an approved mix containing an accelerating admixture.

D. Temperatures of concrete when delivered at Project Site shall conform to temperature limitations in the following Table.

TEMPERATURE LIMITATIONS ON CONCRETE WHEN DELIVERED AT PROJECT SITE			
		Minimum concrete temperature, Degrees F	
	Air Temperature, Degrees F	For sections with least dimension less than 12 inches	For sections with least dimension 12 inches or greater
1.	30 to 45	60	50
2.	0 to 30	65	55
3.	Below 0	70	60

E. If water or aggregate is heated above 100 degrees F at the plant, water shall be combined with aggregate in mixer before cement is added. Cement shall not be mixed with water or with mixtures of water and aggregate having a temperature greater than 100 degrees F.

F. After concrete is placed, and temperature falls below 40 degrees F, provide enclosures, covers, insulation, and/or heat so that temperature of concrete is maintained at temperature indicated in Table above for at least 48 hours.

G. Allow concrete to cool gradually at a rate not to exceed 5 degrees F in any hour, nor more than 40 degrees F in 24 hours.

H. Work that will be subjected to in-service freeze/thaw cycles shall achieve a minimum strength of 4000 psi before being subjected to first cycle of construction freeze and thaw.

3.10 Hot-Weather Concrete Work

A. Except as indicated, follow procedures as outlined in ACI 305.

B. Use hot-weather concreting procedures when mean daily temperature exceeds 80 degrees F. Concrete placed shall be of an approved mix containing a retarding admixture.

C. Wet forms just before placing of concrete, and keep exposed surfaces damp.

D. Do not place concrete if concrete temperature is above 95 degrees F.

E. Use approved evaporation retarder as indicated and in accordance with manufacturer's written recommendations during finishing operation.

3.11 Finishing Formed Surfaces

A. Rough-Formed Finish: For Work not exposed to public view, as-cast concrete texture imparted by form material indicated with tie holes and defective areas repaired and patched as indicated, below. Remove fins and other projections exceeding ACI 347R limits for class of surface indicated.

B. Smooth-Formed Finish: Concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster or painting.

1. As soon as forms have been stripped, remove fins and other projections. Patch and repair surface defects which do not impair structural strength of concrete as indicated. Clean exposed concrete surfaces and adjoining work stained by leakage of concrete.

2. Remove form tie plugs and fill holes as follows:

a. Moisten hole with water and apply a brush coat of neat cement slurry mixed to consistency of a heavy paste.
b. Immediately plug hole with grout consisting of a 1:1.5 mixture of cement and concrete sand mixed slightly damp to touch.

c. Compact grout into hole until dense.
d. Fill hole flush with concrete surface and finish smooth.

C. Rubbed Finish: Apply the following to smooth-formed finish concrete exposed to view in Finished Work:

1. Smooth-Rubbed Finish: Not later than one (1) day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one (1) part Portland cement to one and one-half (1 1/2) parts fine sand with a 1:1 mixture of bonding admixture and water. Add white Portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. 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.

3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one (1) part Portland cement and one (1) part fine sand with a 1:1 mixture of bonding agent and water. Add white Portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.

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

3.12 Concrete Pads, Curbs And Equipment Foundations

A. Provide concrete equipment foundations, pads and curbs as indicated and as required for Mechanical and Electrical Work in accordance with Drawings and the Shop Drawings prepared by those Sections.

3.13 Temperature Records

A. Keep a permanent record of outside air and concrete temperatures for concreting operations (including curing). Take thermometer readings at start of Work each day, at noon, and late in the afternoon. Record locations of all concrete placed and cured. Records shall be kept in such manner as to show any effect temperature may have had on construction. Temperature records shall be available at Project Site at all times for review by Design Professional.

3.14 Defective Concrete

A. Modify or replace Work not conforming to required lines, details and elevations.

B. Repair or replace questionable Work as approved by Design Professional. Do not patch, fill, touch-up, repair, or replace concrete, except for surface patching indicated, without approval of Design Professional. Submit a procedural outline of proposed repair work including, for example, a description of materials, preparation and sequencing for Design Professional's review. Materials proposed for use shall be documented in writing as appropriate for application by material manufacturer prior to use.

3.15 Concrete Mix Design Submittal

A. See next two (2) pages.

CONCRETE MIX DESIGN SUBMITTAL (Page 1 of 2)

Project: ____

Location: ____

Contractor/Construction Manager: ____

Concrete Contractor: ____

Concrete Supplier: ____

♦♦

Mix Design Number: ____

Description (include specified strength (compressive and splitting tensile) and unit weight and building elements to be used for, approximate months of year of intended placement and method of placement):

____

____

____

____

____

♦♦♦

MATERIALS

Cement: ____

Coarse Aggregate: ____

Fine Aggregate: ____

Pozzolan (fly ash, slag, silica fume): ____

Water Reducing Admixture: ____

High-Range Water-Reducing Admixture: ____

Air Entraining Admixture: ____

Retarding Admixture: ____

Accelerating Admixture: ____

Corrosion Inhibiting Admixture: ____

Other Admixture: ____

MIXED PROPORTIONS

Material:	Quantity Per Cubic Yard
Cement (lbs):	_____
Pozzolan (lbs):	_____
Fine Aggregate (lbs):	_____
Coarse Aggregate (lbs):	_____
Water (gals):	_____
Water (lbs):	_____
Admixtures: _____	_____
Admixtures: _____	_____
Admixtures: _____	_____
Admixtures: _____	_____

PROPERTIES

Water/Cementitious Ratio: _____

Slump: _____

Initial: _____

Final: _____

Air Content: _____

Unit Weight: _____

Plastic: _____

Dry: _____

Chloride Content: _____

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section includes polished concrete finishing.

1. Concrete for polished concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, initial finishing, and curing is specified in Section 033000 "Cast-in-Place Concrete."

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Cast-in-Place Concrete: Division 03, refer to for concrete not designated as polished concrete.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Product Data: For each type of product.

C. Sustainability Submittals: Provide the following in accordance with Sustainability Requirements: Division 01.

1. Materials Sustainability Documentation Form.

2. Product data, certification letter, and costs for materials with recycled content.

3. Product data and costs for regional materials.

4. Product data for adhesives and sealants indicating VOC content.

D. Polishing Schedule: Submit plan showing polished concrete surfaces and schedule of polishing operations for each area of polished concrete before start of polishing operations. Include locations of all joints, including construction joints.

E. Samples for Initial Selection: For each type of product requiring color selection.

F. Samples for Verification: For each type of exposed color.

G. Qualification Data: For Installer.

H. Material Certificates: For each of the following, signed by manufacturers:

1. Repair materials.

2. Stain materials.

3. Liquid floor treatments.

1.4 Definitions

A. Design Reference Sample: Sample designated by Architect in the Contract Documents that reflects acceptable surface quality and appearance of polished concrete.

1.5 Preinstallation Meetings

A. Preinstallation Conference: Conduct conference at project site.

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with polished 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. Cast-in-place concrete subcontractor.
e. Polished concrete finishing Subcontractor.

2. Review cold- and hot-weather concreting procedures, curing procedures, construction joints, concrete repair procedures, concrete finishing, and protection of polished concrete.

1.6 Quality Assurance

A. Field Sample Panels: After approval of verification sample and before casting concrete, produce field sample panels to demonstrate the approved range of selections made under Sample submittals. Produce a minimum of three sets of full-scale panels, approximately 48 by 48 inches minimum, to demonstrate the expected range of finish, color, and appearance variations.

1. Locate panels as indicated or, if not indicated, as directed by Architect.

2. Maintain field sample panels during construction in an undisturbed condition as a standard for judging the completed Work.

3. Demolish and remove field sample panels when directed.

B. Mockups: Before casting concrete, build mockups to verify selections made under Sample submittals and to demonstrate typical joints, surface finish, tolerances, and standard of workmanship. Build mockups to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.

2. Demonstrate curing, finishing, and protecting of polished concrete.

3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 Field Conditions

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

Part 2 Products

2.1 Liquid Floor Treatments

A. Liquid dye concentrate formulated to color interior concrete surfaces prior to being densified, sealed and polished. Dye to be as recommended by polished concrete finish manufacturer. Color to be chosen by Design Professional from manufacturer's standard range of available colors. Basis of Design is "Rustic Bark 4405" as manufactured by Scofield Systems.

B. Penetrating Liquid Floor Treatments for Polished Concrete Finish: Clear, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and is suitable for polished concrete surfaces.

1. Scofield.

2. Euclid.

3. Ardex.

Part 3 Execution

3.1 Polishing

A. In order to eliminate need for small edging tool and difference in floor aesthetic, coordinate timing of installation to occur prior to construction on top of slab, with continuous protection board placed, taped and sealed.

B. Polish: Level 3: medium sheen, 800 grit.

C. Apply polished concrete finish system to cured and prepared slabs to match accepted mockup.

1. Machine grind floor surfaces to receive polished finishes level and smooth

2. Apply liquid dye in accordance with manufacturer's recommendations.

3. Apply penetrating liquid floor treatment for polished concrete in polishing sequence and according to manufacturer's written instructions, allowing recommended drying time between successive coats.

4. Continue polishing with progressively finer-grit diamond polishing pads to gloss level, to match approved mockup.

5. Control and dispose of waste products produced by grinding and polishing operations.

6. Neutralize and clean polished floor surfaces.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Manufactured unit masonry for Project, including face brick and concrete masonry units, and as follows:

1. Accessories related to unit masonry work, for example, mortar, reinforcement, anchorage and masonry lintels.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Inspection and Testing Services: Division 01.

C. Inspection and Testing of Masonry: Division 01.

D. Concrete Reinforcement: Division 03.

E. Metal Fabrications: Division 05.

F. Exterior Enclosure, General: Division 07.

G. Thermal Insulation: Division 07.

H. Air/Vapor Barriers: Division 07.

I. Flashing and Sheet Metal: Division 07.

J. Joint Sealants: Division 07.

K. Firestopping: Division 07.

L. High-Performance Coatings: Division 09.

M. Painting: Division 09.

N. Louvers: Division 08.

O. Mechanical: Division 23.

P. Plumbing: Division 22.

Q. Electrical: Division 26.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Shop Drawings:

1. Shape and Profile Drawings for each type of unit.

2. Reinforcement Placement Drawings: For each piece of reinforcing bar.

3. Masonry Control Joint Drawings:

a. Elevations: Minimum 1/4 inch equals 1 foot scale elevation of each area of wall.
b. Details: Full size details of each assembly including heads, sills, corners and intersections with abutting construction and joints in system.
c. Assembly Details: Multiple, exploded, isometric, three-dimensional details showing the sequential assembly of typical intersections including but not limited to corners, tee intersections and cross intersections.

C. Product Data:

1. For each type of concrete masonry unit, reinforcement, anchorage, cleaning products and accessories.

2. Mortar Mix Designs: As indicated.

D. Samples:

1. Full-size Samples of concrete masonry units face brick, custom shapes for Design Professional's review and approval. Samples shall indicate full range of color and texture variation.

2. Colored Mortar.

3. Weep holes/ vent blocks.

E. Quality Control Procedures:

1. Cold and hot weather construction procedures.

2. Cleaning Procedures: As recommended in writing by manufacturer of masonry and cleaning agent. Customize to suit the Work.

3. Preconstruction Testing: As indicated.

F. Certifications:

1. Certifications from material manufacturers of compliance with Referenced Standards and Specifications, including UL Certificates for fire rated Concrete Masonry Units.

2. Certifications from each material manufacturer of Unit Masonry that cleaning products are compatible and have not deleterious effect.

1.4 Definitions

A. Control Joints:

1. In Brick: Creates an open plane in wythe to allow initial expansion.

B. Expansion Joints: A continuous break in entire structure of building and are not necessarily specified in this Section. Note that Brick Institute of America and other similar technical organizations use term "expansion joint" for control joints in brick and tile. When interpreting required reference standards it is Contractor's responsibility to coordinate meaning of each term with its appropriate usage in Specifications.

1.5 Quality Assurance

A. Work of this Section shall be subject to review, inspection and approval of Owner's Representative. Inspection and Testing, including reports and certifications are responsibility of Contractor. Perform Inspection and Testing in accordance with Division 01. Owner reserves right to verify all tests with Owner's independent Inspection and Testing Agency.

B. Manufacturer's Qualifications: Manufacturer of each unit masonry product shall have a minimum ten (10) years experience. Company shall demonstrate through written third party documentation successful completion of five (5) projects of similar scope and complexity in last three (3) years.

C. Mason's Qualifications: Installer of unit masonry shall be a company specializing in performing Work of this Section with minimum five (5) years experience. Company shall demonstrate through written third party documentation successful completion of five (5) projects of similar scope and complexity in last three (3) years.

D. Accessory Manufacturer's Qualifications: Manufacturer of each accessory product shall be a company specializing in manufacture of products specified in this Section with minimum five (5) years experience. Company shall demonstrate through written third party documentation successful completion of five (5) projects of similar scope and complexity in last three (3) years.

E. Single Source Requirements: Each of types of products and materials listed below shall be furnished by a single manufacturer for entire Project.

1. Concrete Masonry Units.

2. Ground Face Concrete Masonry Units.

3. Brick.

4. Reinforcement, Ties and Anchors.

5. Mortar and Grout Materials including Pigments and Admixtures.

6. Cleaning Agent.

F. Referenced Codes and Standards: Comply with the following per requirements of Division 01.

1. Brick Institute of America (BIA): "Technical Notes"

2. Portland Cement Association (PCA): "Concrete Masonry Handbook"

3. National Concrete Masonry Association (NCMA): "TEK Manual for Concrete Masonry Design and Construction"

G. Regulatory Requirements:

1. Comply with technical requirements of ACI530.1/ASCE6 "Specifications for Masonry Structures" except for any requirements which may conflict with responsibilities of Contractor, Owner and Design Professional as required by Conditions of Contract and other Specification Sections.

2. Fire Performance: Where indicated, provide materials and construction identical to those assemblies whose fire resistance has been determined in accordance with ASTM E 119, by an Inspection and Testing Agency, by equivalent concrete masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

H. Masonry Field Sample Panel:

1. Provide unit masonry work required for Field Sample Panel.

2. Construct Field Sample Panels of each type of unit masonry specified to verify selections made under sample submittals and to demonstrate aesthetic effects. Field Sample Panel shall incorporate full range of color and texture variation of units. For exterior masonry face Sample Panel south and build a corner return at east. Build panels 48 inches long by 48 inches high with return ends 16 inches long by 48 inches high. Include a control joint with sealant. Sample Panels for masonry concealed in finished Work are not required. Maintain and protect approved panels for duration of Work. Completed Work shall match approved Sample Panels.

   a. Where masonry is to match existing, erect panels adjacent and parallel to existing surface.
   b. Protect approved sample panels from the elements with weather-resistant membrane.

      1) Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by the Design Professional in writing.

      2) Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless such deviations are specifically approved by the Design Professional in writing.

c. List of Materials Used in sample panel: List product names together with manufacturers, manufacturers' product model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.

3. If Sample Panels are disapproved, provide new panels. Repeat procedure until Sample Panels are approved.

4. Remove Sample Panels, either approved or disapproved, only by direction from Owner's Representative. Removal shall be complete, with all materials disposed off site and Project Site restored.

5. Clean Sample Panel with methods indicated.

I. Mock-up Panel

1. Submit Drawings of masonry mock-up panel.

2. Provide unit masonry work required for mock-up panel in accordance with approved Drawings and as specified in Exterior Enclosure, General: Division 07.

J. Preinstallation Conference: Participate in preinstallation meeting specified in Exterior Enclosure, General: Division 07.

K. Masonry Inspection and Testing shall be performed in conjunction with this Work as specified in Division 01.

1. Furnish materials to Agency for testing as required.

2. Provide free access to portions of Work and cooperate with appointed firm.

3. Submit mortar mix designs and sample prisms for review prior to commencement of Work.

4. If materials do not conform, select new materials and mixes, and resubmit for retesting. Contractor shall pay for retesting.

1.6 Delivery, Handling And Storage

A. Prior to delivery, pack special units, such as ground face, in such manner as to protect faces and edges from damage.

B. Deliver masonry materials to Project Site in undamaged condition.

C. Store and handle masonry units off ground, under cover, and in a dry location to prevent their deterioration or damage due to moisture, temperature changes, contaminants, corrosion, and other causes. If units become wet, do not place until units are in an air-dried condition.

D. Store cementitious materials off ground, under cover, and in a dry location.

E. Store aggregates on tarps, paving or other hard, clean surface where grading and other required characteristics can be maintained and contamination avoided.

F. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.7 Project Conditions

A. Cold-Weather Construction: Comply with ACI 530 unit masonry standard for cold-weather construction and the following:

1. Do not lay masonry units that are wet or frozen.

2. Remove masonry damaged by freezing conditions.

B. Hot-Weather Construction: Comply with ACI 530 referenced unit masonry standard for hot-weather construction.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.

2. Protect sills, ledges, and projections from mortar droppings.

3. Protect surfaces of window and doorframes, as well as similar products with painted and integral finishes, from mortar droppings.

4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

5. Monitor other trades as they come in contact with masonry as to perform their work without damaging masonry. Masonry Contractor shall provide additional protection materials to other trades prior to trades starting their work. Replace masonry if damaged by other trades.

Part 2 Products

2.1 Materials, General

A. Use admixtures that comply with the VOC limits specified in Sustainability Requirements: Division 01.

2.2 Mortar

A. Materials:

1. Cementitious materials, admixtures and sand and admixtures shall remain same throughout entire Work where exposed to view.

2. Comply with ASTM C 270 and as indicated. Cementitious materials shall be Portland cement and lime only. Masonry cement is not acceptable.

3. Portland Cement: ASTM C 150, Type I.

4. Sand and Aggregates: ASTM C 144:

5. Lime: ASTM C 207, Type S.

6. Water: Potable public supply and free of detrimental content.

7. Pigment: Mineral oxide pigment, sunfast and lime proof, with specific gravity approximating that of Portland cement. Pigment shall not exceed 5 percent of the weight of Portland cement. Carbon black shall not exceed 2 percent of weight of Portland cement. Acceptable Manufacturers: Solomon, Glen Gery and Essroc.

   a. Pigmented mortar shall match color as selected by Design Professional from manufacturer's full line

8. Latex Pointing Mortar Additive: "Laticrete 1776: "Grout Admix" manufactured by Laticrete International, Inc. or approved equivalent.

9. Epoxy Pointing Mortar: Prepackaged, multi-component epoxy mortar complying with ANSI A 118.3. Color selected by Design Professional from manufacturer's full line. Provide "SpectraLOCK Pro Grout" manufactured by Laticrete International, Inc. or approved equivalent.

B. Mortar Mixes:

1. Mortar mixes shall comply with ASTM C 270 as follows:

   a. Type S with a minimum 28 day compressive strength of 1800 psi. Proportion shall be one (1) part Portland cement to 1/4 to 1/2 parts hydrated lime. Aggregate ratio shall be 2 1/4 to 3 times sum of separate volumes of cement and lime.
   b. Type M with a minimum 28 day compressive strength of 2500 psi. Proportion shall be one (1) part Portland cement to 1/4 part hydrated lime. Aggregate ratio shall be 2 1/4 to 3 times sum of separate volumes of cement and lime.
   c. Type N with a minimum 28 day compressive strength of 750 psi. Proportion shall be one (1) part Portland cement to 1/2 to 1 1/4 part hydrated lime. Aggregate ratio shall be 2 1/4 to 3 times sum of separate volumes of cement and lime.
   d. Type O with a minimum 28 day compressive strength of 350 psi. Proportion shall be one (1) part Portland cement and 1 1/4 to 2 1/2 parts hydrated lime. Aggregate ratio shall be 2 1/4 to 3 times sum of separate volumes of cement and lime.

2. Trial Batches for Masonry Sample Panel and Mock-up Panels: After material sources have been established and approved, mix trial batches of types required in shades and colors. Once mortar ingredient proportions are established for strength and appearance and approved in Sample Panel, maintain same mortar mixture(s) for entire Work.

3. Add mortar color and admixtures in accordance with manufacturer's written recommendations. Ensure uniformity of mix and coloration.

4. Do not use anti-freeze compounds to lower freezing point of mortar.

5. Use mortar within two (2) hours of mixing. Do not retemper mortar after two (2) hours of mixing.

C. Tuck pointing mortar for existing masonry.

2.3 Grout Materials

A. High slump grout complying with ASTM C 476 with the following 28 day compressive strength when tested in accordance with ASTM C 1019:

1. 2000 psi : Grout for ASTM C 90 unit.

2.4 Masonry Units, General

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to exceed tolerances and to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not uses units where such defects are present, including dimensions that vary from specified dimensions by more than stated tolerances, will be exposed in the completed Work or will impair the quality of completed masonry.

2.5 Concrete Masonry Units (Only As Optional 4" CMU Beneath Brick Veneer)

A. Concrete Block:

1. Type:

a. Load Bearing Units: ASTM C 90.

1) Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi.

b. Non-load Bearing Units: ASTM C 129, Type I moisture controlled.

2. Weight Classification:

a. Normal Weight: 125 pcf or more.

3. Integral Water Repellent: Provide units made with integral water repellent for exposed units and where indicated.

a. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive according to ASTM E 514, with test period extended to 24 hours, show no visible water or leaks on the back of test specimen.

4. Units shall be uniform in color and texture, free of water smears, surface or web cracks, spalls or broken corners within limits of reference standard. Surface effect shall be tight; texture shall be fine for exposed or painted units. Units to receive plaster or stucco shall have an open surface effect and coarse texture.

5. Unit Face Size, Nominal: as indicated Width: Manufactured to dimensions 3/8 inch less than nominal dimensions.

6. Units with narrow core in center web for ease of splitting shall not be used as full-size stretcher units.

7. Provide special shape units for control joints, exposed end units, bond beams, and lintels and as indicated.

8. Units shall have two (2) cores and nominal depth as indicated.

2.6 Face Brick

A. Brick basis of design - Sienna Ironspot Velour as manufactured by Endicott ClayProducts Company. Brick stretcher size shall be Norman size.

1. Other providers:

a. Norman size #374 Autumn Blend as manufactured by Taylor Clay Products Company.
b. Norman size Sienna Blend Velour A by The Belden Brick Company.

B. Provide special solid and molded shapes, sizes, and factory-gaged stretcher brick, matching color and texture of brick stretcher units across full range of variation in order to blend into Final Work.

C. Brick pavers shall be solid 4” x 12” paver brick to match color and texture of face brick.

2.7 Reinforcement, Ties And Anchors

A. General:

1. Acceptable manufacturers are listed below. No substitutions.

a. Blok Lok Limited.
b. A. A. Wire Products Company.
c. Heckmann Building Products, Inc.
d. Hohmann & Barnard, Inc.
e. Wire-Bond.

2. Materials shall be as listed, unless otherwise indicated:

a. Galvanized Steel: ASTM A 82 Carbon Steel Wire, ASTM A 1008/ A1008M Carbon Steel Sheet Metal, ASTM A 36 Steel Plate, Hot Dip Galvanized After Fabrication per ASTM A 153 Class B-1 or B-2 to suit material thickness.
b. Stainless Steel: ASTM A 240 stainless steel sheet, ASTM A 276 stainless steel plates, bars and shapes, ASTM A 479 stainless steel wire.

3. Embedment shall be as per ACI 530 and as follows:

   a. Horizontal reinforcing and ties parallel to wythe shall be 2 3/8 for nominal 4 inch wythes and 2 inches narrower than nominal wythe thickness for all others.
   b. Ties perpendicular to wythe shall extend minimum half way into wythe thickness but shall maintain minimum 5/8 inch cover from exterior face of wall.

4. Custom fabricate reinforcement, ties and anchors for Project conditions. Custom fabricate horizontal reinforcing tees and intersection for other than 90 degree conditions.

B. Horizontal Joint Reinforcing: Single Wythe:

1. Type: Truss.

2. Sidewires: No. 9 gage.

3. Crosswires: No. 9 gage.

D. Ties To Concrete: Dovetail slot, 1 inch wide by 1 inch deep formed from 22 gage sheet and dovetail wire tie. Dovetail end fabricated of 12 gage by 1 inch sheet metal and tapered wire box tie fabricated of 3/16 inch wire.

2.8 Steel Reinforcement

A. Deformed ASTM A 615/A 615M Grade 60 bars fabricated as specified in Concrete Reinforcement: Division 03; sizes as indicated on Drawings. Provide bar positioners of standard No. 9 gage wire with mill galvanized finish.

2.9 Joint Filler

A. Concrete Masonry Control Joint Keys: ASTM D 2000, 2AA-805 rubber shear keys with a minimum durometer hardness of 75 to 85. Size to fit wythe and sash block slot.

B. Compressible Filler: Closed cell neoprene sponge, ASTM D 1056 Class RE41, with 50 percent minimum compressibility in widths that permit sealant.

Premolded Joint Filler: Unimpregnated fiber board, ASTM D 994 or closed cell neoprene sponge, ASTM D 1056 Class RE41, with 50 percent minimum compressibility in widths that permit sealant.

2.14 Joint Sealants

A. As specified in Joint Sealants: Division 07.

2.15 Cell Closure Mesh

A. Galvanized wire mesh of 1/2 inch grid of 16 gage wire.

2.17 Cleaning Solution

A. Contractor's Option:

1. Job mixed detergent solution of trisodium phosphate and laundry detergent one-half (1/2) cup dry measure of each dissolved in 1 gallon of water.

2. Proprietary cleaners without strong acids shall be compatible with masonry.

Part 3 Execution

3.1 Examination

A. Examine substrate conditions including, but not limited to, foundations, concrete work and structural steel cold-formed metal framing, sheathing, vapor barrier, flashing, insulation, metal fabrications and hollow metal for compliance with requirements for installation tolerances and other conditions affecting performance of unit masonry.

1. For record, prepare written report listing conditions detrimental to performance of unit masonry.

B. Examine rough-in and built-in construction to verify actual locations of connections prior to installation.

C. Do not proceed until unsatisfactory conditions have been corrected.

3.2 Preparation

A. Furnish metal dovetail anchor slots for embedment into concrete and anchors to structural steel fabricator for welding to steel. Furnish sufficient quantity, and direct their correct placement.

B. Ensure items built-in by Work of other Sections for this Work are properly located and sized.

C. Establish lines, levels, and coursing. Protect from disturbances.

D. Lay out walls in advance for accurate spacing of bond patterns with uniform joint widths and for accurate locating of openings, movement-type joints, returns, and offsets. Avoid the use of less-than-half-size units at corners, jambs, and where possible at other locations.

E. Broom clean concrete surfaces to support masonry. If surface is smooth finished roughen surface with a bush hammer to ensure masonry bond.

3.3 Installation: General

A. Comply with Referenced Standards, unless otherwise indicated.

B. Thickness: Build cavity and composite walls and other masonry construction to full thickness indicated. Build single-wythe walls to actual thickness of masonry units, using units of nominal thickness indicated.

C. Build chases and recesses as indicated or required to accommodate items specified in this and other Sections. Provide minimum 8 inches of masonry between chase or recess and jamb or openings and between adjacent chases and recesses.

D. Leave openings for equipment to be installed before completion of masonry. After installation, complete masonry to match adjacent construction.

E. Cut masonry units with motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide continuous pattern and to fit adjoining construction. Use full-size units without cutting where possible.

F. Matching Existing Masonry: Match coursing, bonding, color, and texture of new masonry and mortar with existing masonry.

G. Protection: Protect masonry work from freezing and entry of water. Cover and secure top of each day's work with nonstaining waterproof coverings.

H. Unless otherwise indicated, build masonry full height to underside of structure. Nonbearing walls shall stop 3/4 inch clear of structure. Prepare top joint for premolded joint filler and sealant.

I. Stopping and Resuming Work: In each course, rack back one-half (1/2) unit length for one-half (1/2) running bond or one-third (1/3) unit length for one-third (1/3) running bond; do not tooth. Clean exposed surfaces of set masonry, wet clay masonry units lightly, if required, and remove loose masonry units and mortar prior to laying fresh masonry.

J. Mortar Joints: Provide full bed and head mortar joints. Do not deeply furrow mortar beds. Head joints must be fully buttered with mortar and shoved tight against adjacent unit. Slushing head joints is not allowed. Units shall not be moved, tapped or realigned after initial placement. If a unit is displaced, all head and bed mortar must be removed and procedure started over.

K. Building In: Construct unit masonry work to accommodate built-in Work. Build masonry into frames and against dissimilar Work. Slush frames full with mortar and build in anchorage furnished with dissimilar Work. For heavy items installed into masonry, provide a grout bed of 1:3 Portland cement sand mix and use wedges to relieve weight on grout. Rake joints 3/4 inch deep between exposed masonry and dissimilar Work to accommodate sealant. Build in Work furnished under other Specification Sections.

L. Tolerances:

1. Maximum Variation from Masonry Unit to Adjacent Masonry Unit: 1/16 inch.

2. Maximum Variation from Vertical and Horizontal Building Lines: 1/4 inch in 10 feet.

3. Maximum Variation from Cross-sectional Thickness of Cavity Walls: Plus or minus 1/4 inch.

4. Maintain flush face on exposed masonry surfaces.

3.4 Laying Concrete Masonry Units

A. Bond Pattern: One-half (1/2) running bond.

B. Mortar: Use Type S.

C. Lay units with cores vertical.

D. Joints shall be 3/8 inch wide, both horizontally and vertically.

E. Tooled joints in exposed block work shall be concave. Joints in concealed block work may be struck flush.

F. Mortar Coverage:

1. Provide full mortar coverage on horizontal and vertical face shells.

2. Bed webs in mortar in starting course on footings and in all courses of piers, columns, and pilasters, and where adjacent to cells or cavities to be filled with grout.

3. For starting course on footings where cells are not grouted, spread out full mortar bed including areas under cells.

G. Corners and Intersections:

1. Provide interlocking masonry unit bond in each course at corners unless corner is location of a control joint, unless otherwise indicated.

2. At intersections of non-load bearing walls unless intersection is location of a control joint provide fully bonded intersection with wire mesh anchors at 16 inches on center maximum vertically.

H. Where built-in items shall be embedded in cores of hollow masonry units, place a layer of metal mesh in the joint below and rod mortar or grout into core.

I. Fill cores in hollow concrete masonry units with grout in the following locations, unless otherwise indicated:

1. For three (3) courses under bearing plates, beams, lintels, posts, and similar items.

2. Within 16 inches of rated door opening jambs.

J. Isolate top joint of non-load bearing masonry partitions from horizontal structural framing members and slabs or decks with premolded joint filler and sealant. Joint thickness shall be 3/4 inch minimum, unless otherwise indicated.

K. Isolate masonry partitions from vertical structural framing members, unless otherwise indicated. Minimum 3/4 inch.

L. Do not wet concrete masonry units before laying.

M. Clean mortar droppings from walls as Work progresses. Remove dropping or splatter when nearly dry to prevent smears. Dry rub with another concrete unit and with a stiff fiber-bristle or stainless steel brush.

3.5 Grouting Concrete Masonry Units (CMU) (Only As Optional 4" CMU Below Brick Veneer)

A. Grouted spaces shall be free of mortar droppings, debris, loose aggregates, and any material deleterious to masonry grout.

B. In spaces to receive grout, reinforcement and ties shall be in place prior to grouting.

C. Isolate spaces to be grouted with mesh or solid Concrete Masonry Units.

D. Place grout in lifts not exceeding 5 feet. Consolidate each grout lift at time of placement by mechanical vibration and reconsolidate by mechanical vibration after initial water loss and settlement has occurred.

E. If opening to be grouted is smaller than 2 inches by 3 inches clear between masonry surfaces or horizontal reinforcing reduce maximum grout lift to 1 foot.

F. Place grout within 1 1/2 hours from introducing water in mixture and prior to initial set.

G. Reject defective masonry units, do not install masonry units with chips, cracks, crazes or other imperfections in exposed CMU walls that detract from overall appearance when viewed from a distance of 5 feet.

H. Intermingle masonry units from different pallet loads as Work progresses, to evenly mix minor color variations in exposed CMU walls.

I. Clean walls as they are laid. Remove green mortar with brushes or rags. Do not use abrasives. Do not allow mortar lumps or smears to harden on surface.

3.11 Laying Brick

A. Select brick from different pallets in a random mingle of approved color range to avoid concentrations of light and dark areas and so that no repeat patterns of color or texture result.

B. All joints intended to receive mortar in exterior and interior wythes shall be completely filled. Mortar squeezed from joints and protruding into a cavity shall be plastered onto back face of masonry units and not cut off to prevent mortar falling into cavity.

C. Bond Pattern: One-half (1/2) running bond.

D. Mortar: Type N.

E. Both horizontal and vertical joints shall be of same width.

F. Joints exposed to view tool concave, and in a manner that compresses mortar and seals surface along edges of units. Joints not exposed to view may be struck flush except at cavities.

G. Wet clay and shale masonry units with absorption rates in excess of 1 gram per minute per square inch as determined by ASTM C 67 standards, to maintain permissible rate of absorption when laying. Units shall be surface dry when laid. Do not otherwise wet units.

H. Provide interlocking masonry unit bond at each corner and intersection unless location is a control joint.

3.12 Horizontal Joint Reinforcement

A. Place horizontal joint reinforcement 16 incheson center in walls above grade and 8 incheson center in walls below grade.

B. Where openings occur, place horizontal joint reinforcement 8 inches on center in first and second bed joints above and below opening. Extend reinforcement a minimum of 24 inches beyond openings. Do not bridge control joints at openings where indicated.

C. Form corners and intersection in accordance with material manufacturer's written instructions using prefabricated "ELL" and "TEE" units.

D. Lap horizontal joint reinforcing splices a minimum of 6 inches.

E. Cut and bend side rods 90 degrees where joint reinforcement is interrupted by openings and control joints.

3.13 Anchoring And Bracing Masonry

A. General: Provide ties, anchors, clips and other accessories to tie masonry together and to adjoining structure. Anchorage shall allow differential movement of connected materials while restraining applied loads.

C. Anchors to Concrete: Provide vertical dovetail slots 16 inches on center maximum cast into concrete. Install ties at each slot at 16 inches on center spacing maximum.

3.14 Movement Joints

A. Concrete masonry control joints: Install continuous control joint key between two (2) standard sash block, lateral restraint anchors 16 inches on center or in accordance with NCMA. If control joint occurs at an intersection, install compressible filler 1 1/2 inches narrower than wythe between walls.

B. Brick control joints: Install compressible filler 3/4 inch back from exposed face.

C. Build in horizontal pressure-relieving joints above non-bearing masonry where it abuts structure above. Joint shall be minimum 3/4 inch with compressible filler held back 3/4 inch from each face of masonry. Ensure continuity of joint at all structural elements above masonry.

D. Build in horizontal pressure-relieving joints below shelf angles supporting masonry veneer. Install compressible filler.

E. Provide control joints in concrete masonry as indicated and at maximum 40 feet on center and at following points of weakness.

1. At abrupt changes in wall height.
2. At changes in wall thickness, such as those at pipe or duct chases and those adjacent to columns or pilasters.
3. Above joints in foundations and floors.
4. Below joints in roofs and floors that bear on wall.
5. At a distance of not over one-half (1/2) allowable joint spacing from bonded intersections or corners.
6. At one (1) or both sides of door and window openings where indicated.

F. Where control joints are indicated above openings, lintel bearing shall be a slip joint. Grout full cells below lintel, but do not extend reinforcing bars. Provide a slip sheet of two (2) layers of building felts separating bearing surface from lintel. Extend a standard control joint from end of lintel to top of wall. Provide a sealant joint between lintel and bearing.

G. Install control joints in brick where indicated.

3.17 Cleaning New Masonry

A. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry.

B. Remove large mortar particles by hand with wooden paddles and nonmetallic scrapers, hoes or chisels.

C. Test cleaning methods on Sample Panel; Obtain Design Professional's approval of sample cleaning before proceeding with cleaning of masonry.

D. Comply with BIA "Technical Note No. 20 Revised".

E. Concrete masonry be kept clean during installation. Final cleaning is only to supplement cleaning during lay-up. If final cleaning cannot result in a finished wall of matching, unblemished appearance, remove and replace affected units to match adjacent Work.

3.18 Protection Of Finished Work

A. Protect Finished Work as per requirements of Division 01. Remove protection prior to Date of Substantial Completion.

B. Without damaging completed Work, provide protection boards at, for example, exposed external corners, lintels and soffits which may be damaged by construction activities.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Fluoropolymer coatings applied to metal substrates specified in other Sections.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Flashing and Sheet Metal: Division 07.

C. Aluminum Entrances and Storefronts: Division 08.

D. Glazed Aluminum Curtainwall: Division 08.

E. Louvers: Division 08.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Product Data: Manufacturer's pre-printed literature for products and their application.

C. Samples:

1. Color Charts: Manufacturer's pre-printed color charts demonstrating full line of standard and custom colors.

2. Duplicate sets, finish Samples on each substrate to which coatings are to be applied in Final Work. Minimum of three (3) Samples in each set of each finish demonstrating maximum range of variation in finish.

   a. Sheet or Plate: 8 1/2 inches by 11 inches
   b. Extruded, Rolled or Formed Shapes: 12 inch long section of actual section.

D. Qualifications:

1. Manufacturer's Qualifications: Written evidence of compliance.

2. Applicator's Qualifications: Written evidence of compliance.

E. Quality Control Procedures: Applicator's reports of tests performed in accordance with Source Quality Control Article of this Section.

F. Certifications: Manufacturer's certification of approval of applicator.

G. Closeout Submittals: Special written warranty on fluoropolymer coatings.

1.4 Definitions

A. Fluoropolymer Coating: High performance organic coating.

B. Manufacturer: As used in this Section means manufacturer of coating.

1.5 System Description

A. Performance Requirements: Conform to indicated criteria for the following tests:

1. American Architectural Manufacturers Association (AAMA) Standard 2605, "Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels".

2. Specular Gloss: Gloss values shall be within plus or minus five (5) units of manufacturer's specification. Measure in accordance with ASTM D 523 using a 60 degree gloss meter. Samples shall include minimum dry film thickness.

3. Dry Film Hardness: No rupture of film using a Berol Eagle Turquoise pencil, grade F minimum hardness, test in accordance with ASTM D 3363.

4. Film Adhesion: No removal of film under tape within or outside of cross-hatched area or blistering anywhere on wet test specimen, test in accordance with AAMA 2605.

5. Impact Resistance: No removal of film to substrate, test in accordance with AAMA 2605.

6. Abrasion Resistance: Abrasion Coefficient Value of 20 minutes, test in accordance with ASTM D 968.

7. Salt Spray Resistance: Minimum blister rating of 8, in accordance with ASTM D 1654, after 3,000 hours, test in accordance with ASTM B 117.

8. Humidity Resistance: Formation of blisters not to exceed "Few" blisters Size No. 8, as shown in Figure 4, ASTM D 714, after 3,000 hours, test in accordance with ASTM D 2247.

9. Condensing Humidity Resistance: No blisters, undercutting, or adhesion loss after 1,000 hours, test in accordance with ASTM D 4585.

10. Chemical Resistance: Test in accordance with AAMA 2605:

    a. Muriatic Acid Resistance: No blistering, and no visual change in appearance when examined by the unaided eye.
    b. Mortar Resistance: Mortar shall dislodge easily from painted surface, and any residue shall be removable with a damp cloth. Lime residue with 10 percent muriatic solution. There shall be no loss of film adhesion or visual change in appearance when examined by unaided eye.

c. Nitric Acid Resistance: Not more than five (5) delta E Units (Hunter) of color change, calculated in accordance with ASTM D 2244, when comparing measurements on acid-exposed painted surface and unexposed surface.
d. Detergent Resistance: No loss of adhesion on film to metal. No blistering and no significant visual change in appearance when examined by unaided eye.

11. Acid Pollutants Resistance: Not more than five (5) Delta E Units (Hunter) of color change, calculated in accordance with ASTM D 2244, when comparing measurements on acid-exposed painted surface and unexposed surface.

12. Weathering: Test in accordance with AAMA 2605:

a. Color Retention: Maximum of five (5) Delta E Units (Hunter) of color change as calculated in accordance with ASTM D 2244.
b. Chalk Resistance: Chalking shall be no more than that represented by a No. 8 rating based on ASTM D 659 after test site exposure.
c. Gloss Retention: Not less than 30 percent after exposure test.
d. Resistance to Erosion: Less than 10 percent film loss after exposure test.

1.6 Quality Assurance

A. Manufacturer's Qualifications: Company licensed to produce fluoropolymer coatings based on Kynar 500 polyvinylidene fluoride (PVF^2) resin manufactured by Atochem North America or Hylar 5000 polyvinylidene fluoride (PVF^2) resin manufactured by Ausimont USA, Inc.

B. Applicator's Qualifications: Company authorized and approved in writing by fluoropolymer coating manufacturer to apply their product.

C. Single Source Requirements: All products required for fluoropolymer coatings specified in this Section shall be supplied by one (1) manufacturer, regardless of substrate, manufacturer of substrate or Section in which substrate is specified.

1. Coordinate approved coating manufacturer with manufacturers of substrates to which coatings are to be applied.

2. More than one (1) applicator may be used contingent on each applicator complying with indicated requirements and that coatings match approved Samples.

3. Differences in coatings caused by use of more than one (1) applicator shall not relieve Contractor of requirements to match approved Samples. Differences in coatings are not acceptable.

1.7 Special Warranty

A. Warrant fluoropolymer coatings against defects in appearance and performance of materials and workmanship. Warrant coil coatings for a minimum of ten (10) years and spray applied coatings for a minimum of seven (7) years from Date of Substantial Completion of Work to which coatings are applied.

B. Defects include, but not limited to:

1. Failure to conform to appearance and performance requirements set forth in AAMA 2605, and the Physical Test Requirements of NCCA, as applicable to each system.

2. Cracking, chipping, fading, peeling, blistering, running or other deterioration or non-uniformity of color or finish.

Part 2 Products

2.1 Approved Manufacturer

A. Products of indicated manufacturers are acceptable, subject to compliance indicated requirements. Equivalent products of other manufacturers will be evaluated as substitutions in accordance with requirements of Division 01.

1. PPG Industries, Inc.

2. Valspar.

3. Akzo Nobel Coatings, Inc.

4. BASF Corporation.

2.2 Materials

A. Fluoropolymer Coating: Air drying, thermocuring, high performance organic coating, formulated under license, containing not less than 70 percent fluoropolymer Kynar 500 or Hylar 5000 resin by weight.

B. Corrosion Inhibitive Primer: As recommended in writing by coating manufacturer for systems specified.

2.3 Color Matching

A. Colors of fluoropolymer coatings throughout Work shall match the following: Provide variations of color formulation if required to consistently match color across differing base materials and by differing application methods.

1. Custom color to match “Meteon silver grey” phenolic wall panel as manufactured byTrespa.

2. Manufacturer of coating to be matched shall promptly provide required information to other manufacturers of coatings for this Work, upon request by those other manufacturers.

2.4 Fabrication

A. Metal Preparation, Pretreatment, and Application of Coating: In accordance with manufacturer’s written instructions and as required to conform with indicated criteria.

B. Coil Coated Systems:

1. Two Coat System:

a. Corrosion inhibitive primer applied at 0.2 mil dry film thickness.
b. Color topcoat applied at minimum 0.8 mil dry film thickness.
c. Total coating system minimum dry film thickness of 1.0 mil.

C. Spray Applied Systems:

1. Two Coat System:

a. Corrosion inhibitive primer applied at 0.25 mil dry film thickness.
b. Color topcoat applied at minimum 1.0 mil dry film thickness.
c. Total coating system minimum dry film thickness of 1.2 mils.

2.5 Source Quality Control

A. Tests: Perform the following tests on production run Samples with a test area not less than 3 inches by 12 inches. Use test procedures and test criteria specified under Performance Requirements. Test not less than once during each production hour.

1. Specular Gloss.

2. Film Adhesion.

Part 3 Execution

3.1 Adjusting

A. Touch-Up: Repair scratches with air-dry fluoropolymer coating material in accordance with manufacturer's written instructions. Repaired scratches shall be undetectable with unaided eye at a distance of 10 feet.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Steel required for primary structural system as indicated.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Architecturally-Exposed Structural Steel Framing: Division 05.

C. Pipe and Tube Railings: Division 05.

D. Painting: Division 09.

1.3 Submittals

A. Submit per requirements of Division 01.

B. Shop Drawings: Include fabrication and erection drawings. Fabrication detail drawings will not be processed until erection drawings showing size and member markings are submitted. Submit Shop Drawings for review in order required for proper execution of Work. Do not submit all at one time. Show framing work including miscellaneous pieces. Shop Drawings shall comply with the following:

1. Make erection drawings at minimum scale of 1/8 inch to the foot . Draw fabrication drawings at larger scale as required. Do not use Drawings as erection drawings.

2. Show connection design capacity on details and member elevations.

3. Include information necessary for fabrication and erection, including, but not limited to, the following:

   a. Base plate and anchor rod plans showing location, size and identification marks of base screws and bolts, grade of steel, and elevations.
   b. Erection plans showing type, size, weight and identification marks of members, dimensions locating members relative to column grid lines, elevations of members, and clear cross reference with other related Drawings. Erection plans shall include necessary information and instructions regarding field welds and field bolts including type, size and extent of field welds, types of electrodes, welding procedures, welding sequence, size and type of field bolts.

c. Detail drawings showing complete details of members and components including, but not limited to: identification marks, dimensions, size, type, weight and grade of steel, requirements for installation of other materials or parts of construction, such as punch or drilled holes, cleats, openings, type, size and extent of shop and field welds, type of electrodes, joint welding procedures, welding sequences: size and type of shop and field bolts, cleaning requirements prior to painting, type and dry thickness of paint. Use welding symbols used by American Welding Society.

4. Survey(s): Submit signed and sealed survey(s) as indicated.

C. Product Data: For manufacturer's standard products, including shop primer paint.

D. Calculations: Design calculations and details of proposed connections, before preparation of Shop Drawings.

1. Connections which have been fully detailed (including number and size of bolts, length and size of welds and size of plates) on Drawings need not be further substantiated by calculations produced by fabricator. Should fabricator request a substitute detail to detail indicated, Design Professional will provide design forces and fabricator shall perform and submit connection calculations for substitute detail to be designed in accordance with Paragraph 3 below. Review of substituted details and detail calculations will be performed in accordance with Division 01.

2. Should fabricator elect to use shear connections tabulated by AISC, sample calculations shall be submitted that indicate which AISC tables and procedures are being used and demonstrate compliance with design criteria and shear capacity requirements indicated.

3. For connections, other than those described in Paragraphs 1 and 2 above, complete calculations shall be submitted which substantiate compliance with capacities and other design criteria specified. Calculations shall be performed by (or under direct personal supervision of) and sealed by a registered Professional Structural Engineer, registered in North Carolina.

4. Regardless of types of connections used (or degree of calculations submitted) fabricator shall submit shop standards charts showing details of connection types and capacities, including weld, bolt, plate and angle information required to define connections and to facilitate review of detail Shop Drawings.

E. Quality Control Procedures:

1. Mill Test Reports: Certified Mill Test Reports for structural steel members and bolts, washers and nuts containing sufficient evidence of conformity with Contract Documents.

F. Certifications:

1. Certification of location of bolt, nut, and washer manufacturer.

2. Fabricator certification as indicated.

3. Erector certification as indicated.

4. Certification and test data as indicated.

1.4 Quality Assurance

A. Fabricators Qualifications: A qualified fabricator who participates in the AISC Certification Program and is designated an AISC Certified Plant, Category STD at time of Bid. A copy of fabricator's current certificate, or such certification, shall be provided with Bid.

1. Fabricator shall provide effective full time quality control over fabrication activities. Fabricated items shall be subject to inspection. Inspection and testing by Inspection and Testing Agency is not intended to be comprehensive or complete and full responsibility for quality control shall remain with fabricator.

B. Erector Qualifications: A qualified installer who participates in the AISC Certification Program and is designated an AISC Certified Erector, Category CSE at time of Bid. Submit erector's current certificate, or certification of compliance with corresponding AISC checklist.

1. Fabricator and erector shall have together, satisfactorily completed Work of similar scope and shall have necessary skill, equipment, facilities and capacity to fabricate and erect structural steel in accordance with requirements of Contract Documents.

2. Welder's Qualifications:

   a. Welding procedures and qualifications of operators shall be as prescribed in "Structural Welding Code, Steel", AWS D1.1.
   b. Welders shall be qualified to perform type of Work required.
   c. Each welder working on Project shall be assigned an identification symbol or mark and shall mark or stamp his identification at each weldment he completes, both in shop and field.

C. Referenced Codes and Standards: Comply with following in accordance with Division 01.

1. American Institute of Steel Construction (AISC)

   "Specification for Structural Steel Buildings"

   "Code of Standard Practice for Steel Buildings and Bridges", with exception of Section 10, and as modified by Contract Documents

2. American Welding Society (AWS)

   Structural Welding Code, Steel

3. Research Council on Structural Connections: "Specifications for Structural Joints Using ASTM A 325 or A 490 Bolts"

4. Society for Protective Coatings (SSPC)

   Painting Manual, Volume 1, Good Painting Practices

   Painting Manual, Volume 2, Systems and Specifications

D. Predetailing Conference: Prior to starting detailed development of Calculations and Shop Drawings, Contractor shall arrange a meeting to review approach to design and detailing of connections and procedures for fabrication and erection.

1. Meeting shall be attended by responsible representatives of each party concerned with structural steel work including, but not limited to, the following:

   a. Owner's Representative.
   b. Construction Manager.
   c. Contractor's Superintendent.
   d. Steel Inspection and Testing Agency.
   e. Steel Fabricator.
   f. Steel Detailer/Detailing Engineer.
   g. Steel Erector.

2. Design Professional will be present at meeting. Contractor shall give one (1) week written advance notice to Design Professional prior to scheduled conference date.

3. Minutes of meeting shall be recorded and typed by Contractor and distributed to concerned parties within five (5) days of meeting.

E. Inspection and Testing: Services of an independent Inspection and Testing Agency are required in conjunction with the Work of this Section. Facilitate Work of and cooperate with Agency. Refer to Division 01.

1. Furnish Inspection and Testing Agency with the following:

   a. A complete set of approved erection and fabrication drawings.
   b. Information as to time and place of shipment of material to fabrication shop.
   c. Representative pieces and bolts required for testing.
   d. Bolt tension measuring device in accordance with Specification for Structural Joints using ASTM A 325 or A 490 bolts.
   e. Full and ample means and assistance for inspection and testing material and proper facilities, including, for example, scaffolding and temporary work platforms for inspection of Work in shop and field.
   f. A list of qualified welders including each welder's identifying symbol or mark in accordance with AWS.
   g. A copy of each welder's qualifying papers.
   h. Cooperation to facilitate work of Agency during inspection and testing.

2. If, during progress of Work, inspection indicates that Work may not be in conformance with Contract Documents, Design Professional may order additional testing on portions of structure affected.

1.5 Handling

A. Exercise care in handling, storing and erecting Work to avoid damage to shop primer and galvanizing.

Part 2 Products

2.1 Intent

A. Drawings are intended only to indicate arrangements and materials of framing layout. Provide required minor pieces and connections necessary to make Work complete whether or not indicated. Materials and workmanship shall conform to AISC Code of Standard Practice for Steel Buildings and Bridges, as modified by Contract Documents.

2.2 Materials

A. Provide recycled content materials in accordance with Sustainability Action Plan specified in Sustainability Requirements: Division 01.

B. Provide regional materials in accordance with Sustainability Action Plan specified in Sustainability Requirements: Division 01.

C. Use field applied paints and coatings that comply with the VOC limits and chemical restrictions specified in Sustainability Requirements: Division 01.

D. Structural Steel:

1. Rolled Sections:

   a. W Shapes: Conform to requirements of ASTM A 992/A 992M.
   b. Channels: Conform to requirements of ASTM A 572/A 572M, Grade 50, unless otherwise indicated.
   c. Angles: Conform to requirements of ASTM A 36/A 36M, unless otherwise indicated.

2. Hollow Structural Sections: Conform to requirements of ASTM A 500, Grade B.

3. Structural Pipe: Conform to requirements of ASTM A 53, Grade B.

4. Miscellaneous Connection Materials: Conform to requirements of ASTM A 572/A 572M or A 36/A 36M.

E. Bolts:

1. Conform to requirements of ASTM A 490 or A 325.

2. Bolts shall be certified to be of domestic (North American) manufacturer.

F. Nuts:

1. Conform to ASTM A 563, grade to match bolt specified.

2. Nuts shall be provided by same supplier as bolts and shall be certified to be of domestic (North American) manufacturer.

G. Washers:

1. Conform to ASTM F 436.

2. Washers shall be provided by same supplier as bolts and shall be certified to be of domestic (North American) manufacturer.

H. Anchor Rods: ASTM F 1554, grade 55, meeting Supplementary Requirements S1, unless otherwise indicated.

I. Welding Equipment and Materials: Conform to requirements of the AWS D1.1 with the exception that E70XX electrodes shall be used for ASTM A 36/A 36M steel.

J. Shop Primer Paint:

1. Shop primer paint shall conform to applicable provisions regarding Volatile Organic Compounds (VOCs). Primer shall withstand the following tests without any change in adhesion, film integrity, hardness, color, blistering or cracking:

   a. Salt Spray Resistance: ASTM B 117, 500 hours.
   b. Light and Water Resistance: ASTM D 4585, 500 hours.

2. Concealed Structural Steel: Steel concealed within building enclosure, and not requiring fireproofing.

   a. Heavy-duty alkyd primer having not less than 50 percent solids by volume.
   b. Products of the following Manufacturers are acceptable: No substitutions.

      1) Carboline Company.

      2) M. A. Bruder.

      3) Sherwin Williams.

      4) Tnemec Company.

3. Exposed Structural Steel: Steel permanently outside controlled building enclosure, whether exposed or covered by subsequent construction, or otherwise exposed, interior or exterior, including rooftop surfaces.

   a. Inorganic zinc-rich primer having not less than 60 percent volume solids and producing no less than 85 percent metallic zinc in film.
   b. Products of the following Manufacturers are acceptable: No substitutions.

      1) Carboline Company.

      2) M. A. Bruder.

      3) Sherwin Williams.

      4) Tnemec Company.

4. Shop primer paint shall be compatible with finish coat systems specified in Painting: Division 09.

5. Field Touch-Up Paint for steel specified to be galvanized.

    a. Products of the following manufacturers are acceptable: No substitutions.

        1) Carboline Company.

        2) M. A. Bruder.

        3) Sherwin Williams.

        4) Tnemec Company.

K. Direct Tension Indicators shall conform to requirements of ASTM F 959 and shall be by TurnaSure LLC, Langhorne, PA, Applied Bolting Technology Products, Inc., Ludlow, VT. Equivalent products of other manufacturer's will be evaluated as substitutions in accordance with requirements of Division 01.

L. Torque control bolts shall conform to applicable requirements of ASTM A 325 , A 490 and/or F 1852 and shall be certified to be of domestic (North American) manufacturer.

2.3 Design

A. Connections: Design and detail connections to resist loads and reactions indicated. Details submitted shall be consistent with intent of indicated. Proper account of eccentricity shall be taken in design of connections as indicated. Design of connections shall be subject to approval, however review and approval of calculations by Design Professional shall not relieve fabricator's engineer of responsibility for negligence in performance of their professional services.

1. Beam-to-Column Connections: Shall be such as to minimize eccentric loading on column. Unrestrained simple beam end connections shall be detailed and fabricated so as to minimize end restraint of beam. Parts of such connections (such as, welds, bolts and material) shall be designed taking eccentricity into account.

2. Beams shall be designed for an end shear reaction as indicated. Bracing connections shall be designed for forces indicated.

3. Except for moment connections and bracing, make bolted connections with high-strength bolts using bearing type connections. For moment connections and bracing, bolted connections shall be slip critical. Slip critical connections shall be detailed and erected utilizing direct tension indicator washers in conformance with manufacturer's written instructions. Bearing type connections shall be designed assuming threads included in shear plane.

B. Temporary Bracing: Contractor shall be fully responsible for design, strength, safety and adequacy of temporary bracing and methods of construction in accordance with Division 01. Specifying herein of requirements for bracing, approvals by Design Professional, or any other requirements of Contract Documents shall be construed as minimum acceptable, and shall not eliminate, lessen or restrict in any manner responsibility of Contractor for construction methods and for safety and stability of Work at stages of erection, until such time as permanent bracing system becomes effective.

2.4 Fabrication

A. Mill contact surfaces of column splices, bearing stiffeners and other components as indicated to meet ASTM A 6/A 6M, Table 23.

B. Accurately space holes to allow insertion of bolts. Drill or punch bolt holes. Drill holes in material thicker than 7/8 inch and material thicker than bolt diameter.

C. Contact surfaces at high-strength bolt groups shall be cleaned and free of burrs.

D. Shape re-entrant corners notch-free to a radius of at least 1/2 inch.

E. Provide holes in members to facilitate connection of Work of other Sections. Steel requiring adjustment to meet specified tolerances of connected Work shall be provided with slotted holes as required.

F. Provide camber indicated.

G. Do not cut holes or slots in structural steel other than those indicated on approved Shop Drawings, or as specifically authorized in writing by Design Professional.

H. Perform oxygen cutting only with mechanically guided torch. Cut shall be within 1/8 inch of finished dimension.

2.5 Shop Painting

A. Do not shop paint steel, unless otherwise indicated. Do not paint contact surfaces of welded connections and areas within 2 inches of field welds. Do not paint contact surfaces of slip critical bolted connections unless paint has been qualified for this use as required by “Specification for Structural Joints Using ASTM A 325 or A 490 Bolts”. Submit certification and test report prior to painting. Do not paint top flange of beams indicated to receive field installed shear studs.

B. Surface Preparation:

1. Exposed: SSPC-SP6 “Commercial Blast Cleaning”.

2. Concealed: SSPC-SP3 “Power Tool Cleaning”.

C. Where indicated, paint steel with one (1) shop coat of primer. Minimum dry film thickness on interior steel, 2.0 mils ; exterior steel, 3.0 mils .

D. Apply two (2) coats of primer to surfaces inaccessible after assembly.

E. Protect milled surfaces from primer by coating with linseed oil.

F. Do painting only when surface of metal is dry and at a temperature above dew point of surrounding air. Do not paint in freezing weather unless Work is properly protected. Spread paint evenly and work well into joints and open spaces.

2.6 Galvanizing

A. After fabrication, hot-dip galvanized steel exposed to weather, and as indicated, in conformance with ASTM A 123/A 123M.

Part 3 Execution

3.1 Erection

A. Verify anchor rod alignment, elevation, projection and size prior to erection. Notify Design Professional of any errors and propose remedial action. Obtain Design Professional's written approval of methods proposed for correction of errors prior to proceeding with correction and erection.

B. Set base plates and bearing plates level to correct elevations and temporarily support on steel leveling devices until corresponding supported member has been positioned, plumbed and bolted. Leave protruding leveling devices in place until after grout has been placed and has attained required strength, and then cut off flush with edges of base plate.

C. Align, level and adjust members accurately prior to final fastening and as required to provide specified connections of elements to be supported by structural frame. Clean bearing surfaces and surfaces that will be in permanent contact prior to final assembly of members.

D. Erection tolerances shall be as specified in above referenced AISC Code of Standard Practice based on standard temperature of 68 degrees F except as follows:

1. Exterior columns shall be within 3/4 inch of theoretical centerline either toward or away from building line.

2. Centerline of any two (2) adjacent exterior columns shall be within 1/2 inch of each other toward or away from building line.

3. Intermediate exterior columns shall be within 3/4 inch of a line between corner columns.

4. Steel provided to facilitate connection of Work of other Sections shall be erected within tolerances required by those trades. Adjustable connections shall be provided as required. Field weld required adjustable connections after final adjustment.

E. As erection progresses, securely connect Work to resist all dead loads, wind, and erection forces. Provide temporary bracing to resist all loads, including construction loads which structure may be subjected to.

F. Torch cutting in field shall not be done except with written permission of Design Professional. When permitted, execute cutting in accordance with requirements indicated.

G. Take precautions necessary to avoid damage to existing structures.

3.2 Bolted Connections

A. Bolts shall be installed and tightened by any method indicated in Specification for Structural Joints using ASTM A 325 or A 490 Bolts, Paragraph 8.

B. Tightening procedure, and capabilities of each bolting crew, shall be confirmed by Inspection and Testing Agency prior to production. If "Alternate Design Bolts" or "Direct Tension Indicators" are to be used, a qualified technical representative of proprietary manufacturer shall witness confirmation testing.

C. Assign each bolting crew an identification symbol or mark. Each crew shall mark this identification on each joint completed.

D. Make joints without use of erection bolts. Where proper fit-up cannot be obtained, provide additional plumbing, leveling or corrective work as required. Use not more than two (2) washers per bolt.

E. Before bolts are tightened, bring parts tightly together with high-strength bolts. Retighten these bolts as all bolts are finally tightened.

3.3 Welded Connections

A. Definitions: Terms herein relating to welds, welding and oxygen cutting shall be construed to be in accordance with standard definitions of welding terms and master chart of welding processes of American Welding Society, as amended to date.

B. Welding shall be performed by operators who have been qualified within preceding one (1) year period under AWS standard qualification procedures for type of Work required.

C. Begin no welding until joint elements are bolted in intimate contact or adjusted to dimensions established in certified welding procedure, or both, with allowance for any weld shrinkage expected.

D. No members shall be spliced without prior written approval by Design Professional.

E. Field moment connections on beams and girders shall have a minimum of 3/16 inch root opening for all flange preparations prior to welding.

F. Perform welding in a sequence which shall prevent excessive stress and distortion in parent material caused by shrinkage in welds. Repair or replace all defective work.

3.4 Survey

A. Make an accurate survey of actual column locations and column splice elevations immediately upon completion of every tier of steel and immediately submit same to Design Professional. Should column locations vary beyond allowable tolerances, take necessary corrective measures prior to proceeding to next tier and modify details and/or erection procedures as required.

3.5 Rejected Work And Corrections

A. Acceptance of Work at shop does not preclude its rejection at Project Site.

B. Members or assemblies having fabrication errors, or which have errors or deformations preventing proper assembly and fitting of parts shall be reported immediately to Design Professional. Errors shall not be incorporated in Finished Work. Such members or assemblies may be corrected if approved in writing by Design Professional. Such corrective work shall be in accordance with Contract Documents.

C. Work determined to be deficient shall, as directed by Design Professional, be repaired or removed and replaced, at Contractor's expense. Contractor shall reimburse Owner for direct salary costs multiplied by a factor of 3.0 and other expenses incurred by Design Professional for Work required to investigate or correct Work of questionable quality. Contractor shall also pay all additional Inspection and Testing costs incurred by Inspection and Testing Agency relative to investigating, testing and correcting non-complying construction.

D. Prior to corrective work, submit for approval, Drawings showing details of proposed corrections.

E. Remove or correct rejected Work within three (3) working days from Date of Notification.

3.6 Field Touch-Up Painting

A. After erection, touch-up shop finish where missing or damaged.

B. For shop prime-painted surfaces, use same paint as approved for shop coat.

C. Prior to touch-up, remove rust, dirt, and weld slag.

D. Touch-up shop-galvanized surfaces with specified paint to a minimum dry film thickness of 3 mils.

E. Touch-up paint shall extend a minimum of 2 inches onto undamaged finish.

F. Paint shall be uniformly applied to dry surfaces to a dry film thickness no less than that specified for shop coat.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Architecturally Exposed Structural Steel (AESS) required for exposed structural support for lateral support of curtainwall framing within main entry of building, second floor terrace railing support, bus canopy structure, exposed glulam connections and as indicated.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Fluoropolymer Coatings: Division 05.

C. Structural Steel Framing: Division 05.

D. Pipe and Tube Railings: Division 05.

E. Exterior Enclosure, General: Division 07.

F. Glazed Aluminum Curtainwall: Division 08.

G. High-Performance Coatings: Division 09.

1.3 Submittals

A. Submit per requirements of Division 01.

B. Shop Drawings: Per Structural Steel Framing: Division 05.

1. For seamed tube and pipe, indicate seam orientation on Shop Drawings.

2. Show shop and field connection details at a minimum scale of 3/4 inch to the foot.

3. Survey(s): Signed and sealed survey(s) as indicated.

C. Product Data: Product Data for manufacturer's standard products, including shop primer paint.

D. Samples: Two (2) sets of each type of welded, bolted and rod anchor connection to establish basis for acceptance of Work. Sample welds and rod anchor connections shall be a minimum of 8 inches long. Bolted connection Samples shall show size, orientation and thread protrusion of bolts. Show finish, cleaning and shop primer required in finished Work.

1. Full size sample of a typical column and beam connection at curtain wall support.

2. Full size sample of a typical column and beam connection at bus canopy.

3. Full size sample of beam to beam connection at bus canopy.

E. Calculations: Design calculations per Structural Steel Framing: Division 05. Comply with indicated loading and force criteria.

F. Quality Control Procedures:

1. Mill Test Reports: Per Structural Steel Framing: Division 05.

G. Certifications: Per Structural Steel Framing: Division 05.

H. Sustainability Submittals: Provide the following in accordance with Sustainability Requirements: Division 01.

1. Materials Sustainability Documentation Form.

2. Product data, certification letter, and costs for materials with recycled content.

3. Product data and costs for regional materials.

4. Product data for paints and coatings indicating VOC content and chemical composition.

1.4 Quality Assurance

A. Fabricator's and Erector's Qualifications:

1. Fabricator shall be currently certified in Category STD of AISC Quality Certification Program or shall certify to compliance with AISC Category STD requirements. A copy of fabricator's current AISC certificate, or such certification, shall be provided with Bid.

2. Erector shall be currently certified as an AISC Certified Steel Erector or shall demonstrate or certify to compliance with AISC Certified Steel Erector checklist. Submit erector’s current AISC certificate, or such certification, with Bid.

3. Fabricator and erector shall have together, satisfactorily completed work of similar scope and shall have necessary skill, equipment, facilities and capacity to fabricate and erect architecturally exposed structural steel in accordance with requirements of Contract Documents.

4. Fabricator shall provide effective full time quality control over fabrication activities. Fabricated items shall be subject to inspection. Inspection and testing by Inspection and Testing Agencies are not intended to be comprehensive or complete and full responsibility for quality control shall remain with fabricator.

5. Welder's Qualifications:

   a. Welding procedures and qualifications of operators shall be as prescribed in "Structural Welding Code, Steel", AWS D1.1.
   b. Welders shall be qualified to perform type of work required as determined by Design Professional based on Samples submitted.
   c. Each welder working on Project shall be assigned an identification symbol or mark and shall mark or stamp his identification at each weldment completed, in mock-up, in shop and in field.

B. Referenced Codes and Standards: Comply with following in accordance with Division 01.

1. American Institute of Steel Construction (AISC)

   "Specification for Structural Steel Buildings"

   "Code of Standard Practice for Steel Buildings and Bridges", including Section 10, and as modified by Contract Documents

2. American Welding Society (AWS)

   D1.1 Structural Welding Code, Steel

3. Research Council on Structural Connections: "Specifications for Structural Joints Using ASTM A 325 or A 490 Bolts, Load and Resistance Factor Design"

4. Society for Protective Coatings (SSPC)

   Painting Manual, Volume 1, Good Painting Practices

   Painting Manual, Volume 2, Systems and Specifications

C. Mock-up:

1. Provide full size mock-up as indicated.

2. Do not initiate construction of mock-up prior to approval of connection calculations, details and Samples.

3. Welders producing "field" welds in mock-up shall be same welders to perform Work at Project Site.

4. Mock-up shall be representative of finished Work in all respects. Replace unsatisfactory work as directed. Mock-up shall be provided at fabricator's plant. Mock-up assembly will be used as a standard for judging acceptability of Work on Project.

5. Apply finished paint system specified in Fluoropolymer Coatings: Division 05 to exposed surfaces of mock-up.

D. Pre-detailing Conference: Prior to starting detailed development of calculations and Shop Drawings, Contractor shall arrange a meeting to review approach to design and detailing of connections and procedures for fabrication and erection.

1. Coordinate with requirements of Exterior Enclosure, General: Division 07.

2. Meeting shall be attended by responsible representatives of each party concerned with structural steel work including, but not limited to, the following:

   a. Owner's Representative.
   b. Construction Manager.
   c. Contractor's Superintendent.
   d. Steel Inspection and Testing Agency.
   e. Exterior Enclosure Installers.
   f. Architecturally Exposed Structural Steel Fabricator.
   g. Architecturally Exposed Structural Steel Detailer/ Detailing Engineer.
   h. Architecturally Exposed Structural Steel Erector.
   i. Structural Steel Fabricator.
   j. Structural Steel Detailer/Detailing Engineer.
   k. Structural Steel Erector.

3. Design Professional will be present at meeting. Contractor shall notify Design Professional at least five (5) days prior to proposed date of conference.

4. Minutes of meeting shall be recorded and typed by Contractor and distributed to concerned parties within five (5) days of meeting.

E. Independent Inspection and Testing: Services of an independent Inspection and Testing Agency are required in conjunction with the Work of this Section. Facilitate work of and cooperate with Inspection and Testing Agency. Comply with Structural Steel Framing: Division 05. Refer to Division 01.

1.5 Handling

A. Exercise care in handling, storing and erecting Work to avoid damage to fabricated members and to shop primer.

Part 2 Products

2.1 Intent

A. Drawings are intended to indicate only arrangements and materials of framing layout. Materials and workmanship shall conform to AISC Code of Standard Practice for Steel Buildings and Bridges, including Section 10, as modified by Contract Documents.

B. Maintain dimensions, sight lines, jointing, and profiles. Minor variation is allowable only with written approval of Design Professional and if variations are identified on submittals.

C. Details given for connections are to indicate design intent only. Contractor may submit other details if design intent is maintained. Primary intent of connection details is to eliminate any extra plates, gussets or reinforcement and to allow for clean sharp corners and flush surfaces at welds, making them invisible. Use of body filler to mask welds is acceptable. Details require written approval of Design Professional.

2.2 Materials

A. Provide recycled content materials in accordance with Sustainability Action Plan specified in Sustainability Requirements: Division 01.

B. Provide regional materials in accordance with Sustainability Action Plan specified in Sustainability Requirements: Division 01.

C. Use paints and coatings that comply with the VOC limits and chemical restrictions specified in Sustainability Requirements: Division 01.

D. Steel Materials: Comply with Structural Steel Framing: Division 05, unless otherwise indicated.

E. Stainless Steel Rods, Fittings and Connections:

1. Rods: Conform to ASTM A 276 and AISI Type 304 or 316, mill finish.

F. Bolted Connections: Direct tension indicators and torque control bolts shall not be used.

G. Shop Primer Paint: As specified in Fluoropolymer Coatings: Division 05.

H. Shop Primer Paint:

1. Shop primer paint shall conform to applicable provisions regarding volatile organic compounds (VOCs). Primer shall withstand the following tests without any change in adhesion, film integrity, hardness, color, blistering or cracking:

   a. Salt Spray Resistance: ASTM B 117, 500 hours.
   b. Light and Water Resistance: ASTM D 4585, 500 hours.

2. Interior Architecturally Exposed Structural Steel: Steel exposed within building enclosure and indicated as Architectural Exposed Structural Steel.

   a. Heavy-duty alkyd primer having not less than 50 percent solids by volume.
   b. The following products are acceptable:

      1) GP 818 by Carboline Company.

      2) Series FD 88 by Tnemec Company, Inc.

      3) Series B 50 by Sherwin Williams.

      4) Glidden Professional: Devguard 4360 by Devoe Coatings.

   c. Other products will be considered only if certified test reports demonstrate compliance with above performance requirements.
   d. Shop primer paint shall be compatible with finish coat systems specified in Fluoropolymer Coatings: Division 05. Color shall be as selected by Design Professional from manufacturer's standards.

3. Exterior Architecturally Exposed Structural Steel: Steel permanently exposed outside controlled building enclosure, and indicated as Architecturally Exposed Structural Steel. Note: Provide detailed description.

   a. Inorganic zinc-rich primer having not less than 60 percent volume solids and producing no less than 85 percent metallic zinc in film.
   b. The following products are acceptable:

      1) Carbo Zinc by Carboline Company.

      2) Zinc-Clad Series by Sherwin Williams.

      3) Series 90-97 by Tnemec Company, Inc.

      4) Glidden Professional: CathaCoat 302H by Devoe Coatings.

   c. Shop primer paint shall be compatible with finish coat systems specified in Fluoropolymer Coatings: Division 05.

I. Fairing Compound and Filler: Epoxy type, rated for exterior application, compatible with top-coats, compound and filler by same manufacturer.

1. Spray-applied Fairing Compound: AlphaCoat Surfacing System by ITW Spraycore or equivalent.

2. Filler: Spot-Lite by FibreGlass-Evercoat, a Division of ITW, Inc., or equivalent.

2.3 Design

A. Connections: Design and detail connections to resist loads and forces indicated. Details submitted shall be consistent with intent indicated. Design of connections shall be subject to approval, however review and approval of calculations by Design Professional shall not relieve fabricator's engineer of responsibility for negligence in performance of their professional services.

1. Make bolted connections with high-strength bolts using slip-critical type connections.

2. Welded Connections: Continuously weld joints.

B. Temporary Bracing: Comply with Structural Steel Framing: Division 05.

2.4 Fabrication

A. For members adjacent to wall plane, fabricate seamed members with seam facing wall. Other seamed members shall be fabricated with seam facing up. Indicate seam orientation on Shop Drawings.

B. Members shall not be spliced between connections.

C. Shape re-entrant corners notch-free to a minimum radius of 1/2 inch and as indicated.

D. Provide holes in members to facilitate Work of other Sections. Do not cut holes or slots other than those indicated on approved Shop Drawings, or as specifically authorized by Design Professional.

E. Exposed Welds:

1. Welds shall be ground and/or otherwise treated as required to blend with adjacent parent material without impairing structural integrity of connection.

2. Welds shall have a smooth and consistent cross-section and appearance.

3. Dress welds with filler to provide smooth finish, blended invisibly with adjacent surfaces.

4. Welds shall be free of defects visible from a distance of 10 feet under normal lighting conditions.

F. Surface Repair and Dressing:

1. Dress exposed surfaces to a smooth and uniform appearance by grinding, blasting and filling, followed by fairing compound and sanding.

2. Remove mill identification or other marking.

3. Grind and fill seams in pipes and tubes to be invisible in finished Work.

4. Remove, grind or fill dents or other imperfections.

5. Condition of exposed surfaces is subject to approval by Design Professional.

2.5 Shop Painting

A. Comply with requirements of Fluoropolymer Coatings: Division 05.

Part 3 Execution

3.1 Erection

A. Verify anchor rod alignment, elevation, projection and size prior to erection. Notify Design Professional in writing of any errors and propose remedial action. Obtain Design Professional's written approval of methods proposed for correction of errors prior to proceeding with correction and erection.

B. Set base plates level to correct elevations and temporarily support on steel leveling devices as indicated and until corresponding supported member has been positioned, plumbed and connected.

C. Align, level and adjust members accurately prior to final fastening and as required to provide connections of elements to be supported by structural frame within specified tolerances. Clean bearing surfaces and surfaces that will be in permanent contact prior to final assembly of members.

D. Rolling and Fabrication Tolerances: As specified in AISC Code of Standard Practice, Section 10 except as follows:

1. Out-Of-Square, Surface Flatness and Outside Dimension Tolerances: One-half of tolerances in ASTM A 6, ASTM A 53 and ASTM A 500, as applicable.

E. Erection Tolerances: As specified in AISC Code of Standard Practice, Section 10 based on a standard temperature of 68 degrees F except as follows:

1. Comply with Structural Steel Framing: Division 05.

2. AESS framing system shall comply with tolerance requirements of exterior enclosure and shall be erected, surveyed and accepted by exterior enclosure erectors prior to enclosure erection.

F. As erection progresses, securely connect Work to resist gravity loads, wind, and erection forces. Provide temporary bracing to resist loads, including construction loads which structure may be subjected to.

G. Torch cutting in field shall not be done except with written permission of Design Professional. When permitted, execute cutting in accordance with requirements indicated.

3.2 Bolted Connections

A. Bolts shall be installed and tightened by “turn-of-the-nut” method.

B. Capabilities of each bolting crew shall be confirmed by Inspection and Testing Agency prior to production.

C. Make joints without use of erection bolts. Where proper fit-up cannot be obtained, provide additional plumbing, leveling or corrective Work as required. Do not use more than number, size and location of bolts indicated on approved Shop Drawings.

D. Before bolts are tightened, bring parts tightly together. Retighten these bolts as bolts are finally tightened.

E. Connections are subject to Design Professional review and acceptance based on approved Shop Drawings, Samples and Mock-up. Connections shall not be “touch-up” painted in field prior to Design Professional’s acceptance.

3.3 Welded Connections

A. Definitions: Terms herein relating to welds, welding and oxygen cutting shall be construed to be in accordance with standard definitions of welding terms and master chart of welding processes of American Welding Society, as currently amended.

B. Welding shall be performed by operators who have been qualified within preceding one (1) year period under AWS standard qualification procedures for type of work required.

C. Begin no welding until joint elements are adjusted to dimensions established in certified welding procedure with allowance for any weld shrinkage that is expected and are within tolerances specified.

D. Perform welding in a sequence which shall prevent excessive stress and distortion in parent material caused by shrinkage in welds. Repair or replace defective Work.

E. Field-welded connections are subject to Design Professional review and acceptance based on approved Samples and Mock-up. Connections shall not be “touch-up” painted in field prior to Design Professional’s acceptance.

3.4 Survey

A. Make an accurate survey of actual framing locations immediately upon completion of framing and immediately submit to Design Professional.

3.5 Rejected Work And Corrections

A. Comply with Structural Steel Framing: Division 05.

3.6 Field Touch-Up Painting

A. Comply with requirements of Fluoropolymer Coatings: Division 05.

B. After erection, touch-up shop finish where missing or damaged.

C. For shop prime-painted surfaces, use same paint as approved for shop coat.

D. Prior to touch-up, remove rust, dirt, and weld slag.

E. Touch-up paint shall extend a minimum of 2 inches onto undamaged finish.

F. Paint shall be uniformly applied to dry surfaces to a dry film thickness no less than that specified for shop coat.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Metal items, typically custom fabricated, from plate, angles, channels, rods, bars, and other shapes as follows:

1. Counter, shelf and bench supports.
2. Overhead supports.
3. Elevator hoist beams.
4. Steel ladders.
5. Channel Strut Framing (Unistrut).
6. Items indicated, but not specified elsewhere.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Fluoropolymer Coatings: Division 05.

C. Structural Steel Framing: Division 05.

D. Pipe and Tube Railings: Division 05.

E. Exterior Enclosure, General: Division 07.

F. High-Performance Coatings: Division 09.

G. Painting: Division 09.

H. Machine Roomless Holeless Hydraulic Elevators: Division 14.

I. Mechanical: Division 21, 22, 23.

J. Electrical: Division 26.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Shop Drawings:

1. Minimum Scale:

a. Plans and Elevations for Erection: 1/4 inch equals 1 foot scale.
b. Sections: 1/2 inch equals 1 foot scale.
c. Details: 1 1/2 inches equals 1 foot scale.

2. Show the following:

a. Materials by type, shape, size and finish.
b. Extent of shop fabrication versus field work.
c. Joint, connection and anchorage details.
d. Size, location and details welds.
e. Relationship to adjacent materials and construction.
f. Description of all loose, cast-in, and field hardware.

C. Product Data:

1. Manufacturer's standard data for each product including written installation and maintenance instructions.

2. Channel Strut Framing: Manufacturer's standard load data, marked to indicate ability of channel strut framing, accessories and anchors to support load.

D. Calculations: Structural calculations signed and sealed by Design Engineer, licensed in State of North Carolina, to document conformance with specified design intent and criteria. Account for connection eccentricities. Submit calculations for Work indicated for Engineering.

E. Sustainability Submittals: Provide the following in accordance with Sustainability Requirements: Division 01.

1. Materials Sustainability Documentation Form.

2. Product data, certification letter, and costs for materials with recycled content.

3. Product data and costs for regional materials.

4. Product data for paints and coatings indicating VOC content and chemical composition.

1.4 System Requirements

A. Engineering: Engineer listed assemblies in compliance with indicated design intent and criteria.

1. Engineering is required for the following assemblies:

a. Bar Grating and Grating Supports.
b. Channel Strut Framing.

c. Connections, including connections to building structure where requested by Design Professional.

2. Maintain basic dimensions of system, sight lines, jointing and profiles. Minor deviation is allowable only with approval of Design Professional and if deviations are identified on submittals.

3. Engineer components of system not fully detailed within a reasonable inference of design intent.

1.5 Quality Assurance

A. Fabricator's Qualification:

1. Minimum five (5) years experience producing products similar to those required for this Project.

2. Successfully provided products for three (3) projects of scope, schedule and complexity similar to this Project within last two (2) years.

B. Installer's Qualifications:

1. Minimum five (5) years experience installing products similar to those required for this Project.

2. Successful completion of three (3) projects of scope, schedule and complexity similar to this Project within last two (2) years.

C. Welder's Qualifications: Shop and field welders shall be certified within last year per AWS D1.1. Submit certification letter.

D. Single Source Requirements: Work of this Section shall be supplied by one (1) fabricator.

E. Regulatory Requirements: Comply with the following per Division 01. OSHA Regulations for ladders.

F. Referenced Codes and Standards: Comply with the following in accordance with Division 01.

1. American Institute of Steel Construction (AISC)

"Specification for Structural Steel Buildings"

2. American National Standards Institute/National Association of Architectural Metal Manufacturers (ANSI/NAAMM)

MBG 531	Metal Bar Grating Manual
MBG 532	Heavy Duty Metal Bar Grating Manual

3. American Welding Society (AWS)

D1.1	Structural Welding Code, Steel

4. Society for Protective Coatings (SSPC)

Painting Manuals

Part 2 Products

2.1 General

A. Provide recycled content materials in accordance with Sustainability Action Plan specified in Sustainability Requirements: Division 01.

B. Provide regional materials in accordance with Sustainability Action Plan specified in Sustainability Requirements: Division 01.

C. Use field applied paints and coatings that comply with the VOC limits and chemical restrictions specified in Sustainability Requirements: Division 01.

2.2 Steel

A. Structural Steel Plates, Shapes and Bars: ASTM A 36/A 36M.

B. Pipe, Black or Galvanized, Seamless or Welded, Standard Weight (Schedule 40): ASTM A 53/A 53M.

C. Structural Tubing: ASTM A 500.

D. Sheet: ASTM A 1008/ A1008M or A 1011/A 1011M or A 1011/ A1011M.

2.3 Channel Strut Framing

A. General: System of cold-formed metal channels with flange edges returned towards web, and accessories for joining lengths of channel and anchoring to structure or substrate.

B. Sizing: Size channel strut framing, accessories and anchors to support applied load with the following minimum safety factors:

1. Gravity Loads and Bending Stress: 4.
2. Suspended Loads: 6.
3. Vibrating or Moving Loads: 8.
4. Suspended and Vibrating or Moving Loads: 10.

C. Products: Unistrut, Powerstrut, Anvil-Strut or approved equivalent.

D. Channels: Size as required to support indicated load.

1. Width: 1 5/8 inches minimum.
2. Depth: 1 5/8 inches minimum, unless otherwise indicated.
3. Galvanized Steel: ASTM A 653, structural quality, Grade 33, with G90 coating, minimum 0.108 inch nominal thickness.
4. Finish: Hot-dip galvanized after fabrication.

E. Hangers and Diagonal Bracing: Minimum 1/2 inch threaded rod or channel strut with appropriate anchors to structure above as required for load.

2.4 Accessories

A. Fasteners:

1. Fasteners Into Concrete: Cast-in-place, chemical or expansion type anchors. Load Capacity in accordance with ASTM E 488: Six (6) times design load.

2. Fasteners Into Steel: Welded studs, through bolts, or self-drilling or self-tapping screw type fasteners.

a. Load Capacity: Five (5) times design load.
b. Structural Steel Connections: Per AISC Specifications.
c. Non-structural Connections: Per IFI Standards.

3. Powder-Actuated Fasteners: Not acceptable unless approved in writing for applications where no other type fastener is practicable. Load Capacity in accordance with ASTM E 1190: Ten (10) times imposed load.

4. Fastener Material:

a. Steel Work: Uncoated steel fasteners.
b. Stainless Steel Work: Stainless steel fasteners.
c. Aluminum Work: Aluminum or stainless steel fasteners.
d. Galvanized Steel Work: Galvanized steel fasteners complying with ASTM A 153.

5. Fiber or Plastic Plug Type Fasteners: Not acceptable.

B. Prime Paint for Ferrous Metals: As specified in Structural Steel Framing: Division 05.

C. Shop Primer Paint:

1. General: Volatile Organic Compounds (VOCs) Compliant. Withstand the following tests without change in adhesion, film integrity, hardness, color, blistering or cracking:

a. Salt Spray Resistance: ASTM B 117, 500 hours.
b. Light and Water Resistance: ASTM D 4585, 500 hours.

2. Interior Exposure: Alkyd primer, minimum 50 percent solids by volume.

a. GP 818 by Carboline Company.
b. Kem Bond HS Universal Primer by Sherwin Williams.
c. Series FD 88 by Tnemec Company.

3. Exterior Exposure and Galvanizing Touch-up Paint: Inorganic zinc-rich primer minimum 60 percent solids by volume, minimum 80 percent metallic zinc by weight in dry film.

a. Carbo Zinc by Carboline Company.
b. Zinc-Clad IV by Sherwin Williams.
c. Series 90-97 by Tnemec Company.

D. Anticorrosive Paint: SSPC-Pain 20.

E. Grout: Premixed, non-shrink, non-metallic factory-packaged, non-staining, non-corrosive, nongaseous complying with ASTM C 1107.

2.5 Fabrication

A. Shop fabricate per approved submittals.

B. Shop fabricate to the greatest extent possible.

C. Shop fabricate to comply with erection tolerances.

D. Field Measurements: Check actual dimensions prior to fabrication. Allow for trimming and fitting.

E. Welding: Conform to AWS Standards.

1. Type: 1/4 inch fillet or similar type to suit condition which allows development of full strength of joined members.

2. Welding: Continuous except where not exposed to view or weather in the finished work, weld to provide required strength of connection.

3. Finishing: Dress welds smooth.

F. Dress Work free from burrs and sharp edges.

G. Curved Work: Form to true radii without torque or folds. Start and stop curves at tangent points, unless otherwise indicated.

H. Corners: Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing Work.

I. Castings: True, sharp, and straight with all joints neatly made.

2.6 Shop Priming

A. Ferrous Metals, Except Work to be Galvanized:

1. Surface Preparation:

a. Exposed: SSPC-SP6 "Commercial Blast Cleaning".
b. Concealed: SSPC-SP3 "Power Tool Cleaning".

2. Apply primer to surfaces, minimum dry film thickness 2.0 mils.

B. Aluminum and Stainless Steel:

1. Surfaces Which Contact Other Metals: Prime with zinc chromate primer, non-bituminous dielectric material or polyisobutylene tape.

2. Surfaces Which Contact Concrete or Masonry: Coat with anticorrosive paint.

2.7 Galvanizing

A. Where indicated, ferrous metal, including anchorages, shall be hot-dip galvanized after fabrication. If approved in writing by Design Professional, large units may be galvanized as sub-assemblies, with final assembly by mechanical fasteners.

B. Practice: Conform to ASTM A 384, A 385 and A 780.

C. Fabrications: Hot-dip galvanize after fabrication per ASTM A 123.

D. Fasteners: Hot-dip galvanize after fabrication per ASTM A 153.

E. Finish: Do not passivate or treat with oils, grease or chemicals.

2.8 Items Of Work (Non-inclusive)

A. Overhead Supports: Structural steel shapes indicated or minimum 4 inch by 4 inch by 1/4 inch angles or channel strut framing, unless otherwise indicated.

1. Provide overhead supports for:

   a. Ceiling hung projection screens and other audio/visual equipment.
   b. Ceiling-hung equipment.
   c. Work indicated requiring overhead supports.

2. Bracing: Brace overhead supports within 8 inches of each unsupported end and at maximum 48 inches on center with members sloped at approximately 45 degrees from horizontal. Brace in two (2) directions if not anchored to adjacent construction.

3. Coordination: Coordinate overhead supports with supported item.

B. Elevator Shaftways: Fabricate sill angles from 5 inch by 5 inch by 3/8 inch angles or as required by elevator supplier.

C. Steel Ladders:

1. Stringers: 1 inch by 2 inch by 3/16 inch steel channel.

2. Safety Ladder Rungs: 13 gage, ASTM A 653, G90 galvanized, formed steel 1 5/8 inch wide by 1 1/8 inch high, with perforated raised buttons. Weld to stringers.

   a. McNichols Tread Grip Ladder Rungs.
   b. Amico ISG Safety Tread Ladder Rungs.

3. Safety Plank: 13 gage, ASTM A 653, G90 galvanized, formed steel 12 inch wide by 1 1/2 inch high, with perforated raised buttons. Weld to supports.

   a. McNichols Tread Grip Plank.
   b. Amico ISG Safety Tread Channel.

4. Anchors: 2 inch by 3/8 inch bent steel plate brackets, zee-shaped or with welded base plate.

5. Extend ladder stringers beyond top of parapet or platform landing as indicated.

6. Landing Platforms: Frame with stringer stock and make platform from safety plank.

7. Finish: Galvanized at exterior work.

D. Rough Hardware: Custom fabricated bolts, plates, anchors, hangers, and other steel and iron shapes as indicated.

E. Loose Bearing and Leveling Plates: Steel plate, drill to receive anchor bolts.

Part 3 Execution

3.1 Preparation

A. Furnish anchors and sleeves to be embedded in or attached to other Work. Coordinate locations.

3.2 Installation

A. Install Work in accordance with approved submittals, and in case of manufactured items, manufacturer's written instructions.

B. Embed Work into concrete or masonry to be primed/coated as indicated in Article, Shop Priming. If work is not completed in shop then field apply indicated primers/coatings.

C. Anchoring:

1. Secure to concrete, masonry, or building structure, unless otherwise indicated.

2. Do not anchor to, non-structural elements, including windows or curtainwall.

3. Fasten to structural steel with welds or bolts.

4. Fasten to hollow masonry with embedded anchorage or metal toggle bolts.

5. Use approved expansion type anchorage for fastening Work to concrete.

6. Tack weld or peen nuts which anchor moving or vibrating machinery or which shall be concealed in finished construction.

D. Fit exposed connections at ladders, rails, and other locations that are intended to be handled to form tight hairline joints.

E. Dress Work free from burrs and sharp edges.

F. Galvanized Assemblies: Do not weld, cut or abrade surfaces which have been hot-dip galvanized after fabrication, and are intended for bolted or screwed field connections.

G. Field Welding: As indicated.

H. Loose Bearing and Leveling Plates: Set plates on shims or other adjustable devices. After bearing members have been positioned and plumbed, tighten anchor bolts. Cut-off shims flush with edges of bearing plates before grouting. Pack solidly with non-metallic non-shrink grout between bearing surfaces and plates.

I. Touch-up welds, abrasions and identification markings with matching shop primer.

J. Clean Work for field painting.

K. Erection Tolerances: As specified in the AISC Code of Standard Practice based on a standard temperature of 68 degrees F except as follows: Elements provided to support or facilitate connection of Work of other Sections shall be erected within tolerances required by those Sections.

END

Part 1 General

1.1 Summary

A. Section Includes: Railings custom fabricated from, for example, channels, bars, plates and stainless steel cable railing system.

1.2 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. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Product Data: For the following:

1. Steel cabling.

2. Railing brackets.

C. Shop Drawings:

1. Minimum Scale:

a. Plans and Elevations for Erection: 1/4 inch equals 1foot scale.
b. Sections: 1/2 inch equals 1 foot scale.
c. Details: 1 1/2 inches equals 1 foot scale.

2. Show the following:

a. Materials by type, shape, size and finish.
b. Extent of shop fabrication versus field work.
c. Joint, connection and anchorage details.
d. Size, location and details welds.
e. Relationship to adjacent materials and construction.
f. Description of all loose and field hardware.

D. Samples: For each type of exposed finish required.

1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and cables.

2. Fittings and brackets.

3. Welded connections.

4. Assembled Sample of railing system, made from full-size components, top rail, post, handrail, brackets and infill. Indicate method of attaching and finishing members at intersections. Sample to be approximately 2 feet long by full height.

E. Calculations: Structural calculations signed and sealed by Design Engineer licensed in the State of North Carolina to document conformance with specified design intent and criteria. Account for connection eccentricities.

F. Sustainability Submittals: Provide the following in accordance with Sustainability Requirements: Division 01.

1. Materials Sustainability Documentation Form.

2. Product data, certification letter, and costs for materials with recycled content.

3. Product data and costs for regional materials.

4. Product data for paints and coatings indicating VOC content and chemical composition.

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."

1.5 Delivery, Storage, And Handling

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

Part 2 Products

2.1 Quality Assurance

A. Manufacturer’s Qualifications:

1. Minimum five (5) years experience producing products similar to those required for this Project.

2. Successfully provided products for three (3) projects of scope, schedule and complexity similar to this Project within last two (2) years.

3. Design Engineer: Professional Engineer licensed in State of North Carolina, having a minimum five (5) years experience. Design Engineer shall seal all calculations and Shop Drawings.

B. Installer's Qualifications:

1. Minimum five (5) years experience installing products similar to those required for this Project.

2. Successful completion of three (3) projects of scope, schedule and complexity similar to this Project within last two (2) years.

3. Welder's Qualifications: Shop and field welders shall be certified within last year per AWS D1.1.

C. Source Limitations: Obtain each type of railing from single source from single manufacturer.

2.2 Performance Requirements

A. Delegated Design: Engage a qualified licensed professional engineer registered in the State of North Carolina, to design railings, including attachment to building construction.

B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lbf/ ft. applied in any direction.
b. Concentrated load of 200 lbf applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
b. Infill load and other loads need not be assumed to act concurrently.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F.

2.3 Metals, General

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

1. Provide type of bracket with flange tapped for concealed anchorage that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface.

2.4 Stainless Steel

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Tubing: ASTM A 554, Grade MT 304.

C. Pipe: ASTM A 312/A 312M, Grade TP 304.

D. Castings: ASTM A 743/A 743M, Grade CF 8 or CF 20.

E. Plate: ASTM A 167, Type 304.

F. Wire Rope and Fittings:

1. Wire Rope: made from wire complying with ASTM A 492, Type 316.

2. Wire-Rope Fittings: Connectors of types indicated, fabricated from stainless steel and with capability to sustain, without failure, a load equal to minimum strength of wire rope which they are used.

2.5 Fasteners

A. General: Provide the following:

1. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Fasteners for Interconnecting Railing Components:

1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.

2. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.

3. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.

4. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

2.6 Miscellaneous Materials

A. Handrail Brackets:

1. Material: Cast stainless.

2. Type: Concealed single fastener, self-aligning bracket.

3. Product: Carlstadt as manufactured by Julius Blum & Co., Inc. or approved equal..

B. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

2.7 Fabrication

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that are exposed to weather in a manner that excludes water. Provide weep holes where water may accumulate.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with welded connections unless otherwise indicated.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

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 flux immediately.

4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

5. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.

I. Close exposed ends of railing members with prefabricated end fittings.

J. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.

K. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

L. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

2.8 Horizontal Stainless Steel Cable Railing System

A. Basis of Design: I-SYS INOX “IK-Series” Stainless Steel Cable Handrail System, manufactured by Carl Stahl-DecorCable Innovations LLC.

1. Material:

   a. Cables: ASTM A492 Type 316 stainless steel.
   b. IK-140-Field installed RH/RH external thread both ends.
   c. Rope construction: AISI 316 stainless steel rope.
   d. Fittings and Hardware: Includes AISI 316 hex nuts.

2. Fittings and Accessories:

   a. Provide grommet, bushings, nuts, washers, turnbuckles, fittings and other components as required for system installation.
   b. Preassemble items in shop to greatest extent practicable to minimize assembly at project site. Disassemble units only to extent necessary for shipping and handling limitations. Mark units for reassembly.

Part 3 Execution

3.1 Installation, General

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components after fabrication.

2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.

3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.

D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.2 Railing Connections

A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.

B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

3.3 Adjusting And Cleaning

A. Clean stainless steel by washing thoroughly with clean water and soap and rinsing with clean water.

3.4 Protection

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Wood framing, furring and blocking, including fasteners and accessories generally concealed in finished Work or exposed only in utility spaces.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Sheathing: Division 06.

C. Finish Carpentry: Division 06.

D. Architectural Woodwork: Division 06.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Product Data: For preservative and fire-retardant treated material.

C. Certifications: For lumber and wood treatments.

D. Sustainability Submittals: Provide the following in accordance with Sustainability Requirements: Division 01.

1. Materials Sustainability Documentation Form.
2. Product data, certification letter, and costs for materials with recycled content.
3. Product data and costs for regional materials.
4. Product data, costs, and chain-of-custody certificates for products containing certified wood.
5. Product data for adhesives and sealants indicating VOC content.
6. Product data for paints and coatings indicating VOC content and chemical composition.
7. Product data for products containing composite wood or agrifiber products or wood glues indicating that they do not contain urea-formaldehyde resin.

1.4 Quality Assurance

A. Regulatory Requirements: Comply with the following per Division 01.

1. Conform to applicable building code for fire-retardant treatment of wood surfaces for flame spread and smoke developed ratings.

2. Fire-retardant treatment to conform to requirements of Underwriters Laboratories Inc. (UL).

B. Referenced Codes and Standards: Comply with the following in accordance with Division 01.

1. Lumber: Identify with grade stamp of an agency certified by NFPA and WWPA.

2. American Plywood Association (APA) Product Guide: Performance-rated Panels.

Part 2 Products

2.1 Materials

A. Do not use products or adhesives that contain urea-formaldehyde resin.

B. Use adhesives and sealants that comply with the VOC limits specified in Sustainability Requirements: Division 01.

C. Use field applied paints and coatings that comply with the VOC limits and chemical restrictions specified in Sustainability Requirements: Division 01.

D. Lumber: Material concealed from view in the finished Work. Lumber and sizes shall comply with PS-20. Use dry lumber (S-DRY), surfaced four sides (S4S). Moisture content shall not exceed 19 percent except that moisture content of 2 inch lumber shall not exceed 15 percent at time of surfacing. Stamp lumber "S-DRY" and "MC-15" respectively. Lumber shall conform to WWPA Grading Rules as follows for all sizes, nominal:

1. Structural Light Framing (Construction Grade): Lumber 2 inches to 4 inches thick and 2 inches to 4 inches wide.

2. Structural Joists and Planks (No. 2 or Standard Grade): Lumber 2 inches to 4 inches thick and 5 inches and wider (nominal).

3. Construction Boards (No. 2 or Standard Grade): Lumber 1 1/2 inches and thinner.

E. Plywood: As recommended by "Guide to Plywood Grades under Product Standard PS-1 for Softwood Plywood/Construction and Industrial" published by American Plywood Association, unless otherwise indicated.

1. Interior plywood exposed to view: "A" Veneer Grade.

2. Exterior plywood exposed to view: Medium Density Overlay (MDO).

3. Electrical/Telephone Backing Panels: C-D plugged, exposure 1, fire-retardant treated, 3/4 inches nominal.

2.2 Preservative Wood Treatment

A. General: Comply with AWPA Standard C2. Provide arsenic and chromium-free treatment conforming to AWPA C2. Isolate treated wood from adjacent metal with building felt separator. Mark each piece with AWPA or SPIB Quality Mark Requirements.

B. Provide treatment materials for field cut surfaces.

C. Aboveground Wood Treatment: Pressure treat to a minimum retention of 0.25 pcf.

1. Kiln-dry lumber to maximum 19 percent moisture content.

2. Kiln-dry plywood to maximum 15 percent moisture content.

3. Treat aboveground wood where indicated and as follows:

a. In contact with roofing, roof insulation, flashing or waterproofing.
b. In contact with concrete or masonry on exterior side of cavity walls.
c. Exterior locations more than 18 inches above grade.

D. Ground-Contact Wood Treatment: Pressure treat to a minimum retention of 0.40 pcf.

1. Treat ground-contact wood where indicated and as follows:

a. Totally or partially embedded in earth or in concrete embedded in earth.
b. At exterior locations described for above ground usage, but within 18 inches of grade.

2.3 Fire-retardant Pressure Treatment

A. Lumber: Comply with AWPA C 20.

B. Plywood: Comply with AWPA C 27.

C. Treatment: Type A for interior work and protected exterior work, Exterior Type for exterior locations exposed to elements.

D. Provide UL listed identification on fire-retardant treated materials.

E. Provide fire-retardant treated all lumber and plywood on interior and exterior of building, unless otherwise indicated.

2.4 Rough Hardware

A. Provide hardware of size, type, and quantity required to permanently secure Work. Hardware shall include nails, spikes, screws, anchor bolts, lag bolts, toggle bolts, or other approved fasteners.

B. Hardware:

1. Use in fire retardant treated material: Hot-dipped galvanized per ASTM A 153, or stainless steel.

2. Use in preservative treated material: Stainless steel.

C. Nails shall be barbed or ring-shank type and penetrate minimum 1 1/4 inch into substrate.

D. Fasteners into concrete or masonry shall be one (1) of the following as suitable to condition:

1. Hardened Concrete: Minimum No. 10 screws, in pre-drilled holes.

2. Explosive set anchors, minimum 1 inch penetration.

3. Epoxy anchors in pre-drilled holes.

4. No hand driven nails allowed.

5. No lead, fiber or plastic shields or plugs allowed.

E. Fasteners into structural steel shall be one (1) of the following as suitable to condition:

1. Screws, minimum 1/4 inch self-drilling/self-tapping or in pre-drilled and tapped holes.

2. Explosive set anchors, minimum 1/4 inch penetration.

F. Fasteners into sheet metal, 12 gage and under, shall be screws, minimum No. 8 self drilling/self-tapping.

Part 3 Execution

3.1 Installation

A. Comply with American Forest and Paper Association (AFPA) “National Design Specification for Wood Construction” and “Wood Frame Data No. 1”.

B. Construct members of continuous pieces of longest possible lengths.

C. Install Work plumb, level, and true of shape and configuration indicated.

D. Coat cut surfaces of preservative treated wood to comply with AWPA M 4.

E. Anchors:

1. Nailing: As scheduled in applicable building code, unless otherwise indicated.

2. Provide bolts with plate washers.

3. Recess heads of screws and bolts below surface of member where indicated or required for future Work.

F. Blocking, Nailers Edge Strips and Cants at Roofing:

1. Provide at perimeter of roof, around openings through roof, and where roof abuts walls, curbs, and other vertical surfaces.

2. Unless otherwise indicated, members shall be nominally 6 inches wide by thickness of insulation layers.

   a. At nailers on metal decking parallel to flutes, increase width of members as required to span minimum two (2) flutes with 3/4 inch bearing each side.
   b. Bottom layer of members shall be nominal 1 1/2 inch minimum.

3. Install members in longest lengths possible. Offset joints between members by minimum 4 feet

4. Anchor members to structure as follows:

   a. Ends of Members: Provide anchors within 6 inches of ends.
   b. Members Over 4 Inches Wide: Stagger anchors in offset rows and double at ends.
   c. Concrete Masonry Units: 1/2 inch diameter anchor bolts with 2 inch 90 degree leg at 4 feet on center maximum. Minimum 12 inch embedment into grouted core.
   d. Concrete and Bond Beams: 1/2 inch diameter expansion bolts at 3 feet on center or double staggered row of masonry screws, each 12 inches on center.
   e. Structural Steel: Double staggered row of No. 10 self-drilling, self-tapping screws with washers, each 2 feet on center.
   f. Corner Zones: For a distance of minimum 8 feet from each corner, double the number of fastener by decreasing spacing to half of spacing listed above.

5. Anchor Members to Each Other: Use nails which penetrate minimum 1 1/4 inch into wood layers below in two (2) staggered rows, each 24 inches on center or 3/8 inch lag bolts in two (2) staggered rows, each 4 feet on center.

6. Kerf or slot members at 12 inch centers approximately 1/2 inch by 1/2 inch to allow venting of roof.

G. Install wood blocking required for level installation of roof curb mounted items (for example, fans, air handling units, and other motor-driven equipment). Set fasteners flush if required to clear abutting work.

H. Blocking and Nailers to Support Woodwork and Millwork specified in other Sections:

1. Provide minimum 3/4 inch thick material for screw attachment or 1 1/2 inch thick material for nail attachment.

2. Provide blocking and nailers continuous behind, for example, all standing and running trim, casework, cabinets, wall-mounted shelving, countertops, cleats, finish carpentry, millwork and as indicated.

I. Blocking and Nailers to Support Wall-mounted Elements:

1. Provide minimum 1 1/2 inch thick material.

2. Provide blocking and nailers continuous behind every wall mounted element including, but not limited to, finish hardware, toilet accessories, furniture, signage, architectural accessories, wall guards and handrail brackets.

J. Provide grounds for plaster work flush with wall surface.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Cross Laminated Timber (CLT) Roof, Floor Panels and Stair Panels as shown on the Drawings.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Coordination Drawings: Division 01.

C. Glued-Laminated Construction: Division 06.

D. Rough Carpentry: Division 06.

E. High-Performance Coatings: Division 09.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Product Data: For each type of product indicated.

C. Shop Drawings: Include panel location plans, dimensions, shapes and sections, openings, support conditions, connections.

1. Indicate lifting connections.
2. Indicate locations, tolerances, and details of anchorage to supporting structure.
3. Include and locate openings larger than 10 inches.
4. Indicate location of CLT panel by same identification mark placed on panel.
5. Indicate relationship of CLT panels to adjacent materials.
6. Clearly indicate stress grade, service grade, appearance grade.
7. Provide three dimensional models of all interfaces, CLT panels, secondary timber members, plus all connections.

D. CLT supplier to provide a fully accurate three-dimensional (3D) model of the interfaces (supports, abutments, etc.), CLT panels, secondary timber members, plus all connections prior to submission of shop drawings. Model to be generated using software compatible with Revit 2015).

E. Structural Design Calculations: When required by contract drawings provide CLT structural design calculations, by a registered Professional Engineer licensed in the state of NC.

F. Samples: Submit eight (8) Sample of CLT panel; approximately 12 by 12 by 4 inches for field applied coatings by others.

G. APA Product Report and Certified ANSI PRG 320 certificate.

H. Local/Regional Materials: Indicate location of manufacturing facility including name, address and distance between manufacturing facility and the product site.

I. VOC Content: Product data and material safety data sheets (MSDS) for the CLT adhesive used on the interior of the building indicating chemical composition and VOC content.

J. Sustainability Submittals: Provide the following in accordance with Sustainability Requirements: Division 01.

1. Materials Sustainability Documentation Form.
2. Product data, certification letter, and costs for materials with recycled content.
3. Product data and costs for regional materials.
4. Product data, costs, and chain-of-custody certificates for products containing certified wood.
5. Product data for adhesives and sealants indicating VOC content.
6. Product data for paints and coatings indicating VOC content and chemical composition.
7. Product data for products containing composite wood or agrifiber products or wood glues indicating that they do not contain urea-formaldehyde resin.

1.4 Quality Assurance

A. Referenced Codes and Standards: Comply with the following in accordance with Division 01.

1. ANSI D3737-07 Structural Glued Laminated Timber.
2. AITC 405 and ASTM D2559-00 Standards for Wood Adhesives.
3. ANSI A190.1-2007 Structural Glued-laminated.
4. APA Standard for Performance Related CLT- ANSI/APA PRG 320/2011.

B. Manufacturer's Qualifications:

1. Certified by APA The Engineered Wood Association for compliance with ANSI/APA PRG 320/2011 and passed all of its testing standards.

C. Design Standards: Comply with the National Design Specification for Wood Construction NDS 2005 applicable to types of CLT panels indicated.

1.5 Delivery, Storage, And Handling

A. Support units during shipment on non-staining material in same position as during storage.

B. Store units with adequate bracing and protect units to prevent contact with soil and separated with striping (so air may circulate around all faces of members), to prevent staining, and to prevent cracking, distortion, warping or other physical damage.

1. Place stored units so identification marks are clearly visible.

C. Handle and transport units in a position consistent with their shape and design in order to avoid excessive stresses that would cause cracking or damage. Protect corners with wood blocking.

D. Lift and support units only at designated points shown on Shop Drawings.

E. Slit underside of membrane covering during storage at Site. Do not deface members.

F. Cover top and sides with opaque moisture resistant membrane.

G. Maintain protection of CLT panel at all times during construction.

Part 2 Products

2.1 Manufacturers

A. Manufacturers shall have environmental product declaration available to meet LEED requirements. Other equal manufacturers with environmental product declarations may be considered.

B. Structurlam Products Ltd, 2176 Government Street, Penticton, B.C., Canada V2A 8B5; Kris Spickler, 916-797-5588, kspickler@structurlam.com.

C. SmartLam, 335 Spokane Ave., Whitefish, MT 59937, 406-862-0098.

D. Nordic Structures, 504-1100 Canadiens-de-Montreal Avenue, Montrreal, Quebec H3B 2S2, 514-871-8526.

2.2 Materials

A. Wood Species –No.1/No.2 Spruce-Pine-Fir and where Visual grade surface is required use Douglas fir L1 lamstock for Cross Laminated Timber (CLT) panels.

B. Adhesives in compliance with ANSI A190.1, DIN 68141 and EN301 and EN302.

1. Acceptable Product: Purbond HB E452.

2.3 Accessories

A. Steel Connectors: Galvanized Steel.

B. Wrapping Material: Weatherproof, lightproof, stain free material. Cut holes on site and underside of wrapping to avoid accumulation of condensation.

2.4 Fabrication

A. Fabricate Cross Laminated Timber (CLT) members in accordance with ANSI/APA PRG 320/2011 except where specified otherwise and to following classifications. Use multiple layers of 19mm minimum to 38mm maximum thick laminations.

B. Service grade: interior or exterior as located on Drawings.

C. Appearance Classification:

1. Non-Exposed (where panels are concealed):

a. Shake and checks allowed, shall not exceed 36 inches or 1/4 of the length.
b. Heart or blue stain allowed, not limited.
c. Knots well-spaced, quantity not limited.
d. Minimal wane on face.
e. Side pressure on exposed face not required.

2. Exposed (where panels are in view in final construction):

a. Utilize DF L1 lamstock lumber at the exposed visual grade face only.
b. Knots: NLGA Select Structural limitation. Clear of knots. Refer to Spec section 061800 and appearance match between CLT and Glu-lam.
c. Pitch streaks not permitted.
d. Wane on face not permitted.
e. Side pressure on exposed faces required.

D. Cross Laminated Timber (CLT) members to be fabricated with ¼" chamfers on long sides.

E. Cross Laminated Timber (CLT) members to be joined at panel edges using a continuous spline as indicated on Drawings.

F. Mark members for identification during erection. Ensure that marks will be concealed in final assembly for appearance grade members. Clearly mark top surface.

G. Coat all cuts, holes and slots.

H. Field apply sealer to all sides of laminated members. Double coat ends of laminated members.

I. All structural steel connecting CLT panel elements to each other and shall be detailed, and if supplied, test fitted in the shop by the CLT supplier.

Part 3 Execution

3.1 Examination

A. Prior to fabrication, check all dimensions relating to this section of work. Report any discrepancies to Engineer.

B. Prior to site erection, examine all site conditions and ensure an acceptable condition.

3.2 Installation

A. Erect CLT panels in accordance with final reviewed shop drawings.

B. Make adequate provision for possible erection stresses. Set panels level and plumb to correct positions. Securely brace panels and anchor in place to maintain plumb until permanently secured by finished structure.

C. Fit CLT panels closely and accurately, without trimming, cutting or other modifications, unless approved in writing by Engineer.

D. Site cutting or boring of CLT panels, other than shown on shop drawings not permitted without written consent of Engineer.

3.3 Cleaning

A. Clean exposed surfaces of CLT panels after erection and completion of field touch up.

1. Perform cleaning procedures, if necessary, according to CLT manufacturer's written recommendations, Protect other work from staining or damage due to cleaning operations.

2. Do not use cleaning materials or processes that could change the appearance of exposed CLT panels or damage adjacent materials.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Panel type sheathing applied to structural framing. Included are attachments and accessories. Sheathing shall be covered in Finished Work.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Air/Vapor Barriers: Division 07.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Product Data: For preservative and fire-retardant treated material.

C. Sustainability Submittals: Provide the following in accordance with Sustainability Requirements: Division 01.

1. Materials Sustainability Documentation Form.
2. Product data, certification letter, and costs for materials with recycled content.
3. Product data and costs for regional materials.
4. Product data, costs, and chain-of-custody certificates for products containing certified wood.
5. Product data for adhesives and sealants indicating VOC content.
6. Product data for products containing composite wood or agrifiber products or wood glues indicating that they do not contain urea-formaldehyde resin.

1.4 Quality Assurance

A. Regulatory Requirements: Comply with the following per Division 01.

1. Conform to applicable building code for fire-retardant treatment of wood surfaces for flame spread and smoke developed ratings.
2. Fire-retardant treatment to conform to requirements of Underwriters Laboratories Inc. (UL).

B. Referenced Codes and Standards: Comply with the following in accordance with Division 01.

1. American Plywood Association (APA)

	Design/Construction Guide: Performance-Rated Panels
	Design/Construction Guide: Residential and Commercial

2. American Wood-Preservers' Association (AWPA)

C 9	Plywood: Preservative Treatment By Pressure Processes
C 27	Plywood: Fire-Retardant Treatment By Pressure Processes
M 4	Standard For The Care Of Preservative: Treated Wood Products

3. Gypsum Association (GA)

253	Application Of Gypsum Sheathing

4. National Institute of Standards and Technology, Department Of Commerce, Product Standard (PS)

1	Construction And Industrial Plywood

Part 2 Products

2.1 Materials

A. Provide recycled content materials in accordance with Sustainability Requirements: Division 01.

B. Provide regional materials in accordance with Sustainability Requirements: Division 01.

C. Provide certified wood-based materials in accordance with Sustainability Requirements: Division 01.

D. Do not use products or adhesives that contain urea-formaldehyde resin.

E. Use adhesives and sealants that comply with the VOC limits specified in Sustainability Requirements: Division 01.

G. Gypsum Sheathing: Weather resistant gypsum core panel without paper faces and edges conforming with ASTM C 1177. "Dens-Glass Gold" by Georgia Pacific, "Fiberrock Aqua-tough" Sheathing by USG, or "GlasRoc" by CertainTeed.

1. Size: 5/8 inch thick fire rated, 4 feet wide by longest practical length.

2. Type: as indicated to maintain fire rating assemblies.

3. Joint Tape: 2 inches, 10 by 10 glass mesh tape. Or sealant joint preparation as required by fluid applied air barrier installation.

4. Trim: As recommended in writing by manufacturer and complying with ASTM D 1784. All trim shall be the spackled type.

5. Compound: Setting type joint compound as recommended in writing by manufacturer.

I. Accessories:

1. Fasteners: Type recommended in writing by panel manufacturer, hot-dip galvanized per ASTM A 153. Screws for metal framing shall be self drilling, self-tapping for metal thickness of framing.

a. Fasteners into preservative treated lumber or plywood: Stainless steel.

Part 3 Execution

3.1 Examination And Preparation

A. Examine framing or substrate to receive sheathing for conformance to requirements and suitability for sheathing. Notify Contractor of deficiencies and do not proceed until they are remedied.

B. Prepare framing or substrate for sheathing application by installing blocking of pressure-treated wood, minimum 2 inches by 4 inches or cold formed metal studs matching size and thickness of adjacent framing. Provide blocking at unsupported edges of sheathing.

3.2 Installation

A. Fire-rated assemblies shall be installed in conformance with requirements of listing agency.

C. Gypsum Sheathing: Install in accordance with manufacturer's written instructions and applicable published instructions in GA-253.

1. Install sheathing horizontally or vertically in maximum lengths practical. Support four (4) edges of panel over framing, blocking or solid substrate.

2. Attach to framing or substrate with screws on center at perimeter and in field. Do not countersink fasteners.

3. Install trim pieces where exterior gypsum sheathing abuts differing materials and as indicated. Provide control joints maximum 30 feet on center when not indicated.

4. Tape all joints and cover with joint compound. Spackle trim pieces with joint compound.

5. After compound joints and trim has set provide a skim coat over entire surface of sheathing. Sand skim coat as required to even out irregularities. Skim coat shall provide a smooth, planar, blemish free surface.

3.3 Protection And Repair

A. Protect sheathing and air infiltration barrier from damage and excessive weathering until installation of overlying materials and completion.

B. Repair damage to sheathing and air infiltration barrier as approved by Design Professional, prior to application of overlying materials and completion.

END

Part 1 General

1.1 Summary

A. Section includes framing using structural glued-laminated timber.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Rough Carpentry: Section 061000, refer to for dimension lumber items associated with structural glued-laminated timber.

C. Cross Laminated Timber Panels: Section 061543, refer to for glued-laminated wood roof decking.

D. High-Performance Coatings: Section 099600, refer to for final coating of exposed glue-laminated timber.

1.3 Definitions

A. Structural Glued-Laminated (Glulam) Timber: An engineered, stress-rated timber product assembled from selected and prepared wood laminations bonded together with adhesives and with the grain of the laminations approximately parallel longitudinally.

1.4 Submittals

A. Submit per the requirements of Division 01.

B. Product Data: For each type of product.

1. Include data on lumber, adhesives, fabrication, and protection.

2. For preservative-treated wood products. Include chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.

3. For connectors. Include installation instructions.

C. Sustainable Design Submittals: Provide the following in accordance with Sustainability Requirements: Division 01.

1. Materials Sustainability Documentation Form.

2. Product data, certification letter, and costs for materials with recycled content.

3. Product data and costs for regional materials.

4. Product data, costs, and chain-of-custody certificates for products containing certified wood.

5. Product data for adhesives and sealants indicating VOC content.

6. Product data for paints and coatings indicating VOC content and chemical composition.

7. Product data for products containing composite wood or agrifiber products or wood glues indicating that they do not contain urea-formaldehyde resin.

D. Shop Drawings:

1. Show layout of structural glued-laminated timber system and full dimensions of each member.

2. Indicate species and laminating combination, adhesive type, and other variables in required work.

3. Include large-scale details of connections.

E. Samples: Full width and depth, 24 inches long, showing the range of variation to be expected in appearance of structural glued-laminated timber, including variations due to specified treatment.

1. Apply specified factory finish to three sides of half-length of each Sample.

F. Delegated-Design Submittal: For structural glued-laminated timber and timber connectors.

G. Certificates of Conformance: Issued by a qualified testing and inspecting agency indicating that structural glued-laminated timber complies with requirements in AITC A190.1.

H. Material Certificates: For preservative-treated wood products, from manufacturer. Indicate type of preservative used and net amount of preservative retained.

I. Research/Evaluation Reports: For structural glued-laminated timber and timber connectors, from ICC-ES.

1.5 Quality Assurance

A. Manufacturer Qualifications: An AITC- or APA-EWS-licensed firm certified for chain of custody by an FSC-accredited certification body.

1. Factory mark each piece of structural glued-laminated timber with AITC Quality Mark or APA-EWS trademark. Place mark on surfaces that will not be exposed in the completed work.

B. Quality Standard: Comply with AITC A190.1.

C. Forest Certification: Provide structural glued-laminated timber 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.”

1.6 Delivery, Storage, And Handling

A. General: Comply with provisions in AITC 111.

B. Individually wrap members using plastic-coated paper covering with water-resistant seams.

Part 2 Products

2.1 Manufacturers

A. Manufacturers shall have environmental product declaration available to meet LEED requirements. Other equal manufacturers with environmental product declarations may be considered.

B. Structurlam Products Ltd, 2176 Government Street, Penticton, B.C., Canada V2A 8B5; Kris Spickler, 916-797-5588, kspickler@structurlam.com.

C. Nordic Structures, 504-1100 Canadiens-de-Montreal Avenue, Montrreal, Quebec H3B 2S2, 514-871-8526.

2.2 Performance Requirements

A. Delegated Design: Engage a qualified professional engineer registered in the State of North Carolina to design structural glued-laminated timber and connectors.

B. Structural Performance: Structural glued-laminated timber and connectors shall withstand the effects of structural loads shown on Drawings without exceeding allowable design working stresses listed in AITC 117 or determined according to ASTM D 3737 and acceptable to authorities having jurisdiction.

C. Seismic Performance: Structural glued-laminated timber and connectors shall withstand the effects of earthquake motions determined according to ASCE 7-05.

2.3 Structural Glued-Laminated Timber

A. General: Provide structural glued-laminated timber that complies with AITC A190.1 and AITC 117 or research/evaluation reports acceptable to authorities having jurisdiction.

1. Factory mark each piece of structural glued-laminated timber with AITC Quality Mark or APA-EWS trademark. Place mark on surfaces that are not exposed in the completed Work.

2. Provide structural glued-laminated timber made from single species.

3. Provide structural glued-laminated timber made from solid lumber laminations; do not use laminated veneer lumber.

4. Provide structural glued-laminated timber made with wet-use adhesive complying with AITC A190.1.

5. Use adhesive that contains no urea-formaldehyde resins.

6. Product data for products containing composite wood or agrifiber products or wood glues indicating that they do not contain urea-formaldehyde resin.

B. Species and Grades for Structural Glued-Laminated Timber: Douglas Fir or Spruce-Pine-Fir in grades needed to comply with "Performance Requirements" Article.

C. Species and Grades for Structural Glued-Laminated Timber: Douglas Fir or Spruce-Pine-Fir that complies with structural properties**,** combination symbols, and beam stress classifications indicated.

D. Species and Grades for Beams:

1. Species and Beam Stress Classification: Douglas fir-larch, 24F-1.8E; Spruce-Pine-Fir 24F-ES/NPG.

2. Lay-up: Balanced (homogeneous)

E. Species and Grades for Columns:

1. Species and Combination Symbol: Douglas fir-larch, 1.

F. Appearance Grade: Premium, complying with AITC 110.

1. For Premium appearance grade, use clear wood inserts, of matching grain and color, for filling voids and knot holes more than 1/4 inch wide. Refer to Spec section 061543 and appearance match between CLT and Glu-lam.

2.4 Preservative Treatment

A. Preservative Treatment: Where preservative-treated structural glued-laminated timber is indicated, comply with AWPA U1, Use Category 3B.

1. Use preservative solution without water repellents or substances that might interfere with application of indicated finishes.

2. Do not incise structural glued-laminated timber or wood used to produce structural glued-laminated timber.

B. Preservative: One of the following:

1. Pentachlorophenol (Type C) in light Hydrocarbon Solvent with Auxiliary Solvent.

C. Apply preservative treatment prior to gluing the laminations in accordance with AITC 109 “Standard for Preservative Treatment of Structural Glued-Laminated Timber.”

2.5 Timber Connectors

A. Fabricate beam seats from steel with 3/8-inch bearing plates, 3/4-inch-diameter-by-12-inch- long deformed bar anchors, and 0.239-inch side plates.

B. Fabricate beam hangers from steel with 0.179-inch stirrups and 0.239-inch top plates.

C. Fabricate tie rods from round steel bars with upset threads connected with forged-steel turnbuckles complying with ASTM A 668/A 668M.

D. Provide bolts, 3/4 inch unless otherwise indicated, complying with ASTM A 307, Grade A; nuts complying with ASTM A 563; and, where indicated, flat washers.

E. Materials: Unless otherwise indicated, fabricate from the following materials:

1. Structural-steel shapes, plates, and flat bars complying with ASTM A 36/A 36M.

2. Round steel bars complying with ASTM A 575, Grade M 1020.

3. Hot-rolled steel sheet complying with ASTM A 1011/A 1011M, Structural Steel, Type SS, Grade 33.

4. Stainless-steel plate and flat bars complying with ASTM A 666, Type 304 and Type 316.

5. Stainless-steel bars and shapes complying with ASTM A 276, Type 304 and Type 316.

6. Stainless-steel sheet complying with ASTM A 240/A 240M or ASTM A 666, Type 304 and Type 316.

F. Finish steel assemblies and fasteners with rust-inhibitive primer, 2-mil dry film thickness.

G. Hot-dip galvanize steel assemblies and fasteners after fabrication to comply with ASTM A 123/A 123M or ASTM A 153/A 153M.

2.6 Miscellaneous Materials

A. End Sealer: Manufacturer's standard, transparent, colorless wood sealer that is effective in retarding the transmission of moisture at cross-grain cuts and is compatible with indicated finish.

B. Penetrating Sealer: Manufacturer's standard, transparent, penetrating wood sealer that is compatible with indicated finish.

2.7 Fabrication

A. Shop fabricate for connections to greatest extent possible, including cutting to length and drilling bolt holes.

1. Dress exposed surfaces as needed to remove planing and surfacing marks.

B. Camber: Fabricate horizontal and inclined members of less than 1:1 slope with either circular or parabolic camber equal to 1/500 of span.

C. Where preservative-treated members are indicated, fabricate (cut, drill, surface, and sand) before treatment to greatest extent possible. Where fabrication must be done after treatment, apply a field-treatment preservative to comply with AWPA M4.

1. Use Pentachlorophenol treatment for members not in contact with the ground and continuously protected from liquid water, and for members in contact with the ground or not continuously protected from liquid water.

D. End-Cut Sealing: Immediately after end cutting each member to final length and after preservative treatment, apply a saturation coat of end sealer to ends and other cross-cut surfaces, keeping surfaces flood coated for not less than 10 minutes.

E. Seal Coat: After fabricating, sanding, and end-coat sealing, apply a heavy saturation coat of penetrating sealer on surfaces of each unit except for preservative-treated wood where treatment included a water repellent.

2.8 Factory Finishing

A. Clear Finish: Manufacturer's standard, two-coat, clear varnish finish; resistant to mildew and fungus.

Part 3 Execution

3.1 Examination

A. Examine substrates in areas to receive structural glued-laminated timber, with Installer present, for compliance with requirements, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 Installation

A. General: Erect structural glued-laminated timber true and plumb and with uniform, close-fitting joints. Provide temporary bracing to maintain lines and levels until permanent supporting members are in place.

1. Handle and temporarily support glued-laminated timber to prevent surface damage, compression, and other effects that might interfere with indicated finish.

B. Framing Built into Masonry: Provide 1/2-inch clearance at tops, sides, and ends of members built into masonry; bevel cut ends 3 inches; and do not embed more than 4 inches unless otherwise indicated.

C. Cutting: Avoid extra cutting after fabrication. Where field fitting is unavoidable, comply with requirements for shop fabrication.

D. Fit structural glued-laminated timber by cutting and restoring exposed surfaces to match specified surfacing and finishing.

1. Predrill for fasteners using timber connectors as templates.

2. Finish exposed surfaces to remove planing or surfacing marks and to provide a finish equivalent to that produced by machine sanding with No. 120 grit sandpaper.

3. Coat cross cuts with end sealer.

4. Where preservative-treated members must be cut during erection, apply a field-treatment preservative to comply with AWPA M4.

    a. Use Pentachlorophenol treatment for members not in contact with the ground and continuously protected from liquid water, and for members in contact with the ground or not continuously protected from liquid water.

E. Install timber connectors as indicated.

1. Unless otherwise indicated, install bolts with same orientation within each connection and in similar connections.

2. Install bolts with orientation as indicated or, if not indicated, as directed by Architect.

3.3 Adjusting

A. Repair damaged surfaces and finishes after completing erection. Replace damaged structural glued-laminated timber if repairs are not approved by Architect.

3.4 Protection

A. Do not remove wrappings on individually wrapped members until they no longer serve a useful purpose, including protection from weather, sunlight, soiling, and damage from work of other trades.

1. Coordinate wrapping removal with finishing work. Retain wrapping where it can serve as a painting shield.

2. Slit underside of wrapping to prevent accumulation of moisture inside the wrapping.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Finish carpentry items, associated hardware and accessories as follows:

1. Stock wood standing and running trim.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Rough Carpentry: Division 06.

C. Architectural Woodwork: Division 06.

D. Wood Doors: Division 08.

E. Painting: Division 09.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Shop Drawings: Show fabrication and installation details, types of materials and finish, anchors, fastenings, hardware and framing required for proper installation of Work. Show provisions for conformation with indicated criteria. Show extent of shop fabrication versus field work.

1. Minimum Scale:

a. Overall Plans and Elevations: Minimum 1/4 inch equals 1 foot scale.
b. Plans and Elevations of Components: 1 inch equals 1 foot scale.
c. Details: Minimum 3 inch equals 1 foot scale.
d. Typical Profiles for each piece: Full size

2. Show locations and sizes of furring, blocking, and hanging straps, including concealed blocking and reinforcements specified in other Sections.

3. Show locations and sizes of cutouts and holes for light fixtures, telephone and data equipment, plumbing fixtures, faucets, soap dispensers and other items installed in architectural woodwork

C. Samples: Of materials for approval. Show type and range of specified material, finish and color.

D. Sustainability Submittals: Provide the following in accordance with Sustainability Requirements: Division 01.

1. Materials Sustainability Documentation Form.
2. Product data, certification letter, and costs for materials with recycled content.
3. Product data and costs for regional materials.
4. Product data, costs, and chain-of-custody certificates for products containing certified wood.
5. Product data for adhesives and sealants indicating VOC content.
6. Product data for paints and coatings indicating VOC content and chemical composition.
7. Product data for products containing composite wood or agrifiber products or wood glues indicating that they do not contain urea-formaldehyde resin.

1.4 Quality Assurance

A. Unless otherwise indicated, quality of materials for exposed woodwork shall conform to Premium Grade classification of Architectural Woodwork Institute's (AWI) Quality Standards, Guide Specifications and Quality Certification Program.

B. Referenced Codes and Standards: Comply with the following in accordance with Division 01.

1. American National Standards Institute (ANSI)

A 208.1	Wood Particleboard

2. American Plywood Association (APA)

	Product Guide: Performance-Rated Panels

3. American Society for Testing and Materials (ASTM)

D 1037	Standard Methods of Evaluating the Properties of Wood-Base Fiber and Particle Panel Materials

4. Architectural Woodwork Institute (AWI)

	Architectural Woodwork Quality Standards, Guide Specifications and Quality Certification Program, Fifth Edition

5. National Electrical Manufacturers Association (NEMA)

LD 3	High-Pressure Decorative Laminates

6. National Institute of Standards and Technology, Department of Commerce, Product Standard (PS)

1	Construction and Industrial Plywood
20	American Softwood Lumber Standard
51	Hardwood and Decorative Plywood
58	Basic Hardboard

1.5 Delivery, Handling And Storage

A. Store wood materials indoors, in ventilated areas with constant minimum temperature of 60 degrees F

Part 2 Products

2.1 General

A. Do not use products or adhesives that contain urea-formaldehyde resin.

B. Use adhesives and sealants that comply with low VOC limits.

C. Use field applied paints and coatings with low VOC limits.

2.2 Finish Wood

A. Trim wood shall match cross laminate timber species and quality and conform to material Specifications of AWI grade.

2.3 Fabrication

A. Fabricate Work in accordance with approved Shop Drawings and applicable AWI Standards specified.

B. Using templates, prepare the Work to receive finish hardware specified on the drawings, Finish hardware

C. Finishing:

1. Back prime-seal parts of custom woodwork which are entirely concealed from view, using wood sealer or shellac.

2. Finish Work in shop, and touch-up if required after installation at Project Site.

3. Finishes shall be as specified in Painting: Division 09.

Part 3 Execution

3.1 Workmanship

A. Perform Work neatly, properly mitered, coped, scribed and fitted, free of warp and twist, and in proper alignment. Work from field measurements and fit Work correctly. Do not introduce filler pieces not indicated on Drawings or Shop Drawings.

B. Furnish built-in anchorage required with written instructions for installation. For securing Work to completed masonry use expansion or toggle devices having all metal parts.

C. Repair minor defects to blend with color and grain of surrounding wood.

3.2 Carpentry Installation

A. Anchor standing and running trim with finish head nails or screws with head set below surface for putty fill. Fill shall blend with color and grain of surrounding wood.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes:

1. Plastic laminate cabinets.

2. Plastic laminate countertops.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Rough Carpentry: Division 06.

C. Finish Carpentry: Division 06.

D. Joint Sealants: Division 07.

E. Wood Doors: Division 08.

F. Painting: Division 09.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Shop Drawings: Show fabrication, dimensions, materials, interface with other construction, anchoring, and installation. Show provisions for conformance with indicated criteria. Show extent of shop fabrication versus field work.

1. Minimum Scale:

a. Overall Plans and Elevations: Minimum 1/4 inch equals 1 foot scale.
b. Plans and Elevations of Components: 1 inch equals 1 foot scale.
c. Details: Minimum 3 inch equals 1 foot scale.
d. Typical profiles for each piece: Full size.

2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.

3. Show locations and sizes of cutouts and holes for light fixtures, telephone and data equipment installed in architectural woodwork.

4. Show field datum line for work with a consistent horizontal design element including, but not limited to aligned door heads. Show datum to establish field measurements for Shop Drawings and Production.

C. Product Data: On each material, anchor and accessory and miscellaneous product. Indicate provisions for conformance with indicated criteria. Include the following:

1. Materials: For panel products, high pressure decorative laminate, adhesive for bonding plastic laminate

2. Fire Retardant Treatment: Data from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.

3. Hardware and Accessories: For each type of product indicated, including cabinet hardware, accessories, handrail brackets, and finishing materials and processes.

D. Samples:

1. For Verification of the following:

a. Plastic Laminate Clad Panel Products: 8 inches by 10 inches for each type, color, pattern, and surface finish with backer laminate.
b. Solid Surface materials: 3 inch by 3 inch for each type, color and pattern.

2. Cabinet Hardware and Accessories: One (1) unit for each type and finish.

E. Qualifications: Proof of compliance with indicated qualifications.

F. Quality Control Procedures: Indicating compliance with indicated criteria:

1. Factory Quality Control Procedures.

2. Factory Test Procedures.

3. Factory Test Reports.

4. Field Test Procedures.

5. Field Test Reports.

G. Sustainability Submittals: Provide the following in accordance with Sustainability Requirements: Division 01.

1. Materials Sustainability Documentation Form.

2. Product data, certification letter, and costs for materials with recycled content.

3. Product data and costs for regional materials.

4. Product data, costs, and chain-of-custody certificates for products containing certified wood.

5. Product data for adhesives and sealants indicating VOC content.

6. Product data for paints and coatings indicating VOC content and chemical composition.

7. Product data for products containing composite wood or agrifiber products or wood glues indicating that they do not contain urea-formaldehyde resin.

1.4 Definitions

A. Exposed Surfaces: Surfaces visible in the finished Work when viewed from any sightline between 3 feet to 6 feet 6 inches above finished floor, when doors and drawers are closed; bottoms of casework more than 4 feet above finished floor, backs of hinged doors, and edges of hinged doors exposed when opened.

B. Semi-Exposed Surfaces: Surfaces that become visible when drawers and doors are opened and tops of cases 6 feet 6 inches or more above finished floor.

C. Concealed Surfaces: Surfaces not visible after installation.

1.5 Quality Assurance

A. Fabricator Qualifications:

1. Experience: Minimum five (5) years producing architectural woodwork similar to those required for this Project, and provided architectural woodwork for three (3) projects of scope, schedule and complexity similar to this Project within last two (2) years, as acceptable to Design Professional.

2. Fabricators, Detailers and Drafters: Minimum five (5) years experience producing Shop Drawings for architectural woodwork similar to that required for this Project.

3. Single Source Requirements: Architectural woodwork shall be supplied by one (1) fabricator.

   a. Source Limitations: Furnish Work of this Section and wood doors with matching veneer faces specified in Division 08 from same manufacturer.

B. Installer's Qualifications:

1. Experience: Minimum five (5) years installing woodwork similar in materials, construction and design to that required for this Project, and completed three (3) projects of scope, schedule and complexity similar to this Project within last two (2) years, as acceptable to Design Professional.

C. Regulatory Requirements: Comply with the indicated requirements in accordance with Division 01.

1. Fire Rated Construction: Provide materials and products with specified fire test response characteristics as determined by testing identical products.

   a. Test Method: As indicated by UL or other agency acceptable to authorities having jurisdiction.

b. Identification: Appropriate markings of agency, separable paper label or imprint on surfaces of materials that will be concealed from view after installation, as required by authorities having jurisdiction.
c. Oversize Certification: Certify that units larger than tested assemblies are constructed exactly as tested units.

D. Referenced Codes and Standards: Comply with the following in accordance with Division 01.

1. Quality Standard: AWI's Architectural Woodwork Quality Standards

a. Provide AWI Quality Certification Program labels indicating that woodwork complies with requirements of grades specified.
b. Comply with additional requirements beyond those of quality standard where indicated. Comply with such selections and requirements in addition to quality standard.

E. Preconstruction Meetings: Approximately two (2) weeks before scheduled commencement of Work, meet at Project Site to coordinate construction.

1. Attendees: Architectural Woodwork Fabricator and Installer, Installer of each component of associated Work, Installers of structure or substrate to receive woodwork, Installers of other Work that must precede or follow woodwork, Design Professional and Owner's Representative.

2. Review Foreseeable Methods and Procedures:

a. Tour areas of substrates, observe and evaluate condition of substrate, and other preparatory Work.
b. Review structural loading limitations of storage and work areas.
c. Review Contract Documents.
d. Review status of Submittals.
e. Review Construction Schedule and verify availability of materials, Installer's personnel, equipment, and facilities.
f. Review environmental conditions and procedures for correcting unfavorable conditions.
g. Review applicable AWI standards for fabrication and installation.

3. Record discussions of conference, including decisions, agreements and unresolved issues. When unresolved issues exist at conclusion of conference, determine how they will be resolved and set date for reconvening conference.

1.6 Delivery, Handling And Storage

A. Delivery: Do not deliver woodwork until operations that could damage woodwork have been completed.

B. Storage: Comply with environmental condition requirements specified in Article, Project Conditions.

1. Protect from damage, moisture or other foreign matter.

2. Protect from exposed to sunlight.

1.7 Project Conditions

A. Environmental Requirements: Maintain for minimum 48 hour(s) before, installation and until Date of Substantial Completion.

1. Temperature: Between 60 and 90 degrees F

2. Relative Humidity: Maintain at permanent occupancy levels, maximum 50 percent.

3. Illumination: Permanent or temporary lighting providing similar intensity and color as approved by Design Professional.

4. Weather Enclosure: Area for Work shall be weathertight.

B. Field Measurements: Verify dimensions of adjacent construction by field measurements before fabrication.

1.8 Coordination

A. Framing, Blocking, Furring, Reinforcements, and Other Related Work: Direct installation to ensure that architectural woodwork can be supported and installed as indicated.

B. Hardware: Coordinate Finish Hardware specified in Door Hardware: Division 08. Electrical, Plumbing and other fixtures mounted within, or adjacent to woodwork. Coordinate required cut outs using manufacturer's templates and field measurements to verify actual installed locations and dimensions.

1.9 Maintenance

A. Extra Materials: Extra Materials: No extra materials are required for this project.

Part 2 Products

2.1 Materials

A. Do not use products or adhesives that contain urea-formaldehyde resin.

B. Use adhesives and sealants that comply with the VOC limits specified in Sustainability Requirements: Division 01.

C. Use field applied paints and coatings that comply with the VOC limits and chemical restrictions specified in Sustainability Requirements: Division 01.

D. General: Comply with AWI quality standard for each type of woodwork and quality grade specified.

E. Panel Manufacturers: Products of the following manufacturers are acceptable, contingent on compliance with requirements:

1. Boise Cascade.

2. CMI International.

3. The Collins Companies.

4. Columbia Forest Products.

5. Flakeboard Company.

6. Panel Source International.

7. Roseburg Forest Products.

8. SierraPine.

9. Temple Inland Forest Products.

F. Panel Products:

1. Hardboard: AHA A135.4.

2. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue with minimum 90 percent recycled and recovered wood fiber.

3. Medium Density Fiberboard (MDF): ANSI A208.2, Grade MD, exterior glue with minimum 90 percent recycled and recovered wood fiber.

4. Softwood Plywood: DOC PS 1, Medium Density Overlay.

5. Hardwood Plywood and Face Veneers: HPVA HP-1.

G. Thermoset Decorative Overlay (Melamine): Particleboard complying with ANSI A208.1, Grade M-2, or medium density fiberboard complying with ANSI A208.2, Grade MD, with surface of thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.

H. Glass: As Specified in Glazing: Division 08.

1. Clear Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Class 1, Quality q3; manufactured by horizontal (roller hearth) process, with exposed edges seamed before tempering, 3/8 thick, unless otherwise indicated.

I. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated, or if not indicated, as required by woodwork quality standard.

1. Available Manufacturers: Products of indicated manufacturers are acceptable, contingent upon meeting indicated requirements. No substitutions.

a. Formica Corporation.
b. Lamin-Art, Inc.
c. Panolam Industries International Incorporated (Nevamar).
d. Wilsonart International; Div. of Premark International, Inc.

J. Solid Surface Materials: Basis of design products are manufactured by Geos and Consentino. Similar products by Nevamar, Formica or Avonite will be considered acceptable.

K. Adhesive for Bonding Plastic Laminate: Nonstaining type recommended in writing by plastic laminate manufacturer and suitable for work indicated. Suitable for fire rated work where indicated.

2.2 Fire Retardant Treated Materials

A. General: Materials impregnated with fire retardant chemical formulations acceptable to authorities having jurisdiction.

1. Provide products with fire retardant treatment formulations that do not bleed through or otherwise adversely affect finishes.

B. Fire Retardant Treated Lumber and Plywood by Pressure Process: Comply with AWPA C20 (lumber) and AWPA C27 (plywood), Type A: Low-hygroscopic interior formulation.

1. Mill lumber before treatment unless approved in writing by authority having jurisdiction. Prevent lumber from warping, discoloration, marring, and other defects affecting appearance of treated woodwork.

2. Kiln-dry material before and after treatment to levels required for untreated material.

C. Fire Retardant Treated Lumber and Plywood by Nonpressure Process: Apply nontoxic, water soluble, fire retardant treatment by dip, spray, roller, curtain coating, vacuum chamber, or soaking to achieve flame spread rating of 25 or less and smoke developed rating of 450 or less per ASTM E 84.

D. Fire Retardant Particleboard:

1. Performance: Flame spread rating of 25 or less and smoke-developed rating of 25 or less per ASTM E 84.

2. Panels 3/4 inch thick and less: ANSI A208.1, Grade M-2 except for the following minimum properties:

a. Density: 45 pounds per cubic feet.
b. Modulus of Rupture: 1600 psi.
c. Modulus of Elasticity: 300,000 psi.
d. Internal Bond: 80 psi.
e. Screw-holding Capacity on Face and Edge: 250 lbf and 225 lbf respectively.

3. Panels 13/16 inch to 1 1/4 inches thick: ANSI A208.1, Grade M-1 except for the following minimum properties:

a. Density: 44 pounds per cubic feet.
b. Modulus of Rupture: 1300 psi.
c. Modulus of Elasticity: 250,000 psi.
d. Linear Expansion: 0.50 percent.
e. Screw-holding Capacity on Face and Edge: 250 lbf and 175 lbf respectively.

E. Fire Retardant Fiberboard: Medium density fiberboard, ANSI A208.2.

1. Performance: Flame spread rating of 25 or less and smoke developed rating of 200 or less per ASTM E 84.

2.3 Cabinet Hardware And Accessories

A. Butt Hinges: 2 3/4 five (5) knuckle steel hinges made from 0.095 inch thick metal, and as follows:

1. Semiconcealed Hinges for Flush Doors: BHMA A156.9, B01361.

2. Semiconcealed Hinges for Overlay Doors: BHMA A156.9, B01521.

B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 135 degrees of opening, self-closing. Examples of products that meet these requirements:

1. “Snap On 3000” series by Grass.

C. Back Mounted Pulls: BHMA A156.9, B02011.

D. Wire Pulls: Back mounted, Matt Stainless steel, by Hafele. 117.05.620, 117.05.680. See Drawings.

E. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081. Adjustable shelves to be finished on all sides and edges with melamine or laminate to match drawings and finish schedule.

F. Shelf Rests: BHMA A156.9, B04013.

G. Drawer Slides: Side-mounted, full-extension, zinc-plated steel drawer slides with steel ball bearings, BHMA A156.9, B05091, and rated for the following loads:

1. Box Drawer Slides: 75 lbf.

2. Trash Bin Slides: by Hafele. See Drawings.

H. Door Locks: BHMA A156.11, E07121.

I. Drawer Locks: BHMA A156.11, E07041.

J. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

1. Satin Stainless Steel: BHMA 630.

K. Concealed Hardware: Manufacturer's standard finish complying with product class requirements in BHMA A156.9.

2.4 Installation Materials

A. Furring, Blocking, Shims, and Hanging Strips: Fire retardant treated softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.

B. Anchors and Fasteners: Comply with Rough Carpentry: Division 06.

2.5 Fabrication: General

A. Woodwork Grade: AWI Premium grade, unless otherwise indicated.

B. Wood Moisture Content: Comply with AWI requirements.

C. Fabricate woodwork to dimensions, profiles, and details indicated.

D. Edges of Solid Lumber: Ease to 1/16 radius.

E. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible, before shipment to Project Site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at Project Site, provide allowance for scribing, trimming, and fitting.

1. Notify Design Professional seven (7) days in advance of dates and times woodwork fabrication will be complete.

2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.

F. Shop cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs. Seal edges of openings in countertops with a coat of varnish.

G. Install glass to comply with applicable requirements in Glazing: Division 08 and in GANA's Glazing Manual. For glass in wood frames, secure glass with removable stops.

2.6 Plastic Laminate Cabinets

A. Quality Standard: Comply with AWI Section 400 requirements for laminate cabinets.

B. AWI Type of Cabinet Construction: Flush overlay.

C. Reveal Dimension: 1/2 inch. As indicated.

D. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate:

1. Horizontal Surfaces Other Than Tops: HGS.

2. Vertical Surfaces: HGS.

3. Edges: HGS.

E. Core material for cabinet construction at wet locations to be marine grade plywood or moisture resistant medium density fiberboard.

F. Materials for Semi Exposed Surfaces:

1. Surfaces Other Than Drawer Bodies: High pressure decorative laminate, Grade VGS Drawer Sides and Backs: Thermoset decorative overlay.

2. Drawer Bottoms: Thermoset decorative overlay.

3. Drawer Sides and Backs: Thermoset decorative overlay.

G. Laminate Backing Sheet: High pressure decorative laminate, Grade VGS or Undecorated backing laminate, Grade BKL. Balance panels with backing sheet if both surfaces are not otherwise indicated for laminate.

H. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. Plastic Laminate 1, (PL-1): As scheduled.

2. Plastic Laminate 2, (PL-2): As scheduled.

3. Plastic Laminate 3, (PL-3): As scheduled.

4. Plastic Laminate 4, (PL-4): As scheduled.

I. Provide dust panels of 1/4 inch plywood or tempered hardboard above compartments and drawers, unless located directly under tops.

2.7 Plastic-Laminate Countertops

A. Quality Standard: Comply with AWI Section 400 requirements for high pressure decorative laminate countertops.

B. High-Pressure Decorative Laminate Grade: HGS.

C. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. Match Design Professional's Sample as listed on Finish schedule.

D. Core Material: Plywood.

2.8 Solid Surfacing Material Countertops

A. Quality Standard: Comply with AWI Section 400 requirements for countertops.

B. Solid Surfacing-Material Thickness: 3 cm.

C. Colors, Patterns, and Finishes: Refer to Interior Finish schedule.

D. Fabricate tops in one (1) piece with finished edges for field applied backsplashes and side splashes. Comply with solid surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.

E. Drill holes in countertops for plumbing fittings and soap dispensers in shop.

2.9 Shelving

A. Quality Standard: Comply with AWI Section 600.

B. Fabricate from panel material with veneer for opaque finish.

C. Provide solid stock for opaque finish for edge band as exposed edge.

2.10 Shop Finishing

A. Quality Standard: Comply with AWI Section 1500, unless otherwise indicated. Grade: Provide finishes of same grades as items to be finished.

B. General: Finish architectural woodwork at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

C. General: Entire finish of interior architectural woodwork is specified in this Section, regardless of whether shop applied or applied after installation. Extent to which final finish is applied at fabrication shop is Contractor's option, except shop apply at least prime coat before delivery.

D. General: Priming and finishing of interior architectural woodwork required to be performed at fabrication shop are specified in this Section. Refer to Painting: Division 09, for final finishing of installed architectural woodwork and for material and application requirements for woodwork not specified to receive final finish in this Section.

E. General: Shop finish transparent finished interior architectural woodwork at fabrication shop as specified in this Section. Refer to Painting: Division 09 for finishing opaque finished architectural woodwork.

F. Preparations for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of Work.

1. Back priming: Apply one (1) coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two (2) coats to back of paneling and to end grain surfaces. Concealed surfaces of plastic laminate-clad woodwork do not require back priming when surfaced with plastic laminate, backing paper, or thermoset decorative overlay.

Part 3 Execution

3.1 Examination

A. Project Site Verification of Conditions:

1. Substrates: Examine for conformance to requirements indicated for that substrate.

2. Existing Substrates: Examine for conditions which will adversely affect the execution of Work and which are not included in indicated repair and patching.

B. Testing: Test plaster, concrete, CMU and other masonry substrates for moisture content.

C. Conditions: Report to Construction Manager prior to commencing Work.

D. Corrections: Perform corrections as directed by Owner's Representative.

E. Acceptance: Commencing installation constitutes acceptance of substrate as suitable. Provide Work required because of installation over deficient or defective substrates at no additional cost.

3.2 Preparation

A. Condition woodwork to average prevailing Relative Humidity conditions in installation areas before installation.

B. Surface Preparation: Prepare surfaces as required to:

1. Make substrates ready for application of finish or system.

2. Make substrate suitable to provide Finished Work complying with indicated criteria and matching approved Samples.

C. Layout: For work with a consistent horizontal design element, including, but not limited to, chair rail, aligned door heads, paneling and wainscots, establish a datum line extending throughout extent of Work.

1. Datum shall be within tolerances listed for Finished Work.

2. Datum shall be used to establish field measurements for Shop Drawings and production.

3.3 Installation

A. Quality Standard: Install woodwork to comply with AWI Section 1700 for same grade indicated in this Section for type of woodwork involved.

B. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims.

C. Scribe and cut woodwork to fit adjoining work, and refinish cut surfaces and repair damaged finish at cuts.

D. Fire Retardant Treated Wood: Handle, store, and install fire retardant treated wood to comply with written recommendations of chemical treatment manufacturer, including those for adhesives used to install woodwork.

E. Anchor woodwork to substrate or blocking built in or directly attached to substrates.

1. Secure with countersunk and plugged fasteners, concealed fasteners or blind nailing.

2. Where allowed by AWI grade, use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish.

F. Work with a consistent horizontal design element, including, but not limited to, chair rail, aligned door heads, paneling and wainscots.

1. Install work in relationship to datum line indicated on Shop Drawings.

2. Trim or scribe each element of woodwork to adjacent construction to maintain alignment of horizontal design element.

G. Cabinets: Install without distortion so doors and drawers are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items.

1. Maintain veneer sequence matching of cabinets with transparent finish.

2. Fasten wall cabinets through back, near top and bottom, within 2 inches of ends and not more than 16 inches on center.

   a. Use No. 10 wafer head screws, sized for 1 inch penetration into wood framing, blocking, or hanging strips or toggle bolts.
   b. Conceal fasteners at open Premium Grade cabinets.

H. Countertops: Screw through corner blocks of base cabinets or other supports into underside of countertop.

1. Align adjacent solid-surfacing material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Dress joints smooth, remove surface scratches, and clean entire surface.

2. Secure backsplashes to walls with adhesive.

3. Scribe backsplashes at premium grade work to substrates for hairline joint without use of fillers or sealants.

4. Seal space between backsplash and wall with sealant specified in Joint Sealants: Division 07.

I. Complete finishing Work specified in this Section to extent not completed at shop or before installation of woodwork. Fill nail holes with matching filler where exposed. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats were applied in shop.

J. Finishes: Refer to Division 09 Sections for final finishing of installed architectural woodwork.

3.4 Field Quality Control

A. Tolerances:

1. General: Comply with more stringent tolerances than those listed below if required to:

   a. Match approved Sample.
   b. Align with other adjacent Work with more stringent tolerances.

2. Reference Standards: Comply with tolerances listed in AWI, Section 1700 except where more stringent requirements are indicated.

3. Level and Plumb: Maximum 1/8 inch deviation in 96 inches.

4. Line and Location: Maximum 1/8 inch deviation from ideal location or straight line in any 96 inches.

5. Variation of Gaps or Reveals:

   a. Widths less than 1/4 Plus or minus maximum 1/32 inch.
   b. Widths more than 1/4 inch and less than 3/4 inch plus or minus maximum 1/16 inch.
   c. Widths 3/4 inch and wider: Plus or minus 1/8 inch.

3.5 Adjusting And Cleaning

A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean woodwork on exposed and semi exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas as approved by Owner’s Representative.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Administrative procedures, criteria, inspection and testing and supporting work required for construction of exterior enclosure in compliance with design intent and specified criteria as follows:

1. Coordination of Exterior Enclosure Drawings.
2. Structural Criteria.
3. Mock-ups.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Inspection and Testing of Roofing and Waterproofing: Division 01.

C. Inspection and Testing of Exterior Enclosure: Division 01.

D. Technical Specification Sections for each component of exterior enclosure.

1.3 Submittals

A. Submit per the requirement of Division 01. (Mock-up Submittals.)

1. Exterior Enclosure submittals will not be reviewed without receipt of Preliminary Certification letters indicated in Sections 014570 and 014571.
2. Mock-up Submittals: Comply with submission requirements of individual technical sections required for mock-up submittals.

B. Shop Drawings:

1. Show fabrication and installation details for mock-up. Include materials, dimensions, gages, trim, fasteners, closures and finishing including all attachments to surrounding construction. Show how system complies with specified criteria including, but not limited to, accommodation of structural movement, thermal cycling and control of water penetration.
   a. Elevations: Minimum 1/4 inch equals 1 foot scale elevation of each area of curtainwall.

b. Details: Minimum 3 inches equals 1 foot scale details of each assembly including heads, sills, mullions, corners, intersection with abutting construction and joints in system.
c. Coordination Drawings: As indicated.
d. Tolerance Diagram: As indicated.

C. Product Data: Manufacturer's printed specifications for materials and fabrication and installation instructions.

D. Calculations: As indicated.

E. Quality Control Procedures: Test Reports showing compliance with specified criteria.

F. Certifications: As indicated.

1. Coordination.

2. Glass.

3. NFPA-285 tested assembly and components therein for all exterior walls.

1.4 Definitions

A. Exterior enclosure is defined as all of elements required to maintain building watertight; to moderate interior to exterior temperature, humidity, vapor pressure, to secure interior occupants and materials from exterior and other functions describe herein. Extent of exterior enclosure is indicated on Drawings and includes, but not limited to, the following:

1. Foundations and slabs-on-grade with waterproofing and insulation.

2. Horizontal structures below grade with waterproofing and insulation.

3. Exterior walls, curtainwalls and window walls.

4. Exterior doors and windows.

5. Roofing.

6. Louvers.

7. Structural elements required to support enclosure.

8. Anchors, inserts, brackets, clips and braces required to attach enclosure to structural elements.

9. Sealants, joint fillers, joint covers, gaskets, vents, weeps, flashing and trim required to close gaps in enclosure.

10. Firesafing required to close gaps between enclosure and other elements and to seal penetrations in fire rated elements of enclosure.

B. Water penetration is defined as appearance of uncontrolled water on an interior surface of any part of Work. "Controlled" water or condensation is that which is demonstrably drained harmlessly to exterior of Work without endangering or wetting adjacent surfaces and not visible in final construction.

1.5 System Requirements

A. Performance Requirements: Conform to the following requirements for design and engineering and when individual Specification Sections refer to this Specification Section.

B. Air Requirements: Air barrier shall be capable of performing as a continuous vapor-retarding air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

1. Materials used for the air barrier system in the opaque envelope shall have an air permeance not to exceed 0.004 cfm/ft^2under a pressure differential of 1.57 psf when tested in accordance with ASTM E 2178.

2. Limit air leakage through fenestration and insulated metal panel assemblies to 0.06 cfm per square foot of wall area, measured at a reference differential pressure across assembly of 6.24 psf when tested per ASTM E 283.

   a. Air leakage shall not exceed 1.0 cfm per square foot for glazed swinging entrance doors.

3. The air leakage of the entire building shall not exceed 0.15 cfm/ft^2 under a pressure differential of 1.57 psf when tested according to ASTM E 779.

C. Water Requirements: Document conformance with the following criteria through independent Testing provided by manufacturer on systems substantially identical to system proposed for this Project. Manufacturer may use previous tests if suitable and current. If previous tests are unsuitable, provide test per referenced standard.

1. Water Penetration under differential pressure: No uncontrolled penetration shall occur when the exterior wall is tested in accordance with ASTM E 331 using 5.0 gal/ft^2/hr of water for 15 minutes.

2. Water penetration under dynamic conditions: No uncontrolled water penetration through curtainwall system when tested per AAMA 501/501.1.

3. Minimum pressure for water penetration tests shall be the greater of 15 psf or 20 percent of the minimum design wind pressure specified below.

D. Thermal Movement: Provide for expansion and contraction of component materials, as caused by an exterior ambient temperature ranging from minus 5 degrees F to a surface temperature of 180 degrees F, an interior temperature range of plus 50 degrees F to plus 100 degrees F, and an interior to exterior differential of 100 degrees F without causing buckling, excessive stresses, failure of joint seals, undue stress on structural elements, damaging loads on fasteners, reduction of performance, other detrimental effects or excessive condensation.

1. Show amount of accommodated thermal movement in Shop Drawings, and provide thermal calculations.

2. Identify assumed temperature at fabrication versus temperature at installation and how design compensates.

3. Show how thermal movement of interconnected systems is accommodated.

E. Movement of Structure: Accommodate the following structure movements:

1. Floor-To-Floor Differential Movements:

Deflection above exterior walls:

At second floor line: 3/4" (CLT), ½" (Glulam Beams).

And roof line: 1" (CLT), ¼" (Glulam Beams; beams bear on exterior walls except grid 8.5).

2. Show amount of movement accommodated on Shop Drawings.

F. Design Loads:

1. Dead Loads: Self-weight of elements and attached finishes.

2. Roof Loads: As indicated on Drawings.

3. Minimum design wind pressures acting normal to the surface of Work shall be calculated per the 2012 North Carolina Building Code and ASCE 7-05, utilizing the wind parameters provided on the Structural Drawings.

4. Seismic Loads:

a. Seismic forces shall be determined in accordance with the 2012 North Carolina Building Code and ASCE 7-05 and applied at centers of gravity of elements and distributed relative to the distribution of mass.
b. The force shall be applied independently longitudinally and laterally in combination with other loads associated with the element. Combine horizontal and vertical load effects.
c. Seismic loads shall be resisted by positive anchorage and not by friction.

G. Structural Requirements at Design Load:

1. Deflection of framing members in a direction normal to plane of wall when subjected to design loads shall not exceed the lesser of L/360 (L is the clear span of the member) or 1 inch, except as follows:

   a. Cantilever Deflection: Where framing members overhang an anchor point the member span (L) used to determine the maximum allowable deflection may be considered to be two times the actual span.
   b. Masonry Set In Mortar: Limit deflection of members supporting masonry set in mortar to the lesser of L/600.
   c. Metal Panels: Limit deflection of members supporting metal panels only to L/180.
   d. Metal Panels and Gypsum Drywall Construction: Limit deflection of members supporting metal panels and gypsum drywall construction to L/240.
   e. Glass: Limit deflection of framing members supporting glass to the following:

      1) L/175 for spans up to 13 feet 6 inches and L/240 plus 1/4 inch for spans greater than 13 feet 6 inches.

      2) The deflection of the edge of each individual pane of glass shall not exceed the lesser of L/175 (L is the glass edge length) or 3/4 inch.

2. Deflection of framing members parallel to plane of wall when subject to design loads shall not exceed the lesser of L/360 (L is the clear span of the member) or 3/4 inch, except as follows:

   a. Cantilever Deflection: Where framing members overhang an anchor point the member span (L) used to determine the maximum allowable deflection may be considered to be two times the actual span.
   b. Members Supporting Glazing: Limit deflection to the following:

      1) An amount which reduces glazing bite to less than 75 percent of design dimension.

      2) An amount which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch.

      3) Deflection shall not impair function of or damage any joint seals when deflected.

3. Deflection of panels and glazing normal to plane of wall when subject to design loads shall not exceed the following:

   a. Sheet, Plate, Brake Metal, Composite Materials or other similar exposed metal or metal clad panel surfaces: Limit deflection normal to its plane at full design load to lesser of L/180 (L is the least face dimension) or a lesser amount as required to eliminate oil canning visible from more than 3 feet under any lighting conditions.
   b. Glazing: Limit center of glass deflection normal to its plane at full design load to lesser of L/100 (L is the least edge dimension) or 3/4 inch Manufacturer shall certify that design deflection does not cause undue pressure in glass as placed and designed.

4. Limit deflection as required to not adversely affect performance for water penetration, air leakage and other similar specified criteria.

5. Where various exterior enclosure systems are interconnected, design all systems for the most restrictive individual system deflection criteria or provide for adequate flexibility within the connections to allow differential deflection without adversely affecting any of the connected systems.

6. Stresses shall not exceed allowable values established by applicable Codes and Specifications.

7. Glass, sealants, and interior finishes, including gypsum wallboard, shall not be assumed to contribute to framing member strength, stiffness, or lateral stability.

8. Compression flanges of flexural members may be assumed to receive effective lateral bracing only from members in actual contact with compression flange and adequately anchored to building structure. Points of contraflexure shall not be regarded as lateral braces or as end points of an unbraced length; unbraced length shall be the actual distance between effective lateral braces as defined above.

9. All exterior walls utilizing foam plastics shall be tested approved NFPA285 assemblies and components therein. Type X gypsum board to be utilize on the interior side of all exterior walls in these instances.

1.6 Quality Assurance

A. Mock-up: Construct a mock-up as follows:

1. Extent: A minimum size 5'x7' mock-up (see drawings) including all exterior skin components in a location to be designated. If approved, Project mock-up may remain in place as part of Finished Work. If rejected, remove and provide new mock-up. Repeat as required until approval is given. Do not begin fabrication until Project mock-up is approved.

2. Intent: Mock-up shall establish acceptable levels of craftsmanship, quality and appearance.

3. Location: On Project Site at location directed by Design Professional.

4. Submittals: Obtain approvals of mock-up submittals prior to construction of mock-up.

5. Maintain mock-up until all Work included in mock-up has been completed.

6. Obtain Design Professional's acceptance of mock-up. Revise, repair, replace or rebuild mock-up as required to meet design intent and specified performance.

7. Upon completion of Work included in mock-up, but not later than Date of Substantial Completion, demolish mock-up, legally dispose of materials off Project Site as indicated for Final Work.

8. Construction Photographs: Document entire construction of mock-up with photographs taken at a rate of approximately 24 per eight hour workday. Pay particular attention to details and difficult assemblies.

B. Coordination: Contractor shall coordinate Work specified in individual Specification Sections that is required to complete exterior enclosure.

1. Coordination Drawings: Prepare and submit for approval Coordination Drawings wherever submittals required in individual Specification Sections do not adequately describe how finished Work is to be coordinated. Mock-up Drawings may be used for Coordination Drawings to extent of situations covered, but additional Coordination Drawings shall be provided as required. Coordination Drawings shall include, but not limited to, the following:

    a. Continuity Details: Show how provisions for control of water and vapor penetration are maintained across, for example, multiple materials, assemblies and systems.
    b. Show exact relationships of elements.
    c. Show method of support or anchorage.
    d. Show loads imposed on one element by another.

2. Tolerance Diagram: Single line plans, sections and elevations indicating maximum allowable deviations from design location for structure and enclosure. Use diagram to verify required space for adjustment in installing enclosure.

3. Certifications: Submit certification from all manufacturers involved for appropriateness and compatibility of their products for uses indicated. Certifications shall address, but not be limited to, the following criteria:

    a. Compatibility of materials and product which are in contact.
    b. Isolation of dissimilar metals to avoid electrolytic action.
    c. Compatibility of adhesives with substrates.
    d. Compatibility of sealants with substrates.
    e. Compatibility of sealants with other sealants which may come into contact.
    f. Isolation or compatibility of pressure treated wood with adjacent materials.

C. Coordination Meeting: Convene a meeting to coordinate Work related to exterior enclosure.

1. Schedule meeting prior to submittals for any significant portion of exterior enclosure.

2. Location of Meeting: Project Field Office of Contractor.

    a. Conduct meeting per requirements of Division 01.
    b. Notify Owner’s Representative and Design Professional minimum one week in advance.

3. Attendance:

    a. Owner's Representative.
    b. Design Professional's Representative.
    c. Contractor's Representative.
    d. Subcontractors and installers of exterior enclosure work.
    e. Subcontractors and installers of substrates to which exterior enclosure work is applied.
    f. Suppliers of materials for exterior enclosure work.
    g. Manufacturer’s Technical Representatives for exterior enclosure work as indicated in individual Specification Sections.
    h. Others as appropriate.

4. Suggested Agenda related to exterior enclosure and mock-ups:

    a. Review requirements of Drawings and Specifications related to exterior enclosure.
    b. Review of progress of Submittals.
    c. Field observations, problems, conflicts anticipated.
    d. Review of off Project Site fabrication, Delivery Schedules.
    e. Coordination of schedules, deliveries and long lead items.
    f. Review and coordinate interface of different systems.
    g. Review and coordinate relationship of tolerances of different systems.
    h. Maintenance of quality standards.
    i. Review effect on portions of Work.
    j. Other business.

D. Exterior Enclosure Erection Plan: Prepare a plan describing means and methods to erect the exterior enclosure. Include the following.

1. Means and methods to accommodate expansion and contraction of structural frame from time of erection until operation of permanent HVAC system.

2. Means and methods to maintain specified tolerances for exterior enclosure Work accounting for movement and deflection of structural frame.

3. Sequencing and Scheduling.

4. Periodically survey, minimum once per week, the structural steel to anticipate means and methods required at time of erection of exterior enclosure.

5. Coordinate with erection plan indicated for AESS.

E. Preinstallation Meeting: Prior to start of Work for any individual product or system, Contractor shall hold a Preinstallation Meeting with all concerned parties, including parties who will later incorporate new Work into Work for which Preinstallation Meeting is held.

1. Conduct meeting per requirements of Division 01.

2. Notify Owner's Representative and Design Professional minimum one week in advance.

3. Hold a Preinstallation Meeting prior to starting mock-up work.

1.7 Sequencing

A. Sequence Work of exterior enclosure to ensure proper completion of water, air and vapor barriers prior to being covered by subsequent Work and to allow installation of Work as required to conform to design intent and specified criteria.

1.8 Scheduling

A. Schedule Work to allow for:

1. Submissions, and resubmissions of pre-qualification data and required data for mock-up.

2. Construction of mock-up.

3. Testing of mock-up.

4. Modifications and retesting of mock-up.

5. Approval of mock-up.

6. Submittals, resubmittals and approval of required data.

7. Submittals, resubmittals and approval of coordination data.

B. Submittals for Work which is contained within the mock-up will not be reviewed prior to approval of mock-up.

Part 2 Products

2.1 Materials

A. Materials, products, equipment, systems, accessories for mock-up shall match materials, products, equipment, systems, accessories specified for Final Work.

Part 3 Execution

3.1 Erection Of Mock-up

A. Erect mock-up per approved submittals.

B. Notify Owner and Design Professional minimum one week in advance of start of Work on mock-up and minimum 48 hours in advance of commencing Work on any important or large component of mock-up, for example, masonry veneer, storefront, and curtainwall.

1. For other systems, await further written instructions from Owner's Representative and Design Professional.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Membrane waterproofing, including all accessories and protective materials, for the following applications, and at other conditions indicated: where indicated.

1. All vertical surfaces below grade, such as, but not limited to elevator pit.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Inspection and Testing Services: Division 01.

C. Inspection and Testing of Roofing and Waterproofing: Division 01.

D. Concrete: Division 03.

E. Exterior Enclosure, General: Division 07.

F. Thermal Insulation: Division 07.

G. Earth Moving: Division 31.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Shop Drawings: Show installation details for each condition.

C. Product Data: Manufacturer's data and written installation instruction specific to this Project.

D. Closeout Submittals: Special Warranty as specified herein.

E. Sustainability Submittals: Provide the following in accordance with Sustainability Requirements: Division 01.

1. Materials Sustainability Documentation Form.

2. Product data, certification letter, and costs for materials with recycled content.

3. Product data and costs for regional materials.

4. Product data for adhesives and sealants indicating VOC content.

5. Product data for paints and coatings indicating VOC content and chemical composition.

1.4 Quality Assurance

A. Manufacturer Qualifications: Firm shall have minimum five (5) years experience in manufacturing waterproofing system as indicated for this Project and shall have a record of successful in-service performance.

B. Installer's Qualifications: Engage an installer with minimum five (5) years experience who has specialized in installing waterproofing systems as required for this Project and who is licensed by or otherwise acceptable in writing to manufacturer of primary materials.

C. Single Source Responsibility: Obtain entire waterproofing system from a single manufacturer. Obtain accessory products used in conjunction with waterproofing from sources acceptable in writing to waterproofing manufacturer.

D. Preinstallation Conference: Approximately two (2) weeks prior to scheduled commencement of waterproofing installation, meet at Project Site with waterproofing installer, preparer of substrate to receive waterproofing, installers of other work in and around waterproofing that must precede, follow or penetrate waterproofing (including mechanical and electrical installers as applicable), Design Professional, Owner and waterproofing manufacturer's representative to review materials, procedures, schedules and other requirements and conditions related to installing waterproofing system.

1. Coordinate conference with subdrainage system conference.

E. Reference Codes and Standards: Comply with the following in accordance with Division 01.

1. National Roofing Contractors of America (NRCA)

Roofing and Waterproofing Manual.

F. Independent Inspection: Services of an independent Inspection and Testing Agency are required for this Work. Refer to Division 01.

1.5 Delivery, Handling And Storage

A. General: Comply with manufacturer's written recommendations.

B. Deliver materials to Project Site in manufacturer's original unopened containers.

C. Store materials in a dry, well-ventilated space supported off the ground.

D. Remove and replace waterproofing system materials that have been prematurely exposed to moisture.

1.6 Project Conditions

A. Environmental Requirements: Do not apply waterproofing materials to surfaces on which ice or frost is visible. Do not apply waterproofing materials in areas with standing water.

B. Comply with manufacturer's written recommendations regarding weather conditions before and during installation, condition of substrate to receive waterproofing and protection of installed waterproofing system.

1.7 Coordination

A. Coordinate waterproofing work with remainder of Project per Exterior Enclosure, General: Division 07.

1.8 Special Warranty

A. Furnish a written Warranty that waterproofing shall be watertight for five (5) years from Date of Substantial Completion and that, should leakage occur during Warranty Period, it shall be repaired at no additional cost.

Part 2 Products

2.1 General

A. Use adhesives and sealants that comply with the VOC limits specified in Sustainability Requirements: Division 01.

B. Use paints and coatings that comply with the VOC limits and chemical restrictions specified in Sustainability Requirements: Division 01.

2.2 Membrane

A. Self-adhering membrane of rubberized asphalt integrally bonded to polyethylene sheeting, formed into uniform flexible sheets of not less than 56 mils thick, complying with the following:

1. Tensile Strength: 250 psi minimum; ASTM D 412.
2. Ultimate Elongation: 300 percent minimum; ASTM D 412.
3. Pliability Temperature: Minus 25 degrees FASTM D 146.
4. Hydrostatic Head Resistance: 150 feet minimum; ASTM D 5385.
5. Water Absorption: Not more than 0.1 percent weight gain after 48 hours of water immersion at 70 degrees F; ASTM D 570.

B. Pre-applied Waterproofing for blind side applications shall be Preprufe 160R by W.R. Grace & Co. or approved equal.

C. Approved Products/Manufacturers: The following products and manufacturers are specified to establish desired quality and performance of Work. Other products will be considered as substitutions as specified in Division 01.

1. "Bituthene"; W. R. Grace & Co.

2. "Duramem 700-SM"; Pecora Corporation.

3. "MEL-ROL"; W. R. Meadows, Inc.

4. "Polyguard 650"; Polyguard Products, Inc.

2.3 Auxiliary Materials

A. Provide fillets, primer, mastic termination bars, sealant and joint tapes of types recommended in writing by membrane manufacturer.

B. Drainage Matting: Composite mat consisting of three-dimensional drainage core with a protective sheet bonded to back of core and a geotextile filter fabric.

1. Vertical Applications:

a. Minimum Compressive Strength: 15,000 psi per ASTM D 1621.
b. Product: Aquadrain 15XP by CETCO or equivalent acceptable to waterproofing manufacturer.

2. Horizontal Applications:

a. Minimum Compressive Strength: 20,000 psi per ASTM D 1621.
b. Product: Aquadrain 20H by CETCO or equivalent.

3. Filter Fabric: As recommended in writing by manufacturer based on analysis of proposed backfill materials.

2.4 Protection Course

A. Protection Board: 1/8 inch thick, Type PC-2 by W. R. Meadows, Inc., York, Pennsylvania, 1/8 inch thick "Elastibord" by the Celotex Corporation, 1/4 inch thick "Amocor PB4" by Amoco Foam Products or as recommended in writing by membrane manufacturer.

B. Insulation: 2 inch thick extruded polystyrene insulation as specified in Thermal Insulation: Division 07.

C. Adhesives for applying protection course shall be approved in writing by both membrane and insulation manufacturer.

Part 3 Execution

3.1 Examination

A. Examine substrate and identify defects or deficiencies which must be corrected prior to starting Work.

B. Ensure defects or deficiencies in substrate have been corrected. Substrate shall meet membrane manufacturer's written recommendations.

C. Ensure substrate is clean, dry, smooth, free of fins, sharp edges, oil and grease.

3.2 Preparation

A. Remove loose and foreign materials.

B. Protect adjacent surfaces from stains or soiling caused by application of waterproofing.

C. Prime surfaces in accordance with membrane manufacturer's written instructions.

D. Complete Sealant Work required in joints within walls indicated to receive waterproofing before applying waterproofing.

3.3 Membrane Installation

A. Install membrane in accordance with manufacturer's written instructions.

B. Seal all penetrations through membrane to ensure watertight installation.

C. Terminate membrane as indicated or required and seal edge with sealant.

D. Coordinate Work of this Section with contiguous Work of other Sections and/or Contracts involved. Coordinate penetrations of waterproofing and comply with waterproofing manufacturer’s written instructions and warranty requirements.

3.4 Protection Course Installation

A. Install protection course over waterproofing. Butt edges tightly. Adhere protection course to vertical surfaces with adhesive in accordance with manufacturer's written instructions. Tape or otherwise seal joints as required by waterproofing manufacturer for specified Warranty.

3.5 Drainage Mat

A. Install drainage matting using mechanical fasteners in compliance with manufacturer’s written instructions.

B. Coordinate installation of drainage matting with backfilling against structure to achieve immediate backfilling once matting is installed.

3.6 Insulation

A. Coordinate installation of insulation specified in Thermal Insulation: Division 07.

3.7 Field Quality Control

A. Manufacturer’s Representative shall be on Project Site to inspect substrate during initial application procedures for each waterproofing condition and periodically during course of Work. Manufacturer’s Representative shall inspect waterproofing prior to being covered with protection boards, insulation or drainage mat.

B. Installer shall cooperate with Owner’s independent Inspection and Testing Agency.

C. Flood Test:

1. Flood test waterproofing on horizontal surfaces over interior spaces.

2. Do no test until areas have been completed for minimum 48 hours. Advise Design Professional 48 hours prior to testing.

3. Prior to installing protection course, temporarily close-off all points of drainage and flood area with water 2 inches deep.

4. Maintain water level for 72 hours and check for leaks. If leakage is discovered, drain water, allow area to thoroughly dry, repair leaks, wait minimum 24 hours and retest as specified above.

5. When test proves areas to be watertight, drain water and proceed with construction.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Thermal insulation for the following applications:

1. Foundation wall insulation supporting backfill.
2. Insulation in masonry cavity walls.
3. Board-type, blanket-type, and loose glass fiber building insulation not specified in other Sections.

B. Where so specified in other Sections, requirements of this Section apply to Work of such other Sections.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Unit Masonry: Division 04.

C. Air/Vapor Barriers: Division 07.

D. Waterproofing: Division 07, refer to for insulation used as protection course.

E. Roofing: Division 07, refer to for roof and deck insulation.

F. Exterior Enclosure, General: Division 07.

G. Gypsum Board Assemblies: Division 09, refer to for sound attenuation insulation and metal framing for gypsum wallboard.

H. Mechanical: Division 23, refer to for insulation of mechanical systems.

1.3 Submittals

A. Submit per requirements of Division 01.

B. Product Data: For each component or material required including accessories, anchors, and other miscellaneous products.

C. Sustainability Submittals: Provide the following in accordance with Sustainability Requirements: Division 01.

1. Materials Sustainability Documentation Form.

2. Product data, certification letter, and costs for materials with recycled content.

3. Product data and costs for regional materials.

4. Product data for adhesives and sealants indicating VOC content.

5. Product data for paints and coatings indicating VOC content and chemical composition.

1.4 Quality Assurance

A. Source Limitations: Obtain each type of building insulation through one (1) source.

B. Fire-Test-Response Characteristics: Provide insulation and related materials with fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another Inspection and Testing Agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable Inspection and Testing Agency.

1. Surface-Burning Characteristics: ASTM E 84.

2. Fire-Resistance Ratings: ASTM E 119.

3. Combustion Characteristics: ASTM E 136.

1.5 Delivery, Handling And Storage

A. Comply with manufacturer's written recommendations, including recommendations for temperature and humidity range. Do not allow insulation to become wet or damp.

Part 2 Products

2.1 General

A. Provide recycled content materials in accordance with Sustainability Action Plan specified in Sustainability Requirements: Division 01 and as indicated below.

B. Do not use products or adhesives that contain urea-formaldehyde resin.

C. Use adhesives and sealants that comply with the VOC limits specified in Sustainability Requirements: Division 01.

D. Insulation shall not be produced with or contain any U.S. EPA regulated CFC Compounds listed in Montreal Protocol.

2.2 Rigid Insulation

A. Polystyrene: ASTM C 578, extruded only except where expanded polystyrene is indicated, of type indicated.

1. Vertical Below Grade Applications: Type VI.

2. Below Slabs-On-Grade: Type VI.

3. All Other Applications, Unless Otherwise Indicated: Type IV.

4. Thermal Conductivity: 5 year aged R-value of 5.4 and 5 per inch at 40 degrees F and 75 degrees F respectively. 2 inch thickness.

5. Surface Burning Characteristics: Maximum Flame spread of 75 and smoke developed of 450 per ASTM E 84.

6. Edge Shape: Square.

7. HCFC Content: None.

8. Recycled Content: 15 percent minimum.

2.3 Semi-Rigid Insulation

A. Mineral Fiber Insulation: Semi-rigid boards complying with ASTM C 612, approved for use in rainscreen cavity application. Basis of design: Roxul Cavityrock Dual Density , (Others: Fibrx or Thermafiber)

1. Fiber Type: Manufactured from Slag, glass fiber not acceptable.

2. Thickness: R-value of 4.3 per inch. 3 inch thickness.

3. Surface Burning Characteristics:

a. Faced with black mat facer: Maximum flame spread 25 and smoke developed of 50 per ASTM E 84.

4. Facing: faced at exterior walls and as indicated.

5. Recycled Content: 75 percent minimum.

2.4 Blanket/Batt Insulation – Interior Only

A. Interior only - Mineral Fiber Insulation: Thermal insulation produced by combining semi-refactory mineral fibers with thermosetting resin binders, ASTM C 665, Type I, unfaced and Type III, Class A, FRK faced as required.

1. Formaldehyde Content: None.

2. Recycled Content: 20 percent minimum.

B. Fiber Type: Manufactured from Glass.

C. Thermal Conductivity: R-value of 11 for 3 1/2 inch thick material; and 19 for 6 inch thick material.

D. Surface Burning Characteristics: Maximum flame spread 25 and smoke developed of 50 per ASTM E 84.

E. Facing: Unfaced.

2.5 Auxiliary Materials

A. Adhesive: Type recommended in writing by insulation manufacturer and Air/Vapor Barrier specified elsewhere in Division 07.

B. Rigid Insulation Sealing Mastic as component of complete tested NFPA 285 assembly: Henry Bakor Air-Bloc 21 or 230-21 or use insulation adhesive if acceptable to adhesive manufacturer.

C. Rigid Insulation Joint Sealant:

1. Great Stuff Pro by Dow Chemical Company.

2. Pur Fill 1G by Todol Products.

3. Zerodraft Foam Sealant by the Zerodraft Division of Canam Building Envelope Specialists.

D. Furring: Refer to Gypsum Board Assemblies: Division 09.

E. Mechanical Anchors: Type and size as recommended in writing by insulation manufacturer for type of application and condition of substrate.

F. Tape: As recommended in writing by insulation manufacturer for maintaining continuity of vapor retarder.

Part 3 Execution

3.1 Examination

A. Project Site Verification of Conditions:

1. Examine substrates to which insulation shall be applied for suitability and conformance to specified tolerances.

2. Report deficiencies to Construction Manager prior to commencing Work.

3. Commencing Work constitutes acceptance of substrate. Perform future work required because of deficient substrates no additional cost.

3.2 Preparation

A. Clean substrates of substances harmful to adhesives, insulations or facings. Remove projections that might puncture facings.

3.3 Installation: General

A. Comply with manufacturer's written instructions for each condition.

B. Extend insulation full thickness as indicated over entire area to be insulated.

C. Apply insulation in single thickness, unless otherwise indicated.

D. Cut insulation with a saw, knife or other sharp tool, to fit snugly around obstructions including vents, pipe and conduit. Butt boards tightly together.

E. Faced Insulation:

1. Set vapor retarder faced units with vapor retarder to artificially heated side of construction.

2. Install vapor retarder per approved submittals and additional written instructions from manufacturer as required.

3. Coordinate installation with supplemental vapor retarder materials specified in Air/Vapor Barriers: Division 07.

4. Vapor retarder shall form a continuous envelope around conditioned spaces.

a. Seal perimeter of each type of vapor retarder to adjacent vapor retarder or to intervening vapor impermeable materials.
b. Seal all penetrations to vapor impermeable materials.
c. Vapor impermeable materials shall be metal or other materials with a perm rating of less than one (1).
d. When sealing vapor retarders to other vapor impermeable materials, seal joints in vapor impermeable material using mastics, sealants, tapes and sheets as recommended in writing by manufacturer.

3.4 Installation Of Rigid Insulation

A. Perimeter Foundation Insulation:

1. Foundation Walls:

a. Apply insulation board to inside face of foundation walls with adhesive, using either spot or ribbon method.

OR

b. Apply insulation board directly to waterproofing and cover with drainage matting at foundation walls. Hold in place until backfilled.
c. Extend board from underside of floor slab to minimum 24 inches below final exterior grade, unless otherwise indicated.

B. Cavity Wall Insulation:

1. Install insulation within cavity space tightly against inner wythe or back-up wall.

2. Secure insulation in place with adjustable wall ties, stick pins or adhesive.

a. Installation methods not utilizing full adhesive coverage: Continuously butter the edges of the insulation boards using rigid insulation sealing mastic as required to seal all joints and penetrations.

C. Gaps in Vertical Applications: Seal gaps larger than 1/8 inch with mastic or sealant.

3.5 Installation Of Blanket Insulation

A. On suspended ceilings, place insulation with long dimension of insulation parallel to metal furring.

B. On vertical framing, place insulation between framing members and mechanically secure it to framing.

C. Where insulation is suspended, provide mechanically attached galvanized wire mesh.

3.6 Protection

A. Protect insulation from damage due to harmful weather exposure, physical abuse or other causes.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes:

1. Membranes and accessories required for controlling air and water penetration and vapor diffusion in exterior walls, parapets, soffits and where otherwise indicated.

2. Materials and installation to bridge and seal all air leakage pathways and gaps in the exterior enclosure, including but not limited to the following:

a. Connections of the wall to the roof air/vapor barrier.
b. Connections of the wall to foundation air/vapor barriers.
c. Control joints, expansion joints, and other joints in the building to accomodate movement.
d. Joints between wall assemblies and frames for windows, doors, storefront and curtainwall.
e. Joints between various wall assemblies.
f. Piping, conduit, duct and similar penetrations.
g. Ties, screws, anchors, bolts, attachment plates, and similar penetrations.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Cast-In-Place Concrete: Division 03.

C. Unit Masonry: Division 04.

D. Sheathing: Division 06.

E. Exterior Enclosure, General: Division 07.

F. Thermal Insulation: Division 07.

G. Waterproofing and Roofing: Division 07.

H. Flashing and Sheet Metal: Division 07.

I. Aluminum Entrances and Storefronts: Division 08.

J. Glazed Aluminum Curtainwall: Division 08.

K. Gypsum Board Assemblies: Division 09.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Shop Drawings: Show location and extent of air/vapor barrier and details of joints, intersections, transitions, and bridging of gaps. Show provisions for conformance with indicated criteria.

1. Conform with requirements for Coordination Drawings showing continuity of air/vapor barrier per Exterior Enclosure, General: Division 07.

2. Plans and Elevations: Minimum 1/4 inch equals 1 foot scale.

3. Details: Minimum 3 inch equals 1 foot scale. Show each layer of material required.

C. Product Data: For each component or material required, including accessories, anchors, and other miscellaneous products, also include written installation instructions.

D. Qualifications: Manufacturer's and Installer's qualification data.

E. Quality Control Procedures: Show compliance with indicated criteria.

1. Quality Control Plan.

2. Substrate Acceptance Letters.

3. Field Test Procedures.

4. Daily Field Inspection and Test Reports: Within one (1) day after inspection.

5. Manufacturer's Field Reports: Within one (1) week after inspection.

F. Certifications: Written certification letters where indicated.

G. Sustainability Submittals: Provide the following in accordance with Sustainability Requirements: Division 01.

1. Materials Sustainability Documentation Form.

2. Product data, certification letter, and costs for materials with recycled content.

3. Product data and costs for regional materials.

4. Product data for adhesives and sealants indicating VOC content.

5. Product data for paints and coatings indicating VOC content and chemical composition.

1.4 Quality Assurance

A. Manufacturer's Qualification: Manufacturer shall have minimum five (5) years experience producing products similar to those required for this Project. Manufacturer shall have documented experience of successfully providing products for three (3) Projects of scope, schedule and complexity similar to this Project within last two (2) years.

1. Company marketing primary products specified for this Section shall also be manufacturer. Companies marketing products which are manufactured by third parties for private labeling by marketing company will not be allowed.

2. Submit qualifications on manufacturer's letterhead. Include project descriptions with Owner and Design Professional contacts for previous experience.

B. Installer's Qualifications: Installers shall be officially recognized during bidding and installation as a Licensed Contractor by the Air Barrier Association of America (ABAA).

C. Installer's Qualifications: Installers shall demonstrate sufficient qualifications as acceptable to Design Professional including but not limited to the following:

1. Installer shall have minimum five (5) years experience installing products similar to those required for this Project.

2. Installer shall have documented experience of successfully completing three (3) Projects of scope, schedule and complexity similar to this Project within last two (2) years. Submit qualifications on Installer's letterhead. Include project descriptions with Owner and Design Professional contacts for previous experience.

D. Single Source Requirements: Primary products required for Work of this Section shall be supplied by one (1) manufacturer. Accessory products including, for example, fasteners, sealants and anchors may be from other than primary manufacturer if approved in writing by primary manufacturer.

E. Regulatory Requirements: Comply with combustibility rating for exposed materials as required by building codes in accordance with Division 01.

F. Referenced Codes and Standards: Comply with the following in accordance with Division 01.

1. Sealant, Waterproofing and Restoration Institute (SWRI)

Sealant and Caulking Guide Specifications

G. Certifications: Manufacturer shall certify in writing the following:

1. Use and Compatibility Certification: Certify that materials are appropriate for indicated use and that substrates and adjacent materials are compatible.

2. Certify installer qualifications.

3. Certify single source responsibility.

4. Certify acceptance of products manufactured by Others.

H. Field Samples:

1. Construct a Field Sample high as indicated on Drawings at location by Design Professional.

2. Obtain Design Professional's written approval prior to continuing with Work.

3. Approved Field Sample may be incorporated into Final Work.

I. Mock-ups: Provide air/vapor barrier materials required for mock-up specified in Exterior Enclosure, General: Division 07.

J. Field Quality Assurance: Implement the ABAA Quality Assurance Program requirements. Cooperate with ABAA inspectors.

K. Installer's Quality Control Program: Installer shall establish a quality control program to ensure compliance with requirements. Submit plan for approval by Design Professional. Installer's existing quality control program may be acceptable if all requirements listed below are met.

1. Document each aspect of quality control plan, including statistical data regarding compliance to tolerances. Plan shall include names of approved inspectors who shall initial each quality control inspection or check. Include qualifications of inspectors.

2. Program shall include procedures which provide for the following:

a. Installers inspection and checking at each phase of Work including, but not limited to, checking of the following to assure compliance with Contract Documents, submittals and as required to match approved Samples and Shop Drawings.

1) Raw materials upon delivery.

2) Shipping, storage and handling of raw materials.

3) Substrates and structures to which air/vapor barrier is installed.

4) Each phase of installation.

b. Substrate Acceptance Letters: At start of installation or each portion thereof, Installers shall examine substrate and adjacent construction and certify acceptance as indicated.

c. Daily Field Inspection and Test Reports: Prepare a detailed report for each day air/vapor barrier work is being installed on Project Site, describing Work accomplished, condition of stored materials, environmental conditions, number of workers, general progress of Work, condition of substrates and adjacent construction, results of tests conducted, any deficiencies which had to be corrected or still require correction and deficiencies which have been corrected.

d. Manufacturer's Field Reports: As indicated.

e. Installers testing of assemblies in field.

1) Once per day during installation of air/vapor barrier test membrane for adhesion at random locations. Locations may be directed by Design Professional.

2) Once per day during installation of air/vapor barrier test membrane, perform air leakage tests around ties, anchors or other penetrations at random locations per ASTM E 1186, Chamber Depressurization with Detection Liquid. Locations may be directed by Design Professional.

L. Preinstallation Meetings: Convene one (1) week prior to commencing Work of this Section per Division 01.

M. Inspection and Testing: Services of an Inspection and Testing Agency are required in conjunction with Work of this Section. Refer to Division 01. Air barrier will be inspected by Inspection and Testing Agency immediately prior to being covered by subsequent construction. Notify agency 48 hours in advance of commencement of Work that covers air barriers.

1.5 Delivery, Handling And Storage

A. Shipping: Deliver in manufacturer's original labeled, undamaged containers.

B. Handling, Storage and Protection: Store off ground, out of weather and protected from excessive heat or cold.

1.6 Project Conditions

A. Environmental Requirements: Comply with manufacturer's written recommendations for surface and weather conditions. Do not apply air/vapor barrier in snow, rain, fog or mist.

1.7 Sequencing

A. Sequence Work to permit installation of materials in conjunction with other vapor retardant materials and seals.

1.8 Special Warranty

A. General: Special Warranty shall not deprive Government of rights under other provisions of Contract and shall be in addition to, and run concurrent with, other Warranties made by Contractor under requirements of Contract Documents.

B. Special Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of air/vapor barrier that fail in materials or workmanship or fail to perform in accordance with specified criteria within specified Warranty Period including but not limited to loss of adhesion/cohesion, failure to cure, gaps, or failure to achieve an airtight and waterproof seal.

1. Specified Warranty Period: Three (3) years from Date of Substantial Completion.

2. System Includes: Primary membrane and seals to adjacent systems as indicated.

Part 2 Products

2.1 Manufacturers

A. Products of indicated manufacturers are acceptable, contingent upon meeting specified requirements. No substitutions.

2.2 Products

A. Use adhesives and sealants that comply with the VOC limits specified in Sustainability Requirements: Division 01.

B. Use coatings that comply with the VOC limits and chemical restrictions specified in Sustainability Requirements: Division 01.

C. Subject to compliance with indicated requirements, Contractor may choose a self-adhering sheet system or a fluid applied system. Where a manufacturer's product line is indicated, select the product from the full line that complies with indicated requirements. Provide compatible flashing and accessories required to comply with indicated requirements.

1. System shall provide an air tight, waterproof, and vapor permeable barrier.

2. Air Permeability: Maximum 0.004 cubic feet per minute per square foot under a differential pressure of 1.57 psf when tested in accordance with ASTM E 2178.

    a. Resistance to Gust Wind Load: No increase in air leakage at a differential pressure of 60 psf maintained for 5 seconds.
    b. Resistance to Peak Wind Load: No increase in air leakage at a differential pressure of 20 psf maintained for one hour.

3. Vapor Permeance: minimum 10 perms per ASTM E 96.

4. Additional Performance Criteria: Capable to perform to criteria indicated for exterior enclosure assemblies in Exterior Enclosure, General: Division 07.

D. Membrane:

1. Vapor Permeable Fluid-Applied Air/Vapor Barrier as component of complete tested NFPA 285 assembly: Single-component, elastomeric bitumen liquid which cures to a monolithic, rubberlike membrane, minimum 10 perms.

    a. Basis of Design - Air-Bloc by Henry 31MR.
    b. Perm-a-Barrier VP Liquid by W.R. Grace.
    c. ExoAir 230 by Tremco.

E. Membrane Flashing Sheets:

1. Self-Adhering flashing sheets: SBS-modified asphalt sheet with glass reinforcing scrim, minimum 40 mils, minimum 10 perms.

   a. Blueskin by Henry.
   b. Perm-A-Barrier by W.R. Grace.
   c. ExoAir by Tremco.
   d. Proglaze ETA by Tremco.

2. Self-supporting Flashing Sheets: Uncured neoprene complying with ASTM D 200, Designation 2BC415 to 3BC620, 50 to 65 mils thick.

3. Silicone Flashing Sheets: Pre-cured low-modulus silicone extrusions, combined with neutral-curing low modulus silicone sealant for bonding to substrate, Pecora Sil-Span or Dow Corning 1-2-3.

2.3 Accessories

A. Tapes, Mastics, Sealants, Primers, Adhesives, Fasteners and Other Accessories: As recommended in writing by air/vapor barrier manufacturer.

B. Metal Termination Bars: Stainless steel, galvanized steel or aluminum to suit adjacent materials, approximately 1 inch wide by 1/8 inch, or channels formed from 16 gage sheet approximately 1 inch wide by 1/4 inch high, pre-punched for fasteners.

C. Sheet Metal Flashing: Division 07.

D. Anchors:

1. Material:

   a. Contacting Aluminum and Dissimilar Metals: Stainless steel, ASTM F 593 and ASTM F 594, Alloy Group 1.
   b. Contacting Steel or Galvanized Steel Only: Hot dip galvanized steel conforming with ASTM A 563 and ASTM A 153.

2. Anchors into Wood: Large headed, barbed or ring-shank roofing nails and penetrate minimum 1/4 inch into substrate.

3. Anchors into Metal: Self-drilling, self-tapping type screws, minimum No. 8.

4. Anchors into Concrete or Masonry: Hardened concrete screws, minimum size number in pre-drilled holes or explosive set anchors, minimum 1 inch penetration, as suitable to condition. Hand driven nails, lead, fiber or plastic shields or plugs are not acceptable.

Part 3 Execution

3.1 Examination

A. Project Site Verification of Conditions:

1. Examine substrates to which air/vapor barrier shall be applied for suitability and conformance to specified tolerances.

2. Test concrete and masonry substrates for suitable moisture content.

3. Report deficiencies to Construction Manager prior to commencing Work.

4. Commencing Work constitutes acceptance of substrate. Future Work or Rework required because of deficient substrates shall be performed at no additional cost.

3.2 Preparation

A. Protection: Protect adjacent surfaces that are not to receive air/vapor barrier.

B. Surface Preparation: Clean substrate of dust, dirt, oils or other deleterious materials. Knock off projections, fins or other irregularities. Fill voids and holes.

C. Joint Treatment: Bridge non-moving joints in panel type substrate with tape or membrane flashing as recommended in writing by manufacturer.

D. Priming: Prime substrate at application rate recommended in writing by manufacturer.

E. Bring substrate to a condition acceptable to manufacturer's technical representative and as required for system to comply with indicated requirements.

3.3 Application

A. General:

1. Install air/vapor barrier in accordance with approved submittals and additional written instructions from manufacturer as required.

2. Air/vapor barrier shall form a continuous envelope around conditioned spaces.

   a. Seal perimeter of each type of air/vapor barrier to adjacent air/vapor barrier or to intervening vapor impermeable materials.
   b. Seal penetrations to vapor impermeable materials.
   c. Vapor impermeable materials shall be metal or other materials with a perm rating of less than 1.
   d. When sealing air/vapor barriers to other vapor impermeable materials, seal joints in vapor impermeable material using mastics, sealants, tapes and sheets as recommended in writing by manufacturer.

B. Membrane Flashing: Install membrane flashing to bridge discontinuities in substrates, at gaps and joints, as required to accommodate movement of substrate and as recommended by manufacturer. Seal joints, corners and transitions in membrane flashing air and watertight.

1. Self-Adhering Flashing Sheets: Use within field of air/vapor barrier and to metal flashing and other compatible materials. Do not place in contact with silicone sealants. Do not span membrane without support beyond limits recommended by manufacturer. Provide sheet metal flashing for support if necessary to bridge gaps beyond manufacturer's limits.

2. Self-supporting Flashing Sheets: Use to span open joints and gaps which accommodate movement, typically at building expansion joints, at movement joints between different systems and at control joints within systems. Provide a fold of excess membrane sized to accommodate movement. Anchor continuously on edges with metal termination bars.

3. Silicone Flashing Sheets: Use at transitions to aluminum curtainwall, windows and storefront and other metal systems which use silicone sealant as part of their installation. Provide a fold of excess membrane sized to accommodate movement. Anchor continuously on edges with metal termination bars if not mechanically captured in glazing system.

C. Fluid-applied Air/vapor Barrier:

1. Bridge movement joints, change of material or discontinuity of substrate with strips of sheet membrane.

2. Seal to adjacent construction, window frames, curtainwall, penetrating ductwork, louvers or other similar penetrations, or perimeter conditions using membrane flashing.

3. Seal small, round or irregular penetrations such as ties, conduits, bolts and rods less than 1 inch in diameter with mastic or sealant.

4. Shingle over sheet metal flashing with sheet membrane and seal.

5. Apply liquid membrane by trowel or spray.

a. Provide a minimum dry film thickness of 60 mils.
b. Lap membrane minimum 1 inch onto sheet flashing.
c. Trowel membrane at masonry ties and similar small penetrations.

3.4 Field Quality Control

A. Manufacturer's Field Services:

1. Manufacturer's technical field representative shall visit Project Site

a. During initial start of Work and examination of substrates.
b. Once per week while Work of this Section is in progress.
c. Upon completion of Work of this Section.

2. Representative shall prepare a report after each Project Site visit outlining general progress and deficiencies or deviations. Submit report to Construction Manager Contractor within three (3) working days.

3.5 Protection

A. Protect air/vapor barriers from damage until covering Work is complete. Schedule Work of insulation board and sheathing specified elsewhere which will cover air/vapor barrier to minimize time that barrier is exposed.

B. Repair damage to air/vapor barrier per manufacturer's written recommendations.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Exterior solid phenolic cladding panel system and accessories as required for a complete drained and back-ventilated rainscreen system.

1. Wall panels.
2. Fascia.
3. Horizontal soffits.
4. Panel mounting system.

B. Interior solid phenolic cladding panel system and accessories.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Thermal Insulation: Division 07.

C. Exterior Enclosure, General: Division 07.

D. Aluminum Entrances and Storefronts: Division 08.

E. Glazed Aluminum Curtainwall: Division 08.

F. Gypsum Board Assemblies: Division 09.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Shop Drawings: Submit plan, section, elevation and perspective drawings necessary to describe and convey the layout, profiles and product components, including edge conditions, panel joints, fixture location, anchorage, accessories, finish colors, patterns and textures.

C. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.

3. Installation methods.

D. Code Compliance: Documents showing product compliance with local building code shall be submitted prior to the bid. These documents shall include, but not be limited to, appropriate Evaluation Reports and/or test reports supporting the use of the product.

E. Engineering Calculations: Submit engineering calculations as required by the local building code, showing that the installed panels and attachments system meets the wind load requirements for the project.

F. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

G. Verification Samples: For each finish product specified, two samples a minimum of 3.5 inches by 3.5 inches (89 mm by 89 mm) representing actual product, color, and patterns.

H. Operation and Maintenance Data: Submit operation, maintenance, and cleaning information for products covered under this section.

I. Sustainability Submittals: Provide the following in accordance with Sustainability Requirements: Division 01.

1. Materials Sustainability Documentation Form.
2. Product data, certification letter, and costs for materials with recycled content.
3. Product data and costs for regional materials.
4. Product data for adhesives and sealants indicating VOC content.
5. Product data for paints and coatings indicating VOC content and chemical composition.

1.4 Quality Assurance

A. Referenced Codes and Standards: Comply with the following in accordance with Division 01.

1. ASTM International (ASTM):
    a. ASTM B 117 – Standard Practice for Operating Salt Spray (Fog) Apparatus.
    b. ASTM D 635 – Standard Test Method for Small Scale Burning.
    c. ASTM D 1929 – Standard Test Method for Ignition Temperature.
    d. ASTM D 2244 – Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates.
    e. ASTM D 2247 – Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.
    f. ASTM E 84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
    g. ASTM E 119 – Standard Test Method for Fire Rated or Fire Resistive Construction.
    h. ASTM E 330 – Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors Under the Influence of Wind Loads.

2. National Fire Protection Association (NFPA):

   a. NFPA 268- Standard Test Method for Determining Ignitibility of Exterior Wall Assemblies
   b. NFPA 285 –Standard Fire Test Method for Evaluation of Fire Propagation Characteristics

B. Manufacturer Qualifications: All primary panel products specified in this section will be supplied by a single manufacturer with a minimum of five years experience.

C. Installer Qualifications: All products listed in this section are to be installed by a single installer trained and approved by the manufacture or representative.

D. Manufacturer's Field Services: Upon Owner's request, provide manufacturer's field service consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

E. Mock-Up: Provide a mock-up for evaluation of the product and application workmanship.

1. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.

F. Pre-installation Meetings: Conduct pre-installation conference to verify project requirements, substrate conditions, manufacturer's installation instructions and manufacturer's warranty requirements.

1.5 Delivery, Storage, And Handling

A. Delivery:

1. During transportation, use stable, flat pallets that are at least the same dimension as the sheets.

2. Materials shall be packaged to minimize or eliminate the possibility of damage during shipping. Items such as wooden side boards, wooden lid, and spacers or protective sheeting between panels shall be used to protect the panels from surface and/or edge damage.

B. Storage:

1. Store products in an enclosed area protected from direct sunlight, moisture and heat. Maintain a consistent temperature and humidity.

2. Store products in manufacturer's unopened packaging until ready for installation.

3. Stack panels using protective dividers to avoid damage to decorative surface.

4. For horizontal storage, store sheets on pallets of equal or greater size as the sheets with a protective layer between the pallet and sheet and on top of the uppermost sheet.

5. Do not store sheets, or fabricated panels vertically.

C. Handling:

1. Remove protective film within 24 hours of the panels being removed from the pallet.
2. When moving sheets, lift evenly to avoid dragging panels across each other and scratching the decorative surface.
3. Remove all labels and stickers immediately after installation.

1.6 Project Conditions

1. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
2. Field Measurements: Verify actual measurements/openings by field measurements performed by the installer prior to release for fabrication. Recorded measurements to be indicated on shop drawings base on field measurements provided by the installer.
3. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.

1.7 Warranty

A. Warranty: At project closeout, provide manufacturer's limited ten year warranty covering defects in materials. Warranty only available when material installed by an installation contractor trained and approved by the manufacturer's representative.

Part 2 Products

2.1 Manufacturers

A. Basis of Design: Acceptable Manufacturer: Trespa International B.V.; P.O. Box 110, 6000 AC Weert Wetering 20, 6002 SM Weert The Netherlands; www.trespa.com.

1. Acceptable Manufacturer's Representative: Trespa North America, Ltd.; 12267 Crosthwaite Cir., Poway, CA 92064. ASD. Toll Free Tel: (800) 4-TRESPA. Tel: (858) 679-2090. Fax: (858) 679-9568. Email: info.northamerica@trespa.com Web: http://www.trespa.com/na.
2. Other acceptable products:
   a. MEG by Abet Laminati
   b. Vivix by Engineered Assemblies, Inc.
   c. Stonewood Exterior Panels by Fiberesin

2.2 Wall Panels

A. Solid Phenolic Wall Panels: Trespa Meteon by Trespa International as represented by Trespa North America, LTD.

1. Material: Solid panel manufactured using a combination of high pressure and temperature to create a flat panel created from thermosetting resins, homogenously reinforced with wood-based fibers and an integrated decorative surface or printed décor.

2. Color on Primary Face: Silvergrey color with black core and reverse.

3. Finish: Satin.

4. Panel Core: Fire retardant (FR) black core.

5. Panel Thickness: 3/8 inch (10 mm).

6. Physical Properties:

   a. Modulus of Elasticity: 1,300,000 psi (9000 N/mm2) minimum, ISO 178.
   b. Tensile Strength: 10,100 psi (70 N/mm2) minimum, ISO 527-2.
   c. Flexural Strength: 14,500 psi (120 N/mm2) minimum, ISO 178.
   d. Thermal Conductivity: 2.1 BTU/inch/ft2.hr.°F, EN 12524.
   e. Structural Performance (ASTM E330):

      1) Panels shall be designed to withstand the Design Wind Load based upon the local building code, but in no case less than 15 pounds per square foot (psf). Wind load testing shall be done in accordance with this standard to obtain the following results:

         a) Normal to the plane of the wall, the maximum panel deflection shall not exceed L/175 Normal to the plane of the wall between supports, deflection of the aluminum sub-framing members shall not exceed L/175 or 3/4 inch, whichever is less.

         b) At 1-1/2 times design pressure, permanent deflection of framing members shall not exceed L/100 of span length and components shall not experience failure or gross permanent distortion.

         c) If system tests are not available, mock ups shall be constructed and tests performed under the direction of an independent third party laboratory which show compliance to the minimum standards listed above.

7. Fire Performance:

   a. Flame Spread: Class A, ASTM E 84.
   b. Smoke Development: Less than 450, ASTM E 84.
   c. Ignition Temperature: Greater than 650 degree F (350 degree C) above ambient, ASTM D1929.
   d. Burning Classification: CC1 or CC2, ASTM D635.
   e. When required for compliance with local building codes, the wall cladding assembly including cladding and non-cladding elements such as, but not limited to, specific weather resistive barriers and/or exterior insulation materials, shall meet the performance requirements of NFPA 285. Performance shall be determined by actual testing in accordance with NFPA 285 or through an equivalency analysis provided by a recognized fire protection expert.

f. When required for compliance with local building codes, the wall cladding assembly shall not ignite when exposed to a radiant heat energy source, NFPA 268.

8. Finish Performance: Electron Beam Cure resin in conformance with the following general requirements:

a. Color: To match “silver grey” by Trespa with black core and satin finish..
b. Humidity Resistance: No formation of blisters when subjected to condensing water fog at 100% relative humidity and 100 degree F (38 degree C) for 3000 hours, ASTM D 2247.
c. Salt Spray Resistance: Corrosion creepage from scribe line (1/16 inch (1.6 mm) max.) and minimum blister rating of 8 within the test specimen field, ASTM B117.
d. Weather Exposure: Accelerated – 3000 hours in Atlas Type Weatherometer using cycle of 90 minutes light and 30 minutes diminished light and demineralized water with a maximum color change of 5 Delta E units from the original color according to ASTM D-2244, with the exception of Uni-Colors A12.3.7 / A18.3.5 / A04.1.7, which will not deviate more than 10 Delta E units from original color according ASTM D-2244.
e. Color Stability: The decorative surface comply with, classification, 4 – 5 measured with the grey scale according to ISO 105 A02-93 according to test method EN 438-2:29.
f. Microbial Characteristics: Will not support micro-organic growth (ISO 846).

B. Mounting System:

1. TS210-285 – Concealed fastening over fixed depth aluminum sub-framing

2. System shall be a single source install with framing and panels.

C. Aluminum Sub Structure: Aluminum sub-structure designed to withstand structural loading due to wind load and the dead load of the panel, painted as required to conceal behind the open joinery of the attachment system.

1. Extrusions, including corner closures, joint closures and vent screens, formed members, sheet, and plate shall conform with the recommendations of the manufacturer.

D. Fasteners (Concealed): Fasteners shall be non-corrosive and as recommended by panel manufacturer.

2.3 Fabrication

A. Panels: Solid phenolic impregnated kraft paper wall panels with no voids, air spaces or foamed insulation in the core material. Accessory items in accordance with manufacturer's recommendations and approved submittals.

B. Panel Weight: 10 mm (3 lb / ft2).

C. Panel Bow: = 2 mm / m (= 0.079 inch/39.38 inches).

D. Panel Dimensions: Field fabrication shall be allowed where necessary, but shall be kept to an absolute minimum. All fabrication shall be done under controlled shop conditions when possible.

E. Appearance: Panel lines, breaks, and angles shall be sharp, true, and surfaces free from warp and buckle.

Part 3 Execution

3.1 Examination

A. Do not begin installation until substrates have been properly prepared.

B. Surfaces to receive panels shall be even, smooth, dry, and free from defects detrimental to the installation of the panel system. Notify Contractor in writing of conditions detrimental to proper and timely completion of the work.

C. Confirm exterior sheathing is plumb and level, with no deflection greater than 1/4 inch (6 mm) in 20 feet (6096 mm).

D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

E. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 Preparation

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 Installation

A. Install solid phenolic wall panels and sub-frame system in accordance with manufacturer's instructions.

B. Install solid phenolic wall panels plumb and level and accurately spaced in accordance with manufacturer's recommendations and approved submittals and drawings.

C. Anchor panels and sub-framing securely per engineering recommendations and in accordance with approved shop drawings to allow for necessary movement and structural support.

D. Fasten solid phenolic wall panels with fasteners approved for use with supporting substrate.

E. Do not install panels or component parts which are observed to be defective or damaged including, but not limited to: warped, bowed, abraded, scratched, and broken members.

F. Do not cut or trim component parts during installation in a manner that would damage the finish, decrease the strength or result in visual imperfection or a failure in performance. Return component parts with require alteration to the shop for re-fabrication or replacement.

G. Install corner profiles and trim with fasteners appropriate for use with adjoining construction as indicated on the Contract Drawings and as recommended by manufacturer.

3.4 Adjusting And Cleaning

A. Remove masking or panel protection as soon as possible after installation.

B. Adjust final panel installation so that all joints are true and even throughout the installation. Panels out of plane shall be adjusted with the surrounding panels to minimize any imperfection.

C. Repair panels with minor damage. Remove and replace panels damaged beyond repair as a direct result of the panel installation.

D. Clean finished surfaces as recommended by panel manufacturer.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Roofing replacement system consisting of complete tear-off, evaluation of existing insulation and preparation of existing roof surface for, fully-adhered membrane plus new insulation, insulation cover board, base flashing, and accessories.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Inspection and Testing Services: Division 01.

C. Inspection and Testing of Roofing and Waterproofing: Division 01.

D. Rough Carpentry: Division 06.

E. Flashing and Sheet Metal: Division 07.

F. Exterior Enclosure, General: Division 07.

G. Roof Accessories: Division 07.

H. Mechanical: Division 23, refer to for equipment mounted on or penetrating roof.

I. Electrical: Division 26, refer to for equipment mounted on or penetrating roof.

1.3 Submittals

A. Submit per requirements of Division 01.

1. Exterior Enclosure submittals will not be reviewed without receipt of Preliminary Certification letters indicated in Inspection and Testing of Roofing and Waterproofing: Division 01.

2. Coordinate and submit concurrently, submittals required in other Sections that affect Work of this Section.

3. Coordinate with Coordination Drawings specified in Project Coordination Section of Division 01.

B. Shop Drawings: Indicate joint, penetration and termination conditions and conditions of interface with adjacent walls, parapets, and other materials and as follows: Show all layers of the roof system starting from the substrate. Show continuity with other weather-resistive materials and air/vapor retarder materials. Include sufficient detail to indicate compliance with conditions unique for this Project.

1. Submit plan at minimum 1/8 inch equals 1 foot.
2. Submit details at minimum 3 inches equals 1 foot.
3. Relative elevations and slopes of substrates and finished roof surface.
4. Drain locations and size of sumps.
5. Parapet and edge details.
6. Location of tapered edge strips.
7. Curbs, rails, hatches, and vents in accordance with Roof Accessories: Division 07.
8. Expansion joints and area dividers.
9. All flashing details.
10. Walkway pad layout, coordinated with lightning protection system.
11. Layout of components including all layers of roof assembly.
12. Tapered insulation:
    a. Layout of insulation showing slopes, crickets, valleys and drain locations.
    b. Longitudinal and transverse sections showing insulation layers.
13. Roof top equipment and penetrations required for Work of other specification Divisions.

C. Product Data: For each component or material used in system including accessories, primers, and other miscellaneous products.

D. Samples:

1. Paper sample of “Roofing Identification Sign”, with information completed for this Project.
2. Manufacturer’s color coating color chart.

E. Qualifications: Manufacturers and installers qualifications.

F. Quality Control Procedures: Submit Manufacturer’s Field Reports within one (1) week after inspection.

G. Certifications: Written certification letters where specified.

H. Closeout Submittals:

1. Special Warranty:

a. Intent to Warrant letter. Do not commence Work without approval of Intent to Warrant.
b. Executed Warranty after completion of Work.

2. Maintenance Plan: Manufacturer's Roof Maintenance Plan.

I. Sustainability Submittals: Provide the following in accordance with Sustainability Requirements: Division 01.

1. Materials Sustainability Documentation Form.

2. Product data, certification letter, and costs for materials with recycled content.

3. Product data and costs for regional materials.

4. Product data for adhesives and sealants indicating VOC content.

5. Product data for paints and coatings indicating VOC content and chemical composition.

6. Product test reports indicating that roof materials comply with Solar Reflectance Index requirement.

1.4 Definitions

A. Roofing Systems: Components required to maintain building watertight from substrate up to top of base flashing including, but not limited to, substrate primers, insulation, insulation cover board, attachments, membrane, coatings, and base flashing.

1.5 Performance Requirements

A. Roofing manufacturer shall select products and installation techniques to conform to indicated requirements. Thicknesses and material descriptions indicated are minimums. Provide thicker materials or materials with higher performance values if required by roof manufacturer to comply with the indicated performance requirements or if required to issue indicated warranty.

1. Best Practice: Provide materials and detailing which provides most proven durability, generally as recommended by manufacturer for twenty (20) year warranty, whether a twenty (20) year warranty is specified or not.

B. UL Listing: Provide single-ply roofing system and component materials that have been tested for application and slopes indicated and are listed by Underwriters Laboratories, Inc. (UL) for Class A external fire exposure.

1. Provide single-ply roofing system that can be installed to comply with UL requirements for Fire Classified and Class 90 wind-uplift requirements.

1.6 Quality Assurance

A. Manufacturer's Qualification: Manufacturers shall have ten (10) years documented experience producing roofing membranes of the same Type as those required for this Project.

B. Installer's Qualification: Installer shall have satisfactorily completed minimum three (3) projects of similar system, scope and complexity within last one (1) year. Installer shall currently be licensed and approved by manufacturer and shall have been so for previous three (3) years. Submit list of projects with Owner and Design Professional contact with telephone numbers and manufacturer's certification.

C. Single Source Requirements: Primary products and materials required to complete system shall be produced directly by listed manufacturer. Secondary products including insulation, primers, anchors, and may be produced by a secondary manufacturer approved in writing by primary manufacturer.

D. Regulatory Requirements: Comply with applicable Volatile Organic Compounds (VOCs) regulations.

E. Referenced Codes and Standards: Comply with the following in accordance with Division 01.

1. National Roofing Contractors Association (NRCA): Roofing and Waterproofing Manual

2. Single-Ply Roofing Institute (SPRI): Flexible Membrane Roofing: A Professional's Guide to Specifications

F. Certifications:

1. Manufacturer's certification that installer is approved for this Project and has been an approved installer as required above.

2. System Certification Letter: Manufacturer's certification as follows:

   a. List information specific to this project, including Owner, Contractor, Building, and location.
   b. List each material required for roofing system.
   c. Certification of single source responsibility.
   d. Certification of acceptance of secondary products manufactured by Others.
   e. Certification of acceptance of products specified elsewhere which are installed within or in contact with roofing system.
   f. Certification that products and materials comprising roofing system are compatible with each other and with adjacent materials they may contact.
   g. Certification that roof systems comply with specified UL and FMG requirements.
   h. Certification that roof system is eligible for indicated warranty.

G. Insurance Certification: Assist Owner's Representative in preparation and submittal of roof installation acceptance certification as may be necessary in connection with fire and extended coverage insurance on roofing and associated work.

H. Preliminary Roofing Conference: As soon as possible after award of roofing work and before initial submittals, meet with Installer (Roofer), installers of substrate construction (roof decks) and other work adjoining roof system including penetrating work and roof accessories, Design Professional, Owner's Representative, Inspecting Agent, and representatives of other entities directly concerned with performance of roofing system including (as applicable) Owner's insurers.

1. Review requirements (Contract Documents), submittals, status of coordinating work, availability of materials, substrate requirement and installation facilities, and establish preliminary installation schedule. Review requirements for inspections, testing, certifications, forecasted weather conditions, governing regulations, insurance requirements, and proposed installation procedures.

2. Discuss roofing system protection requirements for construction period extending beyond roofing installation. Discuss possible need for temporary roofing.

3. Confirm that all parties involved are aware of Warranty requirements and Intent to Warrant letter has been submitted and approved.

4. Record discussion, including agreement or disagreement on matters of significance; furnish copy of recorded discussions to each participant. If substantial disagreements exist at conclusion of conference, determine how disagreements will be resolved and set date for reconvening conference.

I. Preapplication Roofing Conference: Approximately two (2) weeks before scheduled commencement of roofing installation and associated work, meet at Project Site with Installer, installer of each component of associated work, installers of deck or substrate construction to receive roofing work, installers of rooftop units and other work in and around roofing that must precede or follow roofing work, including mechanical work, if any, Design Professional, Owner's Representative, Inspection Agent, roofing system manufacturer's representative, and other representatives directly concerned with performance of Work, including, where applicable, Owner's insurers, and governing authorities.

1. Review foreseeable methods and procedures related to roofing work, including, but not limited to, the following:

    a. Tour representative areas of roofing substrates (decks), inspect and discuss condition of substrate, roof drains, curbs, penetrations, and other preparatory work performed by other trades.
    b. Review structural loading limitations of steel deck and inspect deck for loss of flatness and for required mechanical fastening.
    c. Review roofing system requirements included on Drawings, Specifications, and other Contract Documents.
    d. Review required submittals, completed and yet to be completed.
    e. Review Intent to Warrant and unexecuted Warranties.
    f. Review and finalize construction schedule related to roofing work and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

g. Review required inspection, testing, certifying and material usage accounting procedures.
h. Review weather and forecasted weather conditions and procedures for coping with unfavorable conditions, including possibility of temporary roofing, if not a mandatory requirement.

2. Record Contractor discussions of conference, including decisions and agreements or disagreements reached, and furnish copy of record to each party attending. If substantial disagreements exist at conclusion of conference, determine how disagreements will be resolved and set date for reconvening conference.

J. Inspection and Testing: Services of an independent Inspection and Testing Agency will be required in relation to Work of this Section. Refer to Division 01.

K. Coordination: Contractor shall coordinate Work specified in other Sections and in other Contracts affecting roof in any way.

1.7 Delivery, Handling And Storage

A. Deliver materials in original unopened containers or packaging clearly labeled with manufacturer's name, brand name, instructions for storage, handling and use, all identifying numbers and labels.

B. Store materials on pallets or other similar raised platform and protected from weather.

C. Do not overload structure by storing large amounts of material in one (1) area.

D. Store adhesives and other temperature sensitive materials between 60 degrees F and 80 degrees F.

1.8 Project Conditions

A. Application of roofing shall not commence or proceed during inclement weather or if precipitation is more than 50 percent likely during next 8 hour period per National Weather Service or if temperatures are outside of manufacturer’s written instructions.

1.9 Sequencing

A. Coordinate Work to minimize construction traffic required over complete roofing system.

1.10 Special Warranty

A. Intent to Warrant: Submit an Intent to Warrant executed by authorized representative of roof membrane system manufacturer, indicating that manufacturer has reviewed Drawings and Specifications, conditions affecting work and relationship of roof membrane system with related work, and that manufacturer proposes to provide warranty as referenced without further stipulation.

B. Manufacturer's Warranty:

1. Provide a twenty (20) year warranty from manufacturer, signed by an authorized representative of manufacturer which shall warrant that manufacturer shall repair any defective workmanship and replace any defective material within roofing system as indicated.

2. The following exclusions are permitted in Warranty:

   a. Natural disasters such as lightning, hail, floods, and earthquakes.
   b. Damage from traffic or storage of material on roof.
   c. Structural failure of roof deck, parapet or coping.
   d. Infiltration of moisture in, through or around walls, coping or building structure.
   e. Movement or deterioration of metal counterflashing or other metal components adjacent to roof.
   f. Damage to building (other than roofing system components) or its contents.

3. Warranty shall include coverage for failure due to wind velocities up to 90 miles per hour.

4. Warranty shall provide that if upon proper notification Warrantor fails to promptly repair roof, Owner may make temporary repairs to avoid damage to facility. Such action shall not be considered a breach of provisions of Warranty.

5. Owner shall be permitted to make alterations, additions and repairs to roof within written approved guidelines of Warrantor without jeopardizing unexpired portion of Warranty's original term.

6. There shall be no deviations from these Specifications or from requirements of roofing material manufacturer that would prevent issuing of Warranty.

1.11 Owner's Instructions

A. Care and Maintenance: Provide manufacturer's written Roof Maintenance Plan customized for Project, for maintenance of roof including, for example, inspection schedules, trouble shooting, early signs of a potential problem and temporary emergency repairs.

Part 2 Products

2.1 Manufacturer

1. Subject to compliance with specified criteria, provide primary system components manufactured by one (1) of the following:

2. TPO:

   a. Firestone Building Products Co.
   b. Carlisle Syntec Systems.
   c. Johns Manville Co.

2.2 Materials, General

A. Use paints and coatings that comply with the VOC limits and chemical restrictions specified in Sustainability Requirements: Division 01.

2.3 Roofing Membrane

A. TPO: A fabric-Reinforced Thermoplastic Polyolefin Sheet complying with ASTM D 6878.

1. Thickness: Minimum 60 mils nominal thickness.

2. Reinforcement: Fiberglass or polyester as required to meet performance criteria.

3. Exposed Face Color: White.

2.4 Insulation

A. Polyisocyanurate: Rigid closed-cell foam boards permanently bonded to non-asphaltic glass fiber facing sheet complying with ASTM C 1289, UL Class A, FMG Class 1 and the following:

1. Compressive Strength per ASTM D 1621: Minimum 20 psi.

2. Maximum Face Size: 4 feet by 4 feet.

3. R-value for a 1 inch board tested per ASTM C 518 and conditioned per RIC/TIMA 281-1: Minimum 5.6.

4. Minimum Thickness: in order to achieve R-25.

5. Crickets: Same material as insulation, tapered so finished surface slopes minimum 1/4 inches per foot.

6. Tapered Insulation:

a. Slope of finished surface: Minimum 1/4 inch per foot including crickets.
b. Minimum thickness measured at perimeter of drain sumps: 2 inches.

B. Insulation Cover Board: Silicone impregnated gypsum board core panels with integral glass fiber facers, 5/8 inch thick, pre-primed, complying with ASTM C 1177, Dens Deck by Georgia-Pacific Corp.

2.5 Bonding Materials

A. Membrane Adhesives: Supplied by same manufacturer as membrane and formulated for use with roof membrane and insulation, inert to weathering by withstanding oxidation, ozonization, hydrolysis, and chemical attach from ponded water. Adhesive shall withstand specified uplift force. Adhesive shall be compliant with all Volatile Organic Compounds (VOCs) regulations.

B. Flashing Cement Mastics, and Sealants: Supplied or approved by membrane manufacturer. Comply with all Volatile Organic Compounds (VOCs) regulations.

2.6 Accessory Materials

A. Accessory materials shall be as recommended in writing by membrane manufacturer, as required to comply with specified criteria, and appropriate for a 20-year warranted system whether or not such a warranty is being offered.

B. Traffic Pads: approximately 24 inches by 24 inches by 1/4 inch as recommended in writing by membrane manufacturer. Layers of additional membrane are not acceptable as traffic pads.

C. TPO Base Flashing: Use TPO membrane.

1. Furnish factory pre-molded inside and outside corner units recommended in writing by manufacturer.

D. Pre-molded Flashing Boots: Manufacturer's standard conical elastomeric boots, molded to fit pipe penetrations.

E. Mechanical Fasteners: Corrosion-resistant per FMG 4470 criteria as recommended by membrane manufacturer and insulation manufacturer for deck type, and complying with fire and insurance uplift rating requirements. Provide system tested and approved for specified wind uplift rating.

F. Tapered Edge Strips: 1 1/2 inches high by 18 inches wide, same material as insulation.

G. Termination Bar: 3/32 inch thick extruded aluminum and punched with elongated holes approximately 1 inch on center.

H. Concrete adjustable roof paver pedestal system where indicated. Basis of design: Wassau Terra Stand System with 36" square concrete pavers. Paver to be selected by Architect from manufacturer's full line.

2.7 Laminated Metal Flashing Fabrication

A. Shop fabricate laminated metal flashing to form base flashing, edge flashing, scuppers and overflows as indicated in accordance with requirements of Flashing and Sheet Metal: Division 07.

B. Shop fabricate inside and outside corners, transitions and terminations in accordance with requirements of Flashing and Sheet Metal: Division 07. Form inside corners with a 1 inch cant.

Part 3 Execution

3.1 Examination

A. Examine substrate surfaces to receive single-ply roofing system and associated work and conditions under which roofing will be installed.

1. Verify roof openings, pipes, conduit, sleeves, ducts, and vents through roof are solidly set, and wood nailers, counterflashing receivers and reglets are in place.

2. Verify that curbs, rails, pipe curb assemblies, roof top mechanical equipment and other roof-mounted elements specified elsewhere are in place and properly anchored.

3. Verify that surrounding parapets, roof edges and walls are properly prepared for application of roofing system.

4. Verify deck is supported and secured.

5. Verify deck is clean and smooth, free of depressions, waves, or projections, properly sloped to drains and valleys.

6. Verify deck surfaces are dry and free of snow or ice. Verify flutes of metal deck are clean and dry.

7. Verify concrete substrates have a moisture content below manufacturer's published maximum recommended value.

8. Verify that penetrating elements have indicated air seal or firestopping.

B. Reporting: Report defects or deficiencies in writing to Contractor, Design Professional and Owner's Representatives.

C. Do not proceed with roofing work until defects or deficiencies have been corrected.

D. Acceptance: Commencement of roofing work constitutes acceptance of substrate. Provide removal and replacement of roofing required for, or caused by, defects or deficiencies in substrate, including damp materials at no additional cost.

3.2 Preparation

A. Protect adjacent surface from staining or soiling caused by roofing application. Prevent liquid materials from entering or clogging drains, pipes, conduits or conductors. Prevent foreign materials from entering or clogging roof drains, scuppers or downspouts.

B. Coordinate installing roofing system components so that, insulation, and insulation cover board are not exposed to precipitation or left exposed overnight. Provide watertight cut offs at end of each day's work to cover exposed sheets and insulation. Remove cut offs immediately before resuming Work.

3.3 Application

A. General: Comply with approved submittals, Specifications, and manufacturer's written instructions for a 20-year warrantable system whether or not such a warranty is required.

B. Insulation Application:

1. General:

a. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.

b. Lay tapered boards, tapered edge strips, or cut boards to slope to form a minimum 3 feet square by 1 1/2 inch deep sump at roof drains.
c. Apply no more insulation than can be covered with membrane in same day.
d. Install tapered edge strips wherever roofing intersects a vertical surface or a curb, at all penetrations, at perimeter of roof edge and as indicated.
e. Use tapered insulation or tapered edge strips to form crickets to direct water to roof drains. Install crickets behind all roof penetrations or irregularities, for example, roof-mounted equipment, curbs, rails and hatches which cross the down slope flow of water.
f. Place tapered thickness insulation to required slope pattern in accordance with manufacturer's written instructions and approved submittals.
g. Insulation cover board shall be top layer of insulation assembly. Cut insulation cover board to follow slope of roof insulation at tapered edge strips, crickets, valleys, ridges and other breaks in slope.

2. Insulation, Mechanically-Fastened:

a. Mechanically-fasten insulation to substrate in accordance with insulation manufacturer's written instructions and as required to comply with specified uplift criteria.
b. Mechanically-fasten subsequent layers of insulation and insulation cover board with joints staggered minimum 6 inches from joints of first layer.

C. TPO Membrane Application, Fully Adhered:

1. Adhere membrane roofing over area to receive roofing and install according to membrane roofing system manufacturer's written instructions.

2. Retain first paragraph below if applicable.

3. Start installation of membrane roofing in presence of membrane roofing system manufacturer's technical personnel.

4. Accurately align membrane roofing and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

5. Retain first paragraph below for adhesive bonding membrane to substrate.

6. Bonding Adhesive: Apply to substrate and underside of membrane roofing at rate required by manufacturer and allow to partially dry before installing membrane roofing. Do not apply to splice area of membrane roofing.

7. In addition to adhering, mechanically fasten membrane roofing securely at terminations, penetrations, and perimeter of roofing.

8. Apply membrane roofing with side laps shingled with slope of roof deck where possible.

9. Seams: Clean seam areas, overlap membrane roofing, and hot-air weld side and end laps of membrane roofing and sheet flashings according to manufacturer's written instructions to ensure a watertight seam installation.

a. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet membrane.

b. Revise number of seam tests in first subparagraph below to suit Project.
c. Verify field strength of seams a minimum of twice daily and repair seam sample areas.
d. Repair tears, voids, and lapped seams in roofing that does not comply with requirements.

10. Spread sealant bed over deck drain flange at roof drains and securely seal membrane roofing in place with clamping ring.

D. TPO Flashings and Accessories:

1. Apply base flashings to seal membrane to vertical elements and penetrations. Install prefabricated corners. Form corners and special shapes with uncured sheets only when prefabricated shapes are not available.

2. Secure top of base flashing with roofing nails maximum 12 inches on center or with termination bar secured maximum 18 inches on center.

3. Coordinate overlap of base flashing under copings and other flashings with air/vapor barrier as indicated. Overlap shall occur on vertical surface and shall be shingled in the direction of flow.

4. Flash each penetrating pipe, conduit, tube or other similar elements using prefabricated flashing boots or pipe curb assembly specified in Roof Accessories: Division 07.

5. Coordinate installation of roof drains, sumps and related flashings.

6. Pitch pockets are not allowed.

E. Scuppers and Overflows: Verify that rough opening for has been lined with air/vapor barrier membrane flashing. Install shop fabricated scuppers and overflows under roofing membrane. Mechanically anchor at maximum 6 inches on center around perimeter of both faces and not less than two (2) anchors per leg. Seal roof membrane to scupper with adhesive at EPDM and TPO and by hot air welding at PVC.

F. Protective Coating: Apply coating to EPDM membrane materials exposed to view in accordance with manufacturer's written instructions.

G. Traffic Pads: Install pads using cold adhesive at EPDM and hot air welding at PVC and TPO as recommended in writing by manufacturer in locations indicated. Space pads to allow for drainage. Install traffic pads under each lightning protection air terminal mounted on roof and continuous under lightning protection cables.

3.4 Field Quality Control

A. Inspection: Services of an independent Inspection and Testing Agency shall be used in relation to this Work.

B. Moisture Test: Prior to Date of Substantial Completion, independent Inspection and Testing Agency specified in Division 01 will survey roof to search for leaks demonstrated by wet insulation.

1. If there has not been rainfall of at least 1 inch in 24 hours during two (2) week period prior to test, use hoses and sprinklers to thoroughly soak roof surface for 12 hours. Submit request for change order for cost of soaking if required. Do not include cost of soaking in Base Price.

2. If leaks or wet underlying materials are found, remove membrane and wet materials, let system dry and repair system. Contractor shall pay for retesting by original independent Inspection and Testing Agency until no leaks or wet underlying materials are discovered.

C. Manufacturer's Representative: Manufacturer's technical field representative shall inspect construction activities, at start of work, minimum two (2) hours per week during work and at completion of each area of work. Representative shall attend meetings concerning roofing when indicated or as scheduled to coordinate Work. Representative shall submit a written report after each inspection noting as a minimum weather conditions, condition of stored materials, work in progress, condition of substrates, number of workers and which workers have completed manufacturers' training programs, and all other pertinent data. Services of manufacturer's field representative are not intended to supersede manufacturer's written requirements for inspection to issue Warranty.

3.5 Cleaning

A. Clean roof areas of roofing tools, unused materials and debris.

B. Clean spilled adhesive or other materials from exposed surfaces that were not to receive roofing.

C. Clean roof areas in order to meet LEED reflectance criteria.

3.6 Protection

A. Protect roof system from construction traffic. Apply temporary protection if roof system is extensive roof traffic is required.

3.7 Roofing Schedule

A. Roof System Type SMNA:

1. Substrate: Cross Laminated Timber Deck.

2. Insulation: Tapered Polyisocyanurate, Mechanically Fastened.

3. Insulation Cover Board: Siliconized Gypsum sheathing, Mechanically Fastened.

4. Roof Membrane: TPO sheet, Fully Adhered.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Custom fabricated flashing and sheet metal including:

1. Metal counterflashing and receivers.
2. Built-in scuppers.
3. Formed fascias, copings and gravel stops.
4. Exposed metal trim.
5. Flashing embedded in masonry.
6. Miscellaneous sheet metal not otherwise specified.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Unit Masonry: Division 04, refer to for installation of flashing embedded in masonry.

C. Fluoropolymer Coatings: Division 05.

D. Phenolic Wall Panels: Division 07.

E. Roofing: Division 07, refer to for manufactured roof components and accessories.

F. Exterior Enclosure, General: Division 07.

G. Joint Sealants: Division 07.

H. Counterflashing of Mechanical Elements: Division 23.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Coordinate flashing and sheet metal submittals with roofing submittals.

C. Shop Drawings: Show layout, profiles, methods of joining, and anchorage details, including major counterflashings, metal masonry flashing, trim/fascia units, gutters, downspouts, scuppers, and expansion joint systems. Provide layouts at 1/4 inch scale and details at 3 inch scale.

D. Product Data: Manufacturer's technical data, installation instructions and general recommendations for each product specified. Include data substantiating that materials and performance comply with requirements.

E. Samples: Duplicate Samples of flashing, sheet metal, and accessory items as follows:

1. 8 inch square Samples of specified sheet materials to be exposed as Finished Work.

2. 12 inch Samples of fabricated products exposed as finished Work including Samples of each type of joint. Provide complete with specified factory finish.

F. Sustainability Submittals: Provide the following in accordance with Sustainability Requirements: Division 01.

1. Materials Sustainability Documentation Form.

2. Product data, certification letter, and costs for materials with recycled content.

3. Product data and costs for regional materials.

4. Product data for adhesives and sealants indicating VOC content.

5. Product data for paints and coatings indicating VOC content and chemical composition.

6. Product test reports indicating that roof materials comply with Solar Reflectance Index requirement.

1.4 Quality Assurance

A. Referenced Codes and Standards: Comply with the following in accordance with Division 01.

1. NRCA Roofing and Waterproofing Manual by National Roofing Contractors Association

2. Architectural Sheet Metal Manual by Sheet Metal and Air Conditioning Contractor's National Association

B. Field Sample: Construct a Field Sample as follows:

1. Extent: Build into Work for inclusion in Final Project as indicated on Drawings one (1) corner and one (1) standard running length of coping and fascia and gravel stop.

2. Location: As indicated at location directed by Design Professional.

3. Obtain Design Professional's acceptance of Field Sample prior to starting additional Work. Revise, repair, replace or rebuild Field Sample as required to meet design intent and specified requirements.

4. Maintain approved Field Sample until all Work included in Field Sample has been completed.

C. Preinstallation Conference: Approximately two (2) weeks before scheduled commencement of flashing, sheet metal and associated Work, meet at Project Site with Installer, installer of each component of associated Work, installers of deck or substrate construction to receive work, Roofing Installer, Design Professional, Owner's Representative, and other representatives directly concerned with performance of Work. Conference may be held together with Roofing Preapplication Conference.

1. Review foreseeable methods and procedures related to flashing and sheet metal including, but not limited to, the following:

   a. Tour representative areas of substrates, inspect and discuss condition of substrate and other preparatory Work performed by Other Trades.
   b. Review interface with roofing system.
   c. Review required submittals, both completed and yet to be completed.

2. Record (Contractor) discussions of conference, including decisions and agreements (or disagreements) reached, and furnish copy of record to each party attending. If substantial disagreements exist at conclusion of conference, determine how disagreements will be resolved and set dated for reconvening conference.

D. Preinstallation Conference: Participate in conference specified in Exterior Enclosure, General: Division 07.

E. Inspection and Testing: Inspection and Testing Agency services will be required in relation to Work of this Section.

1.5 Delivery, Handling And Storage

A. Ship, handle and store material to prevent twisting, bending, denting, abrasion or other damage.

B. Prevent contact with materials which may cause discoloration, staining or damage.

C. Wear gloves while handling copper materials to avoid staining.

1.6 Project Conditions

A. Do not perform flashing or sheet metal work involving sealants, mastics, adhesives or other temperature sensitive materials when temperature is lower than recommended in writing by material manufacturer.

B. Do not install flashing or sheet metal over wet or damp substrate.

1.7 Sequencing

A. Coordinate installation of Work to allow for embedded or covered items.

Part 2 Products

2.1 General

A. Provide recycled content materials in accordance with Sustainability Requirements: Division 01.

B. Provide regional materials in accordance with Sustainability Requirements: Division 01.

C. Use adhesives and sealants that comply with the VOC limits specified in Sustainability Requirements: Division 01.

D. Use field applied paints and coatings that comply with the VOC limits and chemical restrictions specified in Sustainability Requirements: Division 01.

2.2 Sheet Metals

A. Exposed Sheet Metal: Match material and finish of adjacent sheet metal panels specified elsewhere in Fluoropolymer Coatings in Division 05. Minimum 26 gage sheet metal except provide heavier gage if required by SMACNA for application or for welding.

1. Use typically for exposed locations except for locations only visible from roof level.

B. Zinc-Coated Steel: Commercial quality with 0.20 percent copper, ASTM A 653 G90, mill phosphatized; minimum 26 gage except where heavier gage indicated.

1. Use typically for exposed locations except for locations only visible from roof level.

C. Stainless Steel: AISI Type 316, ASTM A 167, 2D annealed finish, except where other finish specified; soft except where harder temper required for forming or performance; 26 gage except where heavier gage indicated.

1. Use typically for concealed locations and for exposed location only visible from roof level.

D. Sheet Aluminum: ASTM B 209, alloy 3003, temper H14, AA-C22A41 mill finish; 0.032 inch thick unless otherwise indicated.

1. Use typically for exposed locations except for locations only visible from roof level.

E. ‘Heavy Gauge’ Sheet Aluminum: where noted in drawing to utilize ‘Heavy Gauge Trim’ utilize ASTM B 209, alloy 3003, temper H14, AA-C22A41 prefinished to match glazing system framing; 0.063 inch thick unless otherwise indicated.

2.3 Masonry Flashing

A. Thru-wall Flashing: Two-part assembly consisting of stainless steel 26 gage flashing and membrane flashing specified below.

B. Keyed Flashing: 0.015 inch 302/304 stainless steel with 3/16 inch high undercut sawtooths or keys 3 inches on center to provide mechanical bond in mortar bed by Cheney Flashing Company or Keystone Flashing Company or approved equivalent. No substitutions.

2.4 Membrane Flashing

A. Membrane Flashing Sheets: As specified in Air/Vapor Barriers: Division 07.

B. Self-Adhering Flashing Sheets: SBS-modified asphalt sheet with glass reinforcing scrim, minimum 40 mils, maximum 0.05 perm.

1. Blueskin by Henry/Bakor.
2. Rub-R-Wall SA by Advanced Coatings Inc.
3. Perm-A-Barrier by W.R. Grace.
4. Aqua Flash 500 by Fiberweb.
5. Polyguard 400 by Polyguard Products, Inc.
6. Air-Shield by W.R. Meadows.

C. Self-supporting Flashing Sheets: Uncured neoprene complying with ASTM D 200, Designation 2BC415 to 3BC620, 50 to 65 mils thick.

2.5 Accessories

A. Fasteners: Same metal as flashing or sheet metal or other non-corrosive metal which will not contribute to galvanic action and as follows:

1. Nails shall be barbed or ring-shank type and penetrate minimum 1 1/4 inch into substrate.
2. Fasteners into concrete or masonry shall be one (1) of the following as suitable to condition:
    a. Hardened concrete screws, minimum No. 8's, in predrilled holes.
    b. Deformed head, drive-in, compression fit spikes, minimum 3/16 inch diameter in predrilled holes.
    c. Explosive set anchors, minimum 1 inch penetration.
    d. Epoxy anchors in predrilled holes.
    e. Hand driven nails are not acceptable.
    f. Lead, fiber or plastic shields or plugs are not acceptable.
3. Exposed fasteners shall be high-domed, capped and neoprene gasketed screws, minimum No. 8's, finish to match adjacent metal.

B. Cleats: Same metal as flashing and minimum two (2) gages heavier, continuous.

C. Clips: Same metal as flashing and minimum two (2) gages heavier. Clips shall be approximately 2 inches wide by 6 inch long strips.

D. Solder: For use with steel or copper, provide 50-50 tin/lead solder per ASTM B 32, with rosin flux.

E. Solder: For use with stainless steel, provide 60-40 tin/lead solder per ASTM B 32, with acid-chloride type flux, except use rosin flux over tinned surfaces.

F. Reglets: Metal, minimum 26 gage profiles as indicated, compatible with related flashing, noncorrosive.

G. Sealant Concealed Within Sheet Metal Work: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.

H. Exposed Sealant: As specified in Joint Sealants: Division 07.

I. Anticorrosive Paint: SSPC-Paint 20.

J. Epoxy Seam Sealer: Two-part noncorrosive metal seam cementing compound, recommended in writing by metal manufacturer for exterior/interior non-moving joints.

K. Paper Slip Sheet: 5 pound rosin-sized building paper.

L. Roofing Cement: ASTM D 2822, asphaltic.

M. Adhesives: Type recommended in writing by flashing sheet manufacturer for waterproof/weather-resistant seaming and adhesive application of flashing sheet.

N. Foam Tape: 9 pcf density (self-adhesive) foam tape with flame retardants to meet FMVSS 302 flammability standard. “Norseal V 780” by Saint-Gobain. Equivalent products of other manufacturers will be evaluated as substitutions in accordance with requirements of Division 01.

1. Provide 1/8 inch thick at metal panels, concrete or other smooth substrate.

2. Provide 1/4 inch thick at masonry or similar rough substrate.

O. Butyl Tape: Preformed 100 percent solids, cross-linked isobutylene tape. “TremPro NGT” by Tremco. Equivalent products of other manufacturer’s will be evaluated as substitutions in accordance with requirements of Division 01. Provide 1/8 inch by 1/2 inch tape, unless otherwise indicated.

P. Splash Pads: Precast concrete, approximately 10 inches by 30 inches by 2 inches with sloped trough to divert water away from building.

2.6 Fabrication

A. General: Shop fabricated in compliance with approved submittals. Comply with referenced standards except where more stringent requirements are indicated.

1. Extent: Shop fabricate Work to greatest extent possible. Limit field work to minor trimming and installing fabricated pieces except for joints in straight running lengths that have to be made up on Project Site.

2. Fixed Seams:

   a. Galvanized Steel and Stainless Steel: Tin edges, form a flat lock seam and solder or provide heavier material and weld lap joint watertight.
   b. Lead: Lap sheets minimum 1 1/2 inches and burn per requirements of Lead Industries Association, Inc.
   c. Aluminum: Form a flat lock seam, fill with epoxy seam sealer and rivet joint or use thicker material and weld butt joint watertight.
   d. Copper: Tin edges, form a flat lock seam and solder.
   e. Welds: Where welds are acceptable, provide material of sufficient thickness to be welded without distortion or burn-through even if a lesser thickness is otherwise allowed. At prefinished or exposed welds, grind smooth and repair finish to match original condition.
   f. Clean soldered joints to remove flux immediately after soldering.

3. Moving Seams: Unless other seam types are indicated, lap minimum 4 inches and bed in three (3) rows of polyisobutylene sealant or two (2) rows of butyl tape.

4. Intersections: Shop-fabricate end dams, corners, tees, transitions and other intersections with approximately 12 inch to 18 inch legs to form a single watertight unit.

5. Curves: Shop-fabricated curved flashing and sheet metal by cutting out each curved plane and welding or soldering pieces together to form indicated cross-section true to radius and shape indicated. Do not cut or bend straight sections to short lengths to approximate curve. Do not kink to follow curve.

6. Terminations: Wherever running lengths of flashing or sheet metal terminate at a vertical plane shop-fabricate a watertight end dam approximately 4 inches high. Turn up integral end dam and patch in at outside corners by attaching separate piece using fixed seams.

7. Edges: Hem exposed edges on least visible side approximately 1/2 inch.

8. Separations: Provide for separation of metal from noncompatible metal or corrosive substrates by coating concealed surfaces with anticorrosive paint or other permanent membrane.

9. Fastener Holes: Prepunch holes for fasteners when thickness of material makes field penetration difficult and where indicated. Provide slotted holes where allowance for expansion and contraction is necessary.

B. Counterflashing: Fabricate counterflashing in two (2) pieces, a receiver and counterflashing leg, to allow future access to base flashing below. Coordinate trades (for example, masonry and mechanical) which may embed receiver portion of counterflashing in their Work. Form counterflashing leg approximately 4 inches high and shaped to spring against base flashing.

   1. Surface-Mounted Counterflashing Receiver: Fabricate from 16 gage material with slotted holes 12 inches on center.

2. Bottom lip of counterflashing to accept continuous concealed cleat except use concealed clips at surface mounted counterflashing and where counterflashing is backed by membrane flashing.

C. Thru-wall Flashing: Fabricate stainless steel portion to profiles indicated. Hem exposed bottom lip. Fabricated 8 inch long backup plates using matching material for flashing under butt joints. Fabricate corner, end dam, intersection, and other transition pieces.

D. Fascias and Gravel Stops: Fabricate to profiles indicated. Bottom lip of exposed fascia to accept continuous cleat.

1. Fascias shall be prepunched in roofside leg with slotted holes 18 inches on center.

2. Fabricate 8 inch long backup plate for flashing under each joint using matching material.

3. Fixed Seams: Welded.

E. Scuppers: Fabricate from stainless steel sheet to shape with flanges and drips indicated. Where possible, make seams at top of scupper and away from potential water exposure. Scupper box shall be one (1) piece and watertight.

F. Pitch Pockets: Not acceptable.

2.7 Finish

A. Exposed sheet metal and flashing shall be prefinished. Color to be selected form manufacturer's full range of standard and special colors.

B. Exposed sheet metal and flashing shall have manufacturer's standard baked-on white acrylic finish on both sides, 1.0 mil minimum dry film thickness.

C. Exposed sheet metal and flashing shall have high performance coating specified in Fluoropolymer Coatings: Division 05.

D. Exposed aluminum sheet metal and flashing shall have a Class I clear anodized finish, minimum 0.7 mil film thickness.

Part 3 Execution

3.1 Examination

A. Examine substrates for compliance with Specifications and suitability for installation of flashing. Do not proceed with installation until deficiencies have been resolved.

B. Starting installation of flashing and sheet metal constitutes acceptance of substrate and no changes on Contract will be allowed if subsequent removal and reinstallation is required in order to access substrate for corrective action.

3.2 Preparation

A. Separations: Provide for separation of metal from incompatible metal or corrosive substrates by coating concealed surfaces with anticorrosive paint or other permanent membrane. Separate stainless steel and aluminum from cementitious or treated wood substrates.

B. Embedded Items: Furnish counterflashing receivers, scuppers, reglets, inserts and other items which must be built into other Work to the appropriate trades. Direct proper installation.

C. Priming: Prime surfaces to receive membrane flashing per manufacturer's written instructions.

3.3 Installation

A. General: Install in compliance with approved submittals. Comply with referenced standards except where more stringent requirements are indicated.

1. Limit field work to minor trimming and installing fabricated pieces except for joints in straight running lengths that have to be made up on Project Site.

2. Seams: Fixed and moving seams shall be as indicated in Article, Fabrication, unless otherwise indicated.

3. Bedding: Bed flanges of Work in a thick layer of roofing cement, polyisobutylene sealant, butyl coated foam tape, or other similar mastic compatible with adjacent construction as required to be watertight.

4. Intersections and Terminations: Install shop-fabricated intersections, corners, transitions and terminations first. Install running lengths of Work between with moving seams as specified.

5. Underlayment: Install per manufacturer's written instructions for primers and seams. Hold underlayment back approximately 1/2 inch from edge of flashing.

6. Cleats: At the bottom edge of counterflashing, copings, fascia and other similar sheet metal pieces, install continuous concealed cleats over 2 inch wide butyl or foam tape and fasten at approximately 6 inches on center. Locate fasteners close to lower brake of cleat. Make butt joints and corners tight while allowing for movement.

B. Membrane Flashing: Install membrane flashing typically under all sheet metal flashing and where otherwise indicated as recommended by manufacturer. Seal joints, corners and transitions in membrane flashing air and watertight. Wherever top termination of membrane flashing is not at a reglet or counterflashing, provide a termination bar with appropriate anchors at maximum 12 inches on center and sealant.

1. Self-Adhering Flashing Sheets: Use over a continuous substrate. Do not place in contact with silicone sealants. Do not span membrane without support beyond limits recommended by manufacturer. Provide sheet metal flashing for support if necessary to bridge gaps beyond manufacturer's limits.

2. Self-supporting Flashing Sheets: Use to span open joints and gaps which accommodate movement, typically at building expansion joints, at movement joints between different systems and at control joints within systems. Provide a fold of excess membrane sized to accommodate movement. Anchor continuously on edges with metal termination bars.

3. Silicone Flashing Sheets: Use at transitions to aluminum curtainwall, windows and storefront and other metal systems which use silicone sealant as part of their installation. Provide a fold of excess membrane sized to accommodate movement. Anchor continuously on edges with metal termination bars if not mechanically captured in glazing system.

C. Counterflashing: Provide two (2) piece counterflashing at upper termination of roofing, waterproofing, base flashings and as indicated, including at top of roof curbs which will support self flashing mechanical equipment. Secure receiver piece with fasteners approximately 12 inches on center below line of counterflashing. Install and secure counterflashing to receiver with exposed fasteners approximately 18 inches on center.

1. Install surface-mounted counterflashing receiver over 1 inch wide butyl tape and fasten at prepunched holes.

2. Install counterflashing over terminations and end dams not otherwise covered by subsequent Work.

3. Hook lower edge of counterflashing over continuous concealed cleat except use concealed clips at surface mounted counterflashing and where counterflashing is backed by membrane flashing.

4. Secure counterflashing in reglets with lead or elastomeric wedges and fill with sealant.

D. Masonry Flashing: Install per requirements of this Section and as further defined in Unit Masonry: Division 04.

E. Fascias and Gravel Stops: Install continuous membrane flashing underlayment unless roofing extends under fascia or gravel stop. Hook front edge over continuous concealed cleat.

1. Secure back edge of fascias with exposed fasteners through prepunched holes.

2. Secure back edge of fascias and gravel stops embedded in roofing membrane with two (2) rows of fasteners, approximately 2 inches apart, each row with fasteners approximately 3 inches on center, staggered from other row.

3. Furnish back-up plate with two (2) rows of butyl foam tape on each side of each joint.

4. Align joints with window mullions.

F. Scuppers: Line opening for scupper with membrane flashing underlayment. Install scupper by bedding flanges in mastic as specified above. Secure anchors through flanges but never through bottom of scupper.

3.4 Protection

A. Clean exposed metal surfaces. Removing substances that might cause corrosion of metal or deterioration of finishes.

B. Protection: Protect flashings and sheet metal work during construction to ensure that Work will be without damage or deterioration other than natural weathering at Date of Substantial Completion.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Accessories required to complete roofing assembly, installation of roofing components specified elsewhere and miscellaneous accessories, as follows:

1. Roof Curbs.
2. Prefabricated Flashing Boots.
3. Pipe Curb Assemblies.
4. Roof Hatches (Scuttles).

B. Products Installed But Not Specified Under This Section.

1. Mechanical: Division 23, refer to for curbs and rails for mechanical equipment.
2. Mechanical and Electrical: Divisions 22, 23 and 26, refer to for roof-top mounted equipment.
3. Fire Protection: Division 21, refer to for roof mounted piping.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Inspection and Testing and of Roofing and Waterproofing: Division 01.

C. Exterior Enclosure, General: Division 07.

D. Flashing and Sheet Metal: Division 07.

E. Joint Sealants: Division 07.

F. Electrical Connections: Division 26.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Shop Drawings: Coordinate with Roofing Drawings. Each roof accessory shall be located on Roofing Drawing Plan.

1. Expansion Joint Covers: Show extent of expansion joints on plans. Provide plan, section and isometric details at minimum 3 inches equals 1 foot scale for each intersection, termination, corner, transition or any condition other than normal straight run. Details shall be sufficient to allow shop prefabrication of each element.

C. Product Data: For each roof accessory indicated, including accessories, primers and other miscellaneous products.

D. Calculations: For each curb and rail include calculations and manufacturer's certified load bearing data indicating that equipment indicated to bear on curb or rail does not exceed the maximum allowable load for curb or rail.

E. Certifications:

1. Independent certification for fire-rated assemblies.

2. Certifications of compatibility for each roof accessory with roofing system.

F. Closeout Submittals: Draft of Warranty prior to start of fabrication or construction. Final Warranty after Date of Substantial Completion.

G. Sustainability Submittals: Provide the following in accordance with Sustainability Requirements: Division 01.

1. Materials Sustainability Documentation Form.

2. Product data, certification letter, and costs for materials with recycled content.

3. Product data and costs for regional materials.

4. Product data for adhesives and sealants indicating VOC content.

5. Product data for paints and coatings indicating VOC content and chemical composition.

6. Product test reports indicating that roof materials comply with Solar Reflectance Index requirement.

1.4 Definitions

A. Refer to Roofing System Specification Section for definitions.

1.5 Quality Assurance

A. Manufacturer's Qualifications: Manufacturer of roof accessories shall be acceptable to manufacturer of roofing system.

B. Installer's Qualifications: Installer shall be installer of roofing system as specified elsewhere in Division 07.

C. Single Source Responsibility: Each type of roof accessory shall be product of a single manufacturer.

D. Regulatory Requirements:

1. Roof accessories indicated to be fire-rated shall be labeled by UL or another agency acceptable to jurisdiction having authority.

2. Products shall comply with applicable Volatile Organic Compounds (VOCs) regulations.

E. Certifications: Roofing manufacturer shall certify that each roof accessory is compatible with roofing system and is acceptable for indicated use.

F. Conferences: Manufacturers of roofing accessories shall participate in Preliminary Roofing Conference and Preapplication Roofing Conference specified in Roofing System Specification Section.

G. Coordination:

1. Coordinate curbs, rails, penetrations and other roof accessories specified in this Section with roof-mounted equipment specified in Divisions 23 and 26.

H. Services of an independent Inspection and Testing Agency will be required in conjunction with Work of this Section.

1.6 Delivery, Handling And Storage

A. Deliver materials in original unopened containers or packaging clearly labeled with manufacturer's name, brand name, instructions for storage, handling and use, all identifying numbers and UL labels.

B. Store materials on pallets or other similar raised platform and protected from weather.

C. Do not overload structure by storing large amounts of material in one (1) area.

D. Store adhesives and other temperature sensitive materials between 60 degrees F and 80 degrees F.

1.7 Project Conditions

A. Substrates to receive roofing accessories shall be broom clean and dry, free of dirt, trash, contaminants, water, dew, frost, ice or snow.

B. Roofing accessories shall be compatible with selected roofing system.

1.8 Special Warranty

A. General: Warranty shall not deprive Owner of rights under other provisions of Contract and shall be in addition to, and run concurrent with, other Warranties made by Contractor under requirements of Contract Documents.

B. Special Warranty: Written Warranty, executed by manufacturer agreeing to repair or replace components of roof hatches (scuttles), that fail in materials or workmanship or fail to perform in accordance with specified criteria within five (5) years from Date of Substantial Completion.

C. Correct defects, at no additional cost, within thirty (30) days after notification in writing of failure to meet Warranty. Owner reserves right to use equipment until service or replacement is performed.

D. Tie in of roofing accessories to roof membrane shall be covered under Roofing Warranty.

Part 2 Products

2.1 General

A. Provide recycled content materials in accordance with Sustainability Requirements: Division 01.

B. Provide regional materials in accordance with Sustainability Requirements: Division 01.

C. Use adhesives and sealants that comply with the VOC limits specified in Sustainability Requirements: Division 01.

D. Use field applied paints and coatings that comply with the VOC limits and chemical restrictions specified in Sustainability Requirements: Division 01.

2.2 Metal Roof Curb

A. Curbs shall be factory assembled of galvanized steel sheet with fully welded corners and integral base plate and as follows:

1. 18 gage minimum. Provide heavier where required for intended load.
2. Internally reinforce any side over 3 feet long at maximum 3 feet on center with 1 inch by 1 inch by 1/8 inch steel angle.
3. Factory insulate curb with 3 pcf semi-rigid glass fiberboard 1 1/2 inch thick.
4. Curb shall extend from substrate to minimum 8 inches above top of insulation and tapered edge strip.
5. Construct curb to match slope of roof and to provide a level top surface.
6. Line curb with galvanized steel sheet when back of curb is exposed to view in finished Work.
7. Provide curb with decay resistant pressure treated and kiln dried lumber nailers, 1 1/2 inches square.

B. Products: Subject to compliance with requirements, provide products manufactured by one (1) of the following. Equivalent products of other manufacturers will be evaluated as substitutions in accordance with requirements of Division 01.

1. Bilco Co.
2. Custom Curb, Inc.
3. O'Keefe's, Inc.
4. Roof Products & Systems (RPS) Corp.
5. The Pate Co.
6. Thy Curb Division/ThyBar Corp.
7. Approved manufacturer of mechanical equipment being mounted on curb. Refer to Mechanical: Division 23.

C. Fabrication: Shop fabricate each metal roof curb as a completed assembly, ready for installation without additional field assembly.

2.3 Prefabricated Flashing Boots

A. Shop fabricated with opening designed specifically for penetrating item and base design coordinated with roofing details.

2.4 Pipe Curb Assemblies

A. Three-part assembly of curb, cover and molded caps.

B. Curb shall be a pre-fabricated box of 18 gage galvanized steel with continuous welded corner seams,1 1/2 inch of 3 pound density rigid fiberglass insulation and a pressure-treated top nailer. Curb shall extend from top of substrate to minimum 8 inches above top of insulation and tapered edge strips. Provide a multiple curb assembly when required for penetrating elements.

C. Cover shall be an acrylic clad thermoplastic molded to counterflash curb and with a turned up collar for cap. Where more than one (1) cover is required on a curb, provide flashing between covers.

D. Cap shall be molded EPDM with stainless steel drawbands. Select cap to suit size and number of penetrating elements.

E. Provide one (1) of the following: Equivalent products of other manufacturers will be evaluated as substitutions in accordance with requirements of Division 01.

1. "RPS Pipe Portal" by Roof Products and Systems Corp.
2. "Pate Pipe Curb Assembly" by The Pate Company.

3. “Portal System” by Portals Plus, Inc.

2.5 Roof Hatches

A. General: Fabricate units to withstand 40 lbf per square feet external loading and 20 lbf per square feet internal loading pressure. Frame with integral-curb, double-wall construction with 1 1/2 inch insulation and cap flashing (roofing counterflashing), with welded or sealed mechanical corner joints. Curb shall extend from substrate to minimum 8 inches above insulation and tapered edge strip. Curb shall have base flange for anchoring and integral counterflashing. Provide double-wall cover (lid) construction with 1 inch insulation core. Provide gasketing equipment with corrosion-resistant or hot-dip galvanized hardware including pintle hinges, hold-open devices, interior padlock hasps, and both interior and exterior latch handles. All surfaces shall be factory-primed for field painting.

B. Type: Single-leaf personnel access.

1. For Ladder Access: Approximately 2 feet 6 inches by 3 feet.

C. Material: Zinc-coated steel sheets. ASTM A 653.

D. Sloping Roofs: Where slope or roof deck exceeds 1/4 inch per foot, fabricate hatch curbs with height tapered to match slope to level tops of units.

E. Grab Bar: Provide 1 inch nominal schedule 40 pipe grab bar mounted to inside face of hatch cover, parallel with slope of stair. Grab bar shall be mounted minimum 1 1/2 inches clear of hatch face and shall have radiused returns welded to mounting escutcheon plates at each end. Reinforce cover for mounting.

F. Hatch Rail System: Provide where indicated on plans hatch rail system, Basis of Design: Bilco Bil-Guard, Model RL-NB and RL-S. Rail system shall be sized to accommodate hatch size as indicated. Hatch rail system shall be field assembled and installed (by Others) per manufacturer's written instructions.

1. Performance Characteristics:

   a. High visibility safety yellow color shall be molded in.
   b. Hatch rail system shall attach to capflashing of roof hatch and shall not penetrate any roofing material.
   c. Hatch rail system shall satisfy the requirements of OSHA 29 CFR 1910.23 and shall meet OSHA strength requirements with a factor of safety of two (2).
   d. UV and corrosion resistant construction with a 25 year warranty.
   e. Self-closing gate shall be provided with hatch rail system.

2. Posts and Rails: Shall be round pultruded reinforced fire retardant yellow fiberglass treated with a UV inhibitor.

3. Hardware: Mounting brackets shall be 1/4 inch thick hot dip galvanized steel. Hinges and post guides shall be 6063T5 aluminum. Fasteners shall be Type 316 stainless steel.

G. Manufacturer: Subject to compliance with requirements, provide hatch manufactured by one (1) of the following: Equivalent products of other manufacturers will be evaluated as substitutions in accordance with requirements of Division 01.

1. Babcock-Davis Hatchways, Inc.
2. Bilco Co.
3. Bristolite Skylights.
4. Dur-Red Products.
5. Milcor, Inc.
6. Naturalite/EPI Skylight Systems.
7. O'Keeffe's, Inc.
8. ThyCurb Division/ThyBar Corp.
9. Wasco Products, Inc.

2.6 Accessories

A. Fasteners: Same metal as flashing or sheet metal or other non-corrosive metal which will not contribute to galvanic action and as follows:

1. Nails shall be barbed or ring-shank type and penetrate minimum 1 1/4 inch into substrate.
2. Concrete or masonry fasteners shall be one (1) of the following:
    a. Hardened concrete screws with corrosion resistant coating, minimum No. 8's, self-tapping in pre-drilled holes.
    b. Deformed head, drive-in, compression fit spikes with corrosion resistant coating, minimum 3/16 inch diameter in pre-drilled holes.
    c. Explosive set anchors, minimum 1 inch penetration.
    d. Driven concrete or masonry nails are not acceptable.
    e. Lead, fiber or plastic shields or plugs are not acceptable.
3. Exposed fasteners shall be high-domed, capped and neoprene gasketed screws, minimum No. 8s, finish to match adjacent metal.

B. Flashing and Sheet Metal: As specified in Flashing and Sheet Metal: Division 07.

C. Sealant Concealed Within Sheet Metal Work: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.

D. Exposed Joint Sealant: As specified in Joint Sealants: Division 07.

E. Anticorrosive Paint: SSPC-Paint 20.

F. Roofing Cement: ASTM D 2822, asphaltic.

G. Adhesives: Type recommended in writing by flashing sheet manufacturer for waterproof/weather-resistant seaming and adhesive application of flashing sheet.

H. Foam Tape: 15 pcf density (self-adhesive) foam tape, 1/4 inch by 1 1/2 inch, unless otherwise indicated. "V 770" by Norton and "V1510" by Certainseal. Equivalent products of other manufacturers will be evaluated as substitutions in accordance with requirements of Division 01.

Part 3 Execution

3.1 Examination

A. Examine substrates to receive roofing accessories for suitability. Do not proceed, unless conditions are acceptable.

3.2 Preparation

A. Isolate dissimilar metals from each other and reactive metals from corrosive substrates with anticorrosive paint.

3.3 Installation

A. General:

1. Comply with approved submittals and manufacturer's written instructions.

2. Coordinate with installation of roof deck and other substrates to receive accessory units, vapor barriers, roof insulation, roofing and flashing, as required, to ensure that each element of Work performs properly and that combined elements are waterproof and weathertight.

B. Prefabricated Flashing Boots: Mechanically anchor base through insulation into substrate at minimum three (3) points. Install cap, secure drawbands and seal top of cap at penetrating element.

C. Curbs: Set curbs directly onto metal or concrete substrate. Do not set curbs on top of insulation.

1. Where indicated set curbs directly on structural steel frame, not on metal deck. Metal deck shall bear on flange of curb.

2. Anchor curbs to metal substrate with 1/2 inch puddle welds, 1 inch fillet welds or No. 10 self-tapping, self-drilling screws at maximum 12 inches on center.

3. Anchor curbs to concrete substrate with self-tapping concrete screws or expansion anchors maximum 12 inches on center.

4. Counterflash curbs with two-piece counterflashing per Flashing and Sheet Metal: Division 07, unless curb has integral counterflashing.

5. Seal tops of curbs before placing materials or equipment on curbs with continuous foam tape.

D. Pipe Curb Assemblies: Set curbs as indicated. Set cover and caps, secure draw bands and seal top of cap at penetrating element.

E. Hatches and Vents: Set curbs as indicated. Set units without twist or distortion to allow for proper operation.

F. Roofing Membrane and Base Flashing: Refer to specific Roofing System Specifications: Division 07.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes:

1. Roof tieoff anchors.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Thermal and Moisture Protection: Division 07, refer to for roofing.

1.3 Submittals

A. Submit per the requirements of Division 01.

1. Submit together with submittals for roofing Sections.

B. Shop Drawings: Show fabrication, dimensions, materials, interface with other construction, anchoring, and installation. Indicate provisions for conformance with indicated criteria. Indicate extent of shop fabrication versus field work.

1. Plans: Show fall arrest roof anchors on roof plan required in roofing section.

2. Details: Minimum 1 1/2 inch equals 1 foot scale.

3. Professional Engineer shall sign and seal Drawings indicating conformance with indicated criteria.

C. Product Data: For each material, anchor and accessory and miscellaneous product. Indicate provisions for conformance with indicated criteria. Include the following additional information:

D. Calculations: Signed and sealed calculations documenting conformance with indicated criteria, by professional engineer licensed in the State of North Carolina.

E. Qualifications: Proof of compliance with indicated qualifications.

F. Quality Control Procedures: Indicating compliance with indicated criteria:

1. Welding qualifications and procedures.

2. Factory Quality Control Procedures.

3. Factory Test Procedures.

4. Factory Test Reports.

5. Field Test Procedures.

6. Field Test Reports.

7. Acoustical Test Reports.

G. Certifications: Indicated certification letters.

H. Sustainability Submittals: Provide the following in accordance with Sustainability Requirements: Division 01.

1. Materials Sustainability Documentation Form.

2. Product data, certification letter, and costs for materials with recycled content.

3. Product data and costs for regional materials.

I. Closeout Submittals:

1. Draft of Warranty prior to start of fabrication or construction. Final Warranty after Date of Substantial Completion.

2. Log Book for recording annual inspection.

1.4 System Requirements

A. Engineering: Engineer components in compliance with indicated design intent and criteria.

1. Maintain basic dimensions of system, sight lines, jointing, and profiles. Minor variation is allowable only with written approval of Design Professional and if variations are identified on submittals.

2. Engineer components of system not fully detailed within a reasonable inference of design intent.

B. Performance:

1. Tieoff Anchors: Design to resist without fracture a pull-out force of 5400 lbf, applied in most adverse direction.

C. Conformance: Document conformance with engineered design.

1.5 Quality Assurance

A. Manufacturers Qualifications:

1. Experience: Minimum five (5) years producing products similar to those required for this Project.

a. Carry $7,000,000.00 liability insurance.

2. Manufacturer's Designer: Professional Engineer licensed in North Carolina, with minimum five (5) years experience designing systems similar to those required for this Project.

3. Single Source Requirements: Products shall be supplied by one (1) manufacturer. Accessory products including, for example, fasteners, sealants and anchors may be from other than primary manufacturer if approved in writing by primary manufacturer and Design Professional.

4. Certify compliance. Include project descriptions with Owner and Design Professional contacts for previous experience and resume for designer.

B. Welders Qualifications:

1. Welding procedures and qualifications: In accordance with "Structural Welding Code, Steel", AWS D1.1.

2. Welders shall be qualified to perform type of work required.

3. Identification: Each welder shall be assigned an identification symbol and shall mark his identification at each shop and field weld.

C. Regulatory Requirements: Comply with the following in accordance with Division 01.

1. U.S. Department of Labor, Occupational Safety & Health Administration (OSHA)

1910.28, Sub Part D	Walking-Working Surfaces
1910.66, Sub Part F	Powered Platforms Manlifts, and Vehicle-Mounted Work Platforms
1926.500, Sub Part M	Fall Protection

D. Referenced Codes and Standards: Comply with the following in accordance with Division 01.

1. American Society of Mechanical Engineers (ASME)

A120.1-1969	Safety Requirements for Window Cleaning Addenda A120.1a-1997 and A120.1b-1999

2. International Window Cleaner's Association (IWCA)

I 14	Window Cleaning Safety Standard

3. Aluminum Association (AA)

5AS-30	Specifications for Aluminum Structures

E. Conferences: Manufacturers of fall arrest roof anchors shall participate in Preliminary Roofing Conference and Preapplication Roofing Conference specified in roofing system Specification Section.

F. Inspection and Testing: Services of an Inspection and Testing Agency are required in conjunction with Work of this Section. Refer to Division 01.

G. Do not cover Work which is to be inspected or tested until directed.

H. Applicable State and Local Requirements: Comply with applicable requirements in accordance with Division 01.

1.6 Warranty

A. General: Warranty shall not deprive Owner of rights under other provisions of Contract and shall be in addition to, and run concurrent with, other Warranties made by Contractor under requirements of Contract Documents.

B. Warranty: Written Warranty, executed by manufacturer agreeing to repair or replace components that fail in materials or workmanship or leak or have condensation within specified Warranty Period.

1. Specified Warranty Period: Twenty (20) years from Date of Substantial Completion.

Part 2 Products

2.1 Manufacturer

A. Provided products manufactured by the following contingent upon meeting indicated requirements. Equivalent products of other manufacturers will be evaluated as substitutions in accordance with requirements of Division 01.

1. Basis of design: Pro Bel Enterprises Limited.

2. Thaler Metal Industries.

3. Tractel Swingstage Division.

2.2 Manufactured Units

A. Roof Tieoff Anchor:

1. Eye: Stainless steel U bolt.

2. Support Post: Insulated, round post (HSS), minimum 4 inch diameter, height as required for top of tie-off to be minimum 8 inches above finished roof surface, welded to minimum 1/2 inch thick base plate. Fabricate from stainless steel.

3. Anchor: refer to drawing details for design intent.

4. Flashing: One (1) piece spun metal flashing with seal at base and Type 304 stainless steel cap flashing.

a. Material: 0.018 inch Type 304 stainless steel.
b. Size: Minimum 7 inches high with 4 inch deck flange.

Part 3 Execution

3.1 Examination

A. Examine substrates to receive anchors for suitability. Do not proceed, unless conditions are acceptable.

3.2 Preparation

A. Isolate all dissimilar metals from each other and reactive metals from corrosive substrates with a heavy coat of bituminous mastic.

B. Furnish and locate anchors to be embedded in or attached to timber.

3.3 Installation

A. General: Install as required to:

1. Comply with manufacturer's written instructions.

2. Comply with approved submittals.

3. Comply with indicated criteria.

B. Bolted Anchors: Lock the nut and minimum two (2) threads by deforming threads, welding, pinning or equivalent method.

C. Flashing: Coordinate installation with roofing. Install as required to maintain anchor and roofing warranties.

3.4 Field Quality Control

A. Project Site Tests and Inspection: Coordinate with Inspection and Testing Agency.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Firestopping of through-penetrations, construction gaps and joints, and wall openings in rated and non-rated assemblies.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Individual Sections specifying assemblies or penetrating items which require firestopping.

C. Mechanical: Division 23.

D. Electrical: Division 26.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Shop Drawings: Show materials, design designations, ratings, installation methods, dimensions, and relationships to adjoining construction for each system, construction condition and penetrating item.

1. Floor Plans: Show vertical and horizontal rated assemblies.

2. Schedule: Show each type of substrate, type of penetrating item, required fire resistance rating of the substrate, “F”, “T” rating of firestopping, design of firestopping system including the type of materials that will be utilized and firestopping design designations.

3. Details: UL Numbered Drawings for each firestopping configuration for construction and penetrating items.

4. Engineering Interpretations: Where Project conditions require modification of a design to suit a particular firestopping condition, submit data signed and sealed by firestopping manufacturer’s fire protection engineer.

C. Product Data: For each product or system.

1. Copies of UL listing for each system.

2. Description of materials.

3. Manufacturer's written installation instructions.

D. Qualifications: Data for manufacturers, installers and designers. Include list of completed projects with project names, addresses, names of Design Professionals and Owners, and other information specified.

E. Quality Control Procedures: Field Inspection Reports from manufacturer as indicated.

F. Certifications:

1. Training Certification: From Manufacturer.

G. Closeout Submittals: Warranty, as indicated.

H. Sustainability Submittals: Provide the following in accordance with Sustainability Requirements: Division 01.

1. Materials Sustainability Documentation Form.

2. Product data, certification letter, and costs for materials with recycled content.

3. Product data and costs for regional materials.

4. Product data for adhesives and sealants indicating VOC content.

5. Product data for paints and coatings indicating VOC content and chemical composition.

1.4 Definitions

A. Construction Gap: A linear opening in or between adjacent assemblies.

B. Engineering Judgement: Evaluations developed by the manufacturer for new firestop systems similar to approved designs which provide the same or higher level of performance, are suitable for the intended use and are acceptable to the authorities having jurisdiction.

C. Fire Rated: Having the ability to withstand effects of fire for a specified time period, as determined by qualified testing.

D. Fire Rated Assembly: A floor/ceiling, roof/ceiling, wall, or other approved assembly able to withstand a design fire and hose stream test without failure for a specific length of time.

E. Fire Resistance Rating: The time, in hours, for which the rated assembly can withstand effects of fire without burn-through or structural failure.

F. Firestop, Firestopping: Firestop system.

G. Firestop System or Firestop Assembly: Combination of materials and devices, including penetrating items, in conjunction with a specific fire rated assembly and specific penetrating materials (if present) required to achieve an approved rated fire barrier.

H. Through-Penetration: An opening that passes entirely through a fire rated assembly.

I. Penetrating Item: A pipe, duct, conduit, cable tray, cable, or other element passing through an opening in a fire rated assembly.

J. Wall or Ceiling Opening: A penetration of one (1) or more layers or a fire rated assembly that is not a through-penetration, such as an electrical box.

1.5 System Description

A. Selection Requirements: Provide each type of firestop system, selected from manufacturers tested assemblies to conform to indicated requirements.

1. Where manufacturer does not have a standard assembly to conform, provide a system acceptable to authority having jurisdiction based on an Engineering Judgement.

1.6 Quality Assurance

A. Manufacturer's Qualifications: A firm which has been manufacturing firestopping for minimum five (5) years. Firm shall manufacture a full line of firestopping products including caulks, sealants, putty, wrap strip, composite sheets, mortar, sprays and pipe choke systems. Manufacturer's Engineer shall have minimum five (5) years experience selecting and engineering firestopping systems.

B. Manufacturer's Technical Field Representative Qualifications: An individual with minimum five (5) years full time experience specializing in selection and application of firestopping systems and certified in writing by manufacturer.

C. Installer's Qualifications: Each individual installer of firestopping shall have completed indicated on-site training program and shall be certified as trained in proper procedures of product installation by Manufacturer's Technical Field Representative.

D. Single Source Responsibility: Obtain each type of firestopping system listed below from one (1) manufacturer.

1. Perimeter fire containment systems.

2. Through-penetration firestop systems, except cable-tray systems.

3. Cable-tray through-penetration firestop systems.

4. Joint systems.

5. Wall or ceiling opening protective materials.

E. Regulatory Requirements:

1. Systems shall be UL labeled and listed in UL Fire Resistance Directory as appropriate for their intended use.

2. Comply with applicable State and Local Code requirements.

F. Firestopping sealants and primers must meet or exceed applicable VOC limits of South Coast Air Quality Management District Rule No. 1168 in effect on January 1, 2003 and rule amendments dated October 3, 2003.

G. Field Samples: Install one (1) Sample in field at location approved by Design Professional for each type of firestopping.

1. Notification: Schedule for Project Site observation by Design Professional accompanied by Manufacturer's Technical Representative, Contractor and Owner's Representative.

2. Report: Manufacturer's Field Representative shall certify in writing on letterhead that field samples comply with specified requirements.

3. Protection: Approved Samples shall be labeled and protected through the remainder of Work. Approved Samples shall be incorporated into completed Work.

H. Installer's Training Program:

1. Each installer of fireproofing shall be trained and certified in writing by manufacturer prior to starting Work.

2. Manufacturer's Technical Field Representative: Conduct training program on Project Site.

3. Certificates: Manufacturer's Technical Field Representative shall issue a certificate, 8 1/2 inches by 11 inches and wallet size, to each individual installer indicating completion of training program for this Project.

4. Program: Provide written instructions for installation of systems selected for this Project. Provide printed training aids, instructions, manufacturer's contacts and other pertinent information.

I. Preinstallation Conference: Schedule conference approximately two (2) weeks prior to scheduled commencement of firestopping installation and associated Work. Meet at Project Site with Contractor, Subcontractors, and Installers of associated Work including mechanical and electrical Work; Firestopping Manufacturer's Representative; and Other Representatives directly concerned with performance of Work including (where applicable) Owner's Insurers, Test Agencies, and Governing Authorities.

1. Review foreseeable methods and procedures related to firestopping work. Tour representative areas where firestopping is to be installed; inspect and discuss each type of condition, each type of substrate encountered, and preparatory Work to be performed under other Sections.

2. Contractor shall record discussion, including agreement or disagreement on matters of significance; furnish copy of recorded discussions to each participant. If substantial disagreements exist at conclusion of conference, determine how disagreements will be resolved and set date for a reconvening conference.

J. Inspection: At discretion of Owner's Representative, Owner will employ and pay for a qualified Inspection and Testing Agency to verify installed firestopping systems for compliance with requirements.

1.7 Delivery, Handling And Storage

A. Deliver firestopping products to Project Site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacturer, lot number, and shelf life, if applicable; UL mark; curing time; and mixing instructions for multi-component materials.

B. Store and handle firestopping materials to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.8 Project Conditions

A. Verify each type of condition and each type of substrate to be encountered.

B. Environmental Requirements: Ambient or substrate conditions as recommended in writing by manufacturers.

1.9 Sequencing And Scheduling

A. Owner's Inspection Agency: Notify minimum one (1) week in advance of firestopping installations.

B. Inspection: Do not cover or conceal firestopping until Owner's Inspection and Testing Agency and authorities having jurisdiction (if either is required) have inspected and approved installation.

1.10 Warranty

A. Warranty: Warrant for a period of one (1) year from Date of Substantial Completion against deterioration or failure in labor or materials.

Part 2 Products

2.1 Manufacturers

A. Products of following manufacturers are acceptable to furnish firestopping systems, subject to compliance with indicated criteria. Equivalent products of other manufacturers will be evaluated as substitutions in accordance with requirements of Division 01.

1. 3M Fire Protection Products.

2. Hilti Inc.

3. Nelson Firestop Products.

4. The Rectorseal Corporation.

5. Specified Technologies, Inc.

2.2 Materials

A. Use adhesives and sealants that comply with the VOC limits specified in Sustainability Requirements: Division 01.

B. Use paints and coatings that comply with the VOC limits and chemical restrictions specified in Sustainability Requirements: Division 01.

C. General:

1. Cold Smoke Seals: Seal against cold smoke and gases without requiring materials to be exposed to heat or flame.

2. Water Leakage: Firestopping systems in floor/ceiling and roof/ceiling assemblies or when exposed to the exterior in the finished construction shall have a W-rating of Class I when tested in accordance with UL Water Leakage Test under ANSI/UL 1479.

3. Sealing Materials:

   a. Flexible in cured or set state to allow for minimum plus-or-minus 25 percent movement without detrimental effect.
   b. Comply with ASTM C 920, type, grade, and class to suit location.

4. Asbestos-free in accordance with 40 CFR, Part 763, Subpart F, Appendix A, Section 1 “Polarized Light Microscopy”.

5. Compatibility: Materials compatible with substrate, penetrating material and other contacting materials.

6. Firestopping Pillows: Not acceptable.

7. Mortar or Fibrous Fill Systems: Not acceptable without an elastomeric sealant, except at systems with an appropriate “L” rating.

8. Volatile Organic Compounds (VOCs) Compliant.

9. Firestopping exposed to view, traffic, moisture, and physical damage: Products that do not deteriorate when exposed to these conditions.

   a. Plumbing and Wet-Pipe Sprinkler Systems: Moisture-resistant through-penetration firestop systems.
   b. Floor penetration with annular spaces exceeding 4 inches in width and exposed to possible loading and traffic: Systems capable of supporting floor loads involved.

10. Insulated Piping: Systems not requiring removal of insulation.

11. Combustibility: Flame-spread values of less than 25 and smoke-developed values of less than 450, as determined per ASTM E 84.

D. Through-Penetration Firestops, except cable-tray systems:

1. F-Rating: Equal to or exceeding the fire rating of penetrated assembly.

2. T-Rating: Equal to or exceeding fire rating of penetrated assembly in the following locations:

a. Where penetration is not concealed in a wall cavity.
b. Where penetration is not concealed in a shaft.
c. Where penetration is located in an assembly required to have doors with a temperature-rise rating.
d. Where penetrating item is larger than 4 inch nominal pipe diameter or 16 square inches in cross-sectional area.

E. Cable Tray Through-Penetration Firestop System: Resealable system complying with criteria above, utilizing a two (2) piece flanged metal enclosure, intumescent sponge, mineral wool and sealant. Provide products of CSD Firestop by CSD Sealing Systems.

F. Multi-Cable Through-Penetration Firestop System: Resealable system complying with criteria above, utilizing a metal frame, modular inserts, and a compression device.

1. Products: MCT by Nelson or Roxtec Inc. Cable Firestop Sealing Systems.

2. Size for 150 percent of capacity required for cables indicated.

G. Joint Systems:

1. Rating: Equal to or exceeding fire rating of adjacent assembly.

2. Joints systems at edges of unrated floor/ceiling assemblies: Minimum one (1) hour.

3. United States Gypsum Products are approved in addition to previously specified manufacturers.

H. Wall or Ceiling Opening Protective Materials:

1. Rating: Equal to or exceeding fire rating of adjacent assembly.

2. Firestopping used as draftstopping at head of partitions which do not extend to structure above: minimum one (1) hour.

I. Sleeves: As specified in Divisions 22, 23 and 26 for penetrating items included in those Sections. Unless otherwise indicated, provide manufacturer's written recommended sleeve.

J. Accessories: Components required for each firestopping system to comply with specified criteria and as required in writing by manufacturer.

Part 3 Execution

3.1 Examination

A. Substrate: Examine for compliance with requirements affecting performance of firestopping.

B. Corrections: Do not proceed with installation until unsatisfactory conditions have been corrected.

C. Acceptance: Commencing installation constitutes acceptance of substrate.

3.2 Preparation

A. Cleaning: Comply with manufacturer's written recommendations and the following:

1. Remove foreign materials from substrates and penetrating items.

2. Remove laitance and form release agents from concrete.

B. Priming: As recommended in writing by manufacturer. Confine primers to areas of bond.

C. Masking: Prevent firestopping from contacting adjoining surfaces that will remain exposed upon completion of Work.

3.3 Installation, General

A. General: Comply with approved submittals.

B. Forming/Damming Materials: As required to support materials to produce cross-sectional shapes and depths required to achieve fire ratings. Remove forming/damming materials and other accessories not indicated as permanent components of systems.

C. Fill Materials:

1. Fill voids and cavities.

2. Fill materials exposed in finished Work to smooth, uniform surfaces flush with adjoining finishes.

D. Sealant Materials:

1. General: Comply with ASTM C 1193.

2. Joint Fillers and Backers: Support sealants at position to allow optimum movement capability and develop required fire rating.

3. Sealant: Install sealants to directly contact and fully wet joint substrates, fill recesses, and provide proper and uniform cross-sectional shapes and depths. Install sealants at same time joint fillers are installed.

4. Tooling: Tool immediately after sealant application and prior to skinning or curing. Form smooth, uniform beads, eliminate air pockets, and ensure adhesion of sealants with sides of joint. Remove excess. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved in writing by sealant manufacturer.

3.4 Installing Firestop Systems

A. Install joint systems at each listed location:

1. Perimeter construction gaps and field joints in rated wall assemblies.

2. Perimeter construction gaps and field joints in all floor/ceiling assemblies, rated and non-rated.

3. Perimeter construction gaps and field joints in rated roof/ceiling assemblies.

B. Install through-firestop systems at each penetration through fire rated assemblies except as otherwise indicated.

1. Install through-firestop systems at each penetration through top member of partitions that do not extend to underside of structure to provide draftstopping.

2. Install through-firestop systems at each penetration of five-sided gypsum wallboard boxes surrounding elements recessed in rated partitions.

C. Install cable support/firestops in the following locations:

1. In floor and wall assembly penetrations of communication closets.

2. In floor and wall assembly penetrations of communications room.

D. Install Multi-Cable Through-Penetration Firestop System in the following locations:

1. In floor and wall assembly penetrations of communication closets.

2. In floor and wall assembly penetrations of communications room.

E. Install opening protective materials over each wall or ceiling opening in a fire rated assembly including, but not limited to, boxes for electrical, communication, data, control and instrumentation unless specifically exempted by code authority having jurisdiction.

3.5 Field Quality Control

A. Independent Inspection:

1. An independent Inspection Agency will examine completed firestopping to determine whether it is installed in compliance with requirements.

2. Inspection Agency will report observations promptly and in writing to Contractor and Design Professional.

3. Do not proceed to enclose firestopping with other construction until reports of examinations are issued.

4. Where deficiencies or non-compliances are found, repair or replace firestopping so that it complies with requirements at no additional cost.

B. Manufacturer's Technical Field Representative shall visit Project Site to inspect installed systems and installation procedures. Representative shall verify that each installer performing Work has completed project training program. Representative shall check that only approved materials and systems are being installed. Submit written Field Inspection Reports.

3.6 Protection

A. Protect firestopping during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so that they are without deterioration or damage at Date 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 produce firestopping complying with specified requirements.

3.7 Cleaning

A. Clean off excess fill materials and sealants adjacent to openings and joints as Work progresses, using methods and cleaning materials approved in writing by manufacturers of firestopping products and of products in which opening and joints occur.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Joint sealing at the following locations:

1. Joints exposed to weather in Finished Work.
2. Joints not exposed to weather, but visible in Finished Work, except tight joints between smooth materials.
3. Expansion joints and control joints, except where indicated or specified to be covered or made tight elsewhere.
4. Where required to make joints weathertight.
5. Joints between items of equipment and other construction.
6. Joints between plumbing fixtures and other construction.
7. Acoustical sealant work.
8. Foam Sealant.
9. Pre-formed Foam Sealant.
10. Where indicated and as otherwise required by Project conditions.

B. Joint sealant work specified as Work of other Sections, but required to comply with provisions of this Section, includes:

1. Sealant work internal to Membrane Roofing work specified in Division 07.
2. Sealant work internal to doors, windows, storefront and curtainwall, and butt joint and structural glazing specified in Division 08.
3. Acoustical sealant work in gypsum wallboard specified in Division 09.
4. Joint sealants in tile work specified in Division 09.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Firestopping: Division 07.

C. Exterior Enclosure, General: Division 07.

D. Joints in concrete slabs finish flooring: Division 09.

E. Mechanical: Divisions 22 and 23, refer to for packing and sealing within pipe sleeves for mechanical work.

F. Mechanical: Division 23, refer to for packing between metal ductwork and wall, floor, ceiling penetrations.

G. Electrical: Division 26, refer to for packing and sealing within sleeves for electrical work.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Product Data: Manufacturer's Product Specifications, handling, installation and curing instructions, for each product specified. Include manufacturer's written instructions for required cure time for inner line of sealant where double lines of sealant are indicated.

C. Samples: (For the following purposes):

1. Initial Selection: Manufacturer's standard bead. Samples consisting of strips of actual products showing full range of colors available, for each product exposed to view.

2. Verification: Samples of each type and color of joint sealant required. Furnish joint sealant Samples formed with 1/2 inch wide joints between two (2) 6 inch long strips of material matching appearance of exposed surfaces adjacent to joint sealant in Work.

D. Quality Control Procedures:

1. Test Reports:

a. Manufacturer's certified compatibility, nonstaining, and adhesion test reports for elastomeric sealants indicating that materials forming each joint substrate and joint backing have been tested for compatibility, nonstaining, and adhesion with proposed joint sealant.
b. Manufacturer's written interpretation of test results relative to product performance and recommendations for primers and substrate preparation needed to obtain adhesion.

E. Certifications: Manufacturer's written certification for each joint system including the following: Describe each joint system including each combination of substrates, sealants, backers, accessories, and joint profiles.

1. Each product to be furnished complies with Contract Documents.

2. Each product and system is recommended and approved in writing by manufacturer for intended application indicated, and lists requirements for primers, backers and accessories.

3. Each product and system is compatible with other materials in joint system and substrate.

F. Sustainability Submittals: Provide the following in accordance with Sustainability Requirements: Division 01.

1. Materials Sustainability Documentation Form.

2. Product data, certification letter, and costs for materials with recycled content.

3. Product data and costs for regional materials.

4. Product data for adhesives and sealants indicating VOC content.

1.4 Definitions

A. Joint sealants: "Caulk", "caulking", and "sealant" are synonymous, and mean "Joint Sealants" as indicated.

B. "Joints" include interfaces between general construction materials, and exposed interfaces between mechanical and electrical materials and other materials where mechanical and electrical work penetrates walls and floors, except where such penetrations are indicated to be covered and made tight by flanges, gaskets, escutcheons or similar devices.

C. Exposed: Joints exposed to view in Finished Work.

D. Concealed: Joints concealed from view in Finished Work.

E. Exterior: Joints at exterior surfaces of building, whether or not directly exposed to weather.

F. Interior: Joints at interior surfaces of building and not exposed to weather.

G. Masonry: Joints in unit masonry, concrete, precast concrete, rough stone, cut stone, ceramic and quarry tile, except paving.

H. Paving: Joints in floors, sidewalks, steps, ramps, curbs, and other traffic surfaces.

1.5 Quality Assurance

A. Installer shall have successfully completed within last three (3) years at least three (3) applications similar in type and size to this Project and shall assign mechanics from referenced applications, of whom one (1) shall serve as lead mechanic.

B. Obtain materials only from manufacturers who shall, if requested, send a qualified Technical Representative to Project Site to advise Installer of proper procedures and precautions for use of materials.

C. Single Source Requirements: Supply each type of sealant required for Work from one (1) manufacturer. Accessory products including, for example, backers, bond breakers and primers may be from other than primary manufacturer if approved in writing by primary manufacturer.

D. Referenced Codes and Standards: Comply with the following in accordance with Division 01.

1. ASTM International (ASTM)

C 790	Standard Guide for Use of Latex Sealants
C 804	Practices for Use of Solvent-Release Type Sealants
C 919	Practices for Use of Sealants in Acoustical Applications
C 1193	Guide for Use of Joint Sealants

2. Sealants: Professionals' Guide by Sealant, Waterproofing & Restoration Institute

E. Preinstallation Conference:

1. A preinstallation conference shall be held at Project Site to review requirements and procedures for installation of sealants, coordination and sequence of events, and any special Project conditions.

2. Meeting shall be attended by Owner's Field Representative, Contractor, Sealant Subcontractor, and other Subcontractors whose Work requires or may affect or be affected by joint sealants.

F. Inspection and Testing: Services of an Inspection and Testing Agency are required in conjunction with Work of this Section. Refer to Division 01.

1. Do not cover Sealant Work that is to be inspected or tested, including but not limited to the inner line of double lines of sealant, until directed.

1.6 Delivery, Handling And Storage

A. Packing, Shipping: Ship in labeled containers indicating compliance with specified criteria, storage and environmental conditions and installation instructions.

B. Handling and Storage: Comply with manufacturer's written recommendations.

1.7 Project Conditions

A. Environmental Requirements: Perform Work under climatic conditions recommended in writing by material manufacturer.

1.8 Special Warranty

A. Warrant Work to be waterproof, windproof, and dustproof for a period of five (5) years following Date of Substantial Completion. Repairs or replacements required during this period shall be at no additional cost.

Part 2 Products

2.1 Sealants

A. Colors: For each of sealant types listed, provide colors as indicated. Manufacturer's full line of colors shall be all colors published in promotional literature without regard to cost.

1. General Use Weatherproofing Sealants: colors selected from manufacturer's full line.
2. Paving and Floor Sealants: colors selected from manufacturer's full line.
3. Interior Sealant colors selected from manufacturer's full line.
4. Special Use Sealants: colors selected from manufacturer's full.

B. Use adhesives and sealants that comply with the VOC limits specified in Sustainability Requirements: Division 01.

C. General Use Weatherproofing Sealants:

1. Type 2: Silicone, single-part, non-sag, neutral cure, ASTM C 920, Type S, Grade NS, Class 50, for Use NT.
    a. Acceptable Products:
        1) Dow Corning Corporation; "790" and "795".
            a) Do not use "795" with porous substrates.
        2) GE Advanced Materials; "SilPruf SCS 2000".
        3) Tremco; "Spectrem 1", "Spectrem 2", or "Spectrem 3".
        4) Pecora Corporation; "864NST".

D. Paving and Floor Sealants:

1. Type 5: Silicone, one-part, self-leveling and non-sag, for traffic use, ASTM C 920, Grade P or Grade NS, Class 25 (FS TT-S-227E, Class A, Types I and II).
    a. Acceptable Products: Self-leveling listed first, non-sag in parentheses:
        1) Dow Corning Corporation; "SL Parking Structure Sealant", (NS Parking Structure Sealant).
        2) Pecora Corporation; "300 SL" or "310 SL", ("301 NS" or "311 NS").

E. Interior Sealants:

1. Type 7: Silicone, single-part, mildew-resistant, acid or neutral cure, for non-traffic use, USDA/FDA compliant, ASTM C 920, Type S, Grade NS, Class 25 for Use NT.
    a. Acceptable Products:
        1) Dow Corning Corporation; "786 Mildew Resistant".
            a) Do not use with porous substrates.

2) General Electric Company; “Sanitary SCS 1700”.

a) Do not use with porous substrates.

3) Pecora Corporation; "898 NST".

2. Type 8: Acrylic Latex, ASTM C 834.

a. Acceptable Products:

1) Bostik, Inc.; “Chem-Calk 600”.

2) Pecora Corporation; "AC-20+".

3) Tremco; "Tremflex 834".

3. Type 10: Acoustical sealant, concealed, non-drying, non-hardening, non-skinning, non-staining, gun-grade, synthetic rubber sealant for sealing interior concealed joints to reduce transmission of airborne sound.

a. Acceptable Products:

1) Pecora Corporation; "BA-98”,non-skinning butyl.

2) USG, “Sheetrock Acoustical Sealant”.

2.2 Primers

A. Non-staining, compatible with sealer and substrate, and manufactured or recommended in writing by sealant manufacturer. Comply with specified VOC requirements.

2.3 Joint Backing (Backer Rod)

A. Preformed compressible, resilient, nonwaxing, nonextruding, nonstaining strips, polyethylene foam, closed cell sponge neoprene, urethane foam, or neoprene, butyl or EPDM tubing, ASTM D 1056, as recommended in writing by sealant manufacturer. Backing shall be of sizes and shapes to control sealant depth and otherwise contribute to optimum sealant performance, sized to suit various conditions, and shall be compatible with sealant, primers and substrates.

2.4 Bond Breaker

A. Polyethylene or other plastic tapes as recommended in writing by sealant manufacturer for preventing bond between sealant and materials at back (3rd) surface of joint.

2.5 Miscellaneous Materials

A. Provide masking type and cleaning agent as recommended in writing by sealant manufacturer.

2.6 Weep Tubes

A. 3/8 inch diameter plastic weep tube with compressive polyethylene filler.

2.7 Foam Sealants

A. Foamed in Place (FIP) Sealant: Moisture cured, hydrophobic, low-expansion, one or two component urethane expanding foam sealant, containing no formaldehyde, CFCs or HCFCs.

1. Fire Performance: Maximum flame spread index of 25 and smoke developed index of 250 per ASTM E 84.

2. Acceptable Products:

a. Great Stuff Pro by Dow Chemical Company.
b. Pur Fill 1G by Todol Products.
c. Zerodraft Foam Sealant by the Zerodraft Division of Canam Building Envelope Specialists.

B. Preformed Foam Sealants: High-density urethane foam impregnated with a nondrying, water repellent agent; faced with a layer of silicone, factory-produced in precompressed sizes in roll or stick form to fit joint widths and to develop a watertight and airtight seal. Products shall be permanently elastic, mildew-resistant, non-migratory, nonstaining, and compatible with adjacent materials.

1. Acceptable Products: Emseal Corporation; "Colorseal" or equivalent by LymTal International, MM Systems Corp., Schul International, or Watson Bowman Acme Corp. (BASF).

Part 3 Execution

3.1 General

A. Each joint sealant system shall include cleaning of joints, priming where required, backing as specified, masking along both sides of joints where required, bond-breaker where conditions of joints require, and finish sealing with type of material specified.

B. Comply with approved submittals and manufacturer’s written requirements.

3.2 Schedule Of Systems

A. Exterior joints, and interior side of exterior curtainwalls and storefront, unless otherwise indicated: Type 1 or 2.

B. Joints In Paving:

1. Exterior: Type 4 or 5; pourable type allowed where gradients are 3 percent or less.

2. Interior: Type 4 or 5 except joints indicated to be filled in specification for overlying finish.

C. Interior Work, other than interior side of exterior curtainwalls or window walls:

1. Toilet rooms, janitor closets and similar damp areas: Type 7.

2. Concealed, except acoustic: Type 8.

3. Concealed, acoustic: Type 10.

4. Exposed, unless otherwise indicated: Type 8 and Type 7.

3.3 Examination

A. Project Site Verification of Conditions:

1. Substrates: Examine for conformance to requirements indicated for that substrate.

2. Existing Substrates: Examine for conditions that adversely affect execution of Work and that are not included in indicated repair and patching.

B. Conditions: Report unsatisfactory conditions to Contractor prior to commencing Work.

C. Corrections: Make corrections to substrates prior to commencing Work at no additional cost.

D. Acceptance: Provide rework required because of installation over deficient or defective substrates at no additional cost.

3.4 Preparation

A. Cleaning: Clean joints of loose particles, dust, and other materials detrimental to adhesion.

B. Masking: Mask edges of joints to prevent misplacement of primer or sealant onto adjacent exposed surfaces.

C. Priming: Apply primer as recommended in writing by sealant manufacturer, to dry surfaces prior to application of joint backing, bond-breaker or sealants.

D. Surface Preparation: At substrates with pinholes, pock marks, honeycombing or other similar surface irregularity including, but not limited to, cast-in-place concrete, pre-cast concrete, cast stone, or open textured stone, pre-fill with a skim coat of sealant tooled to fill irregularities.

E. Joint Backing:

1. Install where indicated and in joints where depth of joint exceeds required depth of sealant.

2. Install to provide backing and uniform depth of sealant.

3. Install with approximately 30 percent compression.

4. Do not stretch, twist, puncture or tear joint backing.

5. Butt joint backing at intersections.

F. Bond Breaker: Install bond breaker smoothly at back of joint to eliminate three-sided adhesion where joint backing cannot be installed.

3.5 Installation

A. Sealant Application: Apply sealant in accordance with manufacturer's written instructions and referenced standards, using hand guns or pressure equipment with proper nozzle size. Force sealant into and against sides of joint. Avoid pulling of sealant from sides. Fill joint completely with sealant.

B. Install weep tubes at spacing recommended in writing by window and skylight manufacturers and as indicated for sealant work at window sill framing, base of curtainwall framing, skylight framing and storefront sill framing, as a part of sealant work. Do not apply sealant in or block weepholes.

C. Tooling:

1. Typical Joints: Tool exposed surfaces to compress sealant to concave joint configuration in accordance with ASTM C 1193, Figure 8A.

2. Horizontal Joints: Tool to provide a slight wash.

3. Recessed Joint: Tool to configuration in accordance with ASTM C 1193, Figure 8C.

4. Joints shall be straight, uniform, smooth and neatly finished.

5. Tooling agents shall only be used as recommended in writing by sealant manufacturer.

D. Double Line of Sealant:

1. Sequencing: Install inner line, allow curing, and obtaining approval from Independent Testing and Inspection Agency before installing outer line of sealant.

2. Maintain a minimum 1/2 inch cavity between inner and outer lines of sealant and backers.

3. Where cavity between lines of sealant is interrupted, continue inner line to seal bottom of cavity and weep to exterior. Stop the outer line of sealant short a minimum 1/2 inch at the bottom of the cavity and connect the two lines of sealant at the top to create a pressure-equalizing chamber.

E. Pour self-leveling traffic grade sealants in horizontal joints to 1/16 inch below adjoining surface, except where other level shown.

F. Against rough surfaces or in joints of uneven widths, locate sealant back into joint to avoid appearance of excess sealant.

G. Special Sealing: Coordinate with work of Divisions 22, 23 and 26 to provide special sealing around mechanical and electrical equipment.

1. Sealant installation shall create continuous, washable and vermin proof joints. Joints shall remain watertight under direct high-pressure hose spray.

2. At gasketed access panels, light fixtures, mechanical diffusers and similar operable panels, frames or doors, seal fixture or equipment housing to adjacent construction, allow for operation of panel, frame or door.

H. Installation of Foamed in Place Sealants: Comply with manufacturer's written instructions. Fill all voids to create an airtight seal. Do not over fill or allow expanding foam to move or dislocate adjacent construction. Do not allow foam to expand beyond the face of adjacent surfaces.

I. Installation of Preformed Foam Sealants: Comply with manufacturer's written instructions. Install each length immediately after removing protective wrapping. Do not pull or stretch material. Ensure seal continuity at ends, turns, and intersections of joints. At low ambient temperatures, apply heat where expansion of sealant requires acceleration to produce seal.

J. Gun-Applied Epoxy Grout: Since product produces a vapor retarder, do not apply to surfaces where transmitted vapor can condense and freeze under coating.

3.6 Cleaning

A. Strip off protective masking tape immediately after compound has been applied. Strip toward joint. Do not reuse masking material. Discard tape carefully to prevent defacing adjacent surfaces.

B. Clean off excess compound or smears with cleaning material recommended in writing by manufacturer of compound.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Flush steel doors and pressed steel frames.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Wood Doors: Division 08.

C. Door Hardware: Division 08.

D. Painting: Division 09.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Shop Drawings: Indicate fabrication and installation of each door and frame. Show elevations of each frame and door type. Show details of construction, installation, connections, anchors, reinforcement, hardware preparation and floor and threshold clearances.

C. Product Data:

1. For each component or material required including accessories, anchors, and other miscellaneous products including data substantiating compliance with Specifications.

2. Schedule: Show each door and opening, unique for actual location, using room number, and sub number if more than one door or opening per room. Show, as a minimum, the same information as on schedule included herein. Show hardware group on schedule.

    a. Where doors or opening are indicated by generic type instead of unique mark for actual location, list all doors and openings by unique mark under each heading for the generic type indicated.
    b. Provide one schedule for the entire project, coordinate schedule for doors and openings of materials specified in other sections.

D. Qualifications: Manufacturer's qualification data.

E. Sustainability Submittals: Provide the following in accordance with Sustainability Requirements: Division 01.

1. Materials Sustainability Documentation Form.

2. Product data, certification letter, and costs for materials with recycled content.

3. Product data and costs for regional materials.

1.4 Quality Assurance

A. Manufacturer's Qualification: Manufacturer shall have minimum five (5) years experience producing products similar to those required for this Project. Manufacturer shall have documented experience of successfully providing products for three (3) projects of scope, schedule and complexity similar to this Project within last two (2) years.

1. Manufacturer shall currently be a member in good standing of SDI and shall have been so for previous three (3) years. Submit membership certification.

2. Submit qualifications on manufacturer's letterhead. Include project descriptions with Owner and Design Professional contacts for previous experience.

B. Single Source Requirements: All doors and frames required for Work of this Section shall be supplied by one (1) manufacturer. Accessory products including fasteners and anchors may be from other than primary manufacturer if approved in writing by primary manufacturer.

C. Regulatory Requirements: Comply with the following per Division 01.

1. Fire Rated Assemblies: Units shall comply with NFPA 80, shall be identical to assemblies whose fire resistance characteristics have been determined in accordance with ASTM E 152, and shall be labeled and listed by Underwriters Laboratories, Inc. (UL), Warnock Hersey, Inc. (WHI) or other Inspection and Testing Agency acceptable to code authorities having jurisdiction.

   a. Rate of rise for indicated doors shall be a maximum transmitted temperature end point of not more than 250 degrees F above ambient at end of 30 minutes of standard fire test exposure.
   b. Installed Door and Frame Assembly: Shall conform to NFPA 80 for fire rated class indicated.

2. Conform to requirements of ANSI A 117.1, unless otherwise indicated.

D. Referenced Codes and Standards: Comply with the following in accordance with Division 01.

1. Door Hardware Institute (DHI)

   The Installation of Commercial Steel Doors and Steel Frames, Insulated Steel Doors in Wood Frames and Builder's Hardware

2. Steel Door Institute (SDI), SDI-100 "Recommended Specification Standard Steel Doors and Frames"

1.5 Delivery, Handling And Storage

A. Deliver clearly labeled, undamaged materials in a timely manner to allow for minimum storage time at Project Site.

B. Deliver doors and frames palleted, wrapped or crated to protect from damage.

C. Break seal of packaging to permit ventilation. Remove any wet or damp packaging.

D. Store materials on planks or dunnage in a clean, dry location, protected from weather and abuse. Store doors in a vertical position, spaced by blocking to permit air circulation.

1.6 Coordination

A. Coordinate Work of this Section with Work in which hollow metal work is to be installed.

B. Coordinate hardware installation with opening construction. Hardware is specified in Door Hardware: Division 08.

C. Coordinate doors and frames with glass and glazing specified in Glazing: Division 08.

Part 2 Products

2.1 Manufacturers

A. Manufacturers shall comply with all specified qualifications and be capable of providing products complying with all specified criteria.

2.2 Materials

A. Cold-Rolled Steel Sheet: Commercial-quality, level, carbon steel complying with ASTM A 1008/ A1008M.

B. Hot-Rolled Steel Sheet and Strips: Commercial-quality carbon steel, pickled and oiled, complying with ASTM A 1011/ A1011M, free of scale, pitting or surface defect.

C. Galvanized Steel Sheet: Hot-dipped galvanized, carbon steel, commercial-quality, complying with ASTM A 924 or ASTM A 653 with G60 coating, mill phosphatized.

D. Inserts, Bolts and Fasteners: Manufacturer's standard units, hot-dipped galvanized complying with ASTM A 153, Class C or D, where frame is galvanized.

E. Primer: Rust-inhibitive paint complying with ANSI A224.1, "Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames."

F. Glazing: Refer to Glazing: Division 08.

2.3 Doors

A. General:

1. Doors shall be of types and sizes indicated, with no visible seams, joints, welds or dimples on their faces.

2. Minimum Door Thickness: 1 3/4 inch.

3. Vertical Edge Profiles:

   a. Single-acting Swing Doors: Beveled 1/8 inch in 2 inches.
   b. Double-acting Swing Doors: Rounded on 2 1/8 inch radius.

4. Top and Bottom Edges: Close with a continuous recessed steel channel, extending full width of door and spot welded to both faces.

   a. Flush Closure: Close to provide flush, waterproof seal by addition of welded inverted channel at exterior doors.

B. Interior Doors: Fabricate from two (2) outer cold-rolled, stretcher-leveled steel sheets, to comply with SDI Grade II, Models 1 or 2 minimum 18 gage.

1. Core Material: Manufacturer's standard steel stiffeners, insulation, unitized steel grid or rigid mineral fiber core, with sound deadener on insides of face sheets where appropriate.

C. Hardware Reinforcements:

1. Mortise, reinforce, drill and tap at factory for fully templated hardware in accordance with Hardware Schedule and templates provided per Door Hardware: Division 08.

2. Reinforce at factory for surface-mounted hardware.

3. Minimum gages and sizes per Steel Door Institute (SDI).

D. Astragals:

1. Interior Doors: Overlapping rabbet formed into edge of door.

2.4 Hollow Metal Panels

A. Hollow metal panels shall be fabricated of same materials and constructed and finished in same way as specified for hollow metal doors.

1. Edge Detail Between Flush Doors and Panels: Plain design, surface-mounted plate continuously welded to panel.

2.5 Hollow Metal Frames

A. Interior Openings: Form from commercial-quality, cold-rolled steel. Minimum 16 gage.

B. Design and Construction:

1. Form frames into units with integral trim of sizes and profiles indicated.

a. Fabricate interior frames with mitered or coped corners knocked down for field assembly.

2. Grind, fill and dress welds to be invisible and provide a flush, smooth surface.

3. Multiple or Special Openings: Mullion and rail members shall be closed tubular shapes having no visible seams or joints. Joints shall be welded and finished smooth.

4. Dust Cover Boxes (or Mortar Guards): Provide minimum 26 gage steel boxes at hardware mortises on frames to be set in masonry or plaster partitions.

C. Hardware Reinforcements:

1. Mortise, reinforce, drill and tap at factory for fully templated hardware in accordance with Hardware Schedule and templates provided per Door Hardware: Division 08.

2. Reinforce at factory for surface-mounted hardware.

3. Minimum hardware reinforcing as recommended in writing by Steel Door Institute (SDI).

D. Floor Anchors:

1. Welded inside each jamb with two (2) holes for floor anchorage.

2. Minimum Thickness: 18 gage.

E. Jamb Anchors:

1. Frames for Installation in Stud Partitions: Welded steel anchors of suitable design, not less than18 gage.

2. Frames anchored to previously placed concrete, masonry or structural steel: Welded-in steel anchors for expansion bolts or machine bolts. Provide anchors within 6 inches of head and jamb and at maximum 26 inches on center. Provide snap-in metal cap to cover bolt head access hole.

3. Anchors Required in Each Jamb of Welded Frames: One (1) anchor at or aligned with each hinge.

a. Frames over 42 inches wide: Two (2) anchors plus one (1) for each 24 inches or fraction thereof in width over 42 inches.

2.6 Glass Moldings And Stops

A. Molding and Stops: Minimum 20 gage steel with mitered corner joints.

B. Glass Moldings at Doors:

1. Overlapping Type: Molding shall overlap cutout in door faces. Fixed stop shall be welded in place.

C. Loose Stops: Secure to opening by non-tamper "Spanner" type cadmium or zinc-coated countersunk screws. Snap-on attachments are not acceptable.

2.7 Hardware Locations

A. General: Locate hardware as indicated and as shown on final Shop Drawings. If location is not indicated, comply with published SDI recommendations.

2.8 Fire Rated Assemblies

A. Provide appropriate label based on hourly fire ratings as indicated. Door frames with fire windows exceeding sizes for which label service is offered shall be inspected in accordance with NFPA 80.

1. Permanently attach labels to hinge side of labeled doors and jambs (hinge side) of labeled frames.

    a. Where continuous hinges are indicated, door manufacturer shall permanently attach labels to top edge of labeled door.

2. Where pairs of door are to be labeled, doors assemblies shall have passed appropriate UL test and NFPA criteria without use of astragals, except for A Labeled, 3-hour fire rated door assemblies.

B. Notwithstanding other requirements of this Specification, supply gage of metal, method of construction, hardware preparation, glass size restriction, and other specifics required to obtain label. Label shall contain fire-resistance rating (for example, 20 minute, 30 minute, 45 minute, 1 hour, 1 1/2 hour, and 3 hour). Fire doors, when used in stairway enclosures, shall be so constructed so that maximum transmitted temperature and point shall not exceed 450 degrees F above ambient at end of 30 minutes of Standard Fire Exposure Test and shall be so noted on label.

2.9 Factory Priming

A. Finish: After fabrication, tool marks and surface imperfections shall be removed, and exposed faces of welded joints shall be dressed smooth. Frames shall be chemically treated to insure maximum paint adhesion and shall be coated on accessible surfaces with a rust-inhibitive primer which is fully cured before shipment.

2.10 Clearances And Tolerances

A. Comply with requirements of SDI-117.

Part 3 Execution

3.1 Examination

A. Prior to installation, all frames shall be checked and corrected for size, swing, squareness, alignment, twist and plumbness in accordance with published SDI recommendations.

B. Verify that opening sizes and tolerances are acceptable.

C. Report deficiencies to Owner's Representative prior to commencing Work.

D. Commencing Work constitutes acceptance of substrates and rough openings. Provide future work or re-work required because of deficient substrates or rough openings at no additional cost.

3.2 Installation Of Hollow Metal Work

A. Install hollow metal work in compliance with SDI published recommendations, manufacturer's written instructions, and approved submittals. In the event of a discrepancy, most stringent requirement shall prevail.

B. Install fire rated doors and frames as per local code or NFPA 80, whichever is more stringent.

C. Erect frames plumb, square and aligned by use of accurate instruments. Brace frames to maintain positioning during building-in of adjacent dissimilar work.

D. Anchor each frame to adjacent construction as indicated and in accordance with approved submittals.

E. Field weld where required, grind, fill and finish to be invisible and match adjacent surfaces.

F. Keep spreaders in place until surrounding work is complete. Brace midspan of frames as required to prevent bowing. Remove spreaders and bracing when frames are firmly set. Spreaders shall not be used for installation purposes.

3.3 Cleaning And Touch-Up

A. After installation, clean doors and frames of dirt, grime, grease and oil, and touch up scratched or damaged surfaces. Use type of primer used for or compatible with shop primer.

3.4 Installation Tolerances

A. Squareness: Plus or minus 1/16 inch measured on a line 90 degrees from one (1) jamb, at upper corner of frame at other jamb.

B. Alignment: Plus or minus 1/16 inch measured on jambs on a horizontal line parallel to plane of wall.

C. Twist: Plus or minus 1/16 inch measured at face corners of jambs on parallel lines perpendicular to plane of wall.

D. Plumbness: Plus or minus 1/16 inch measured on jamb at floor.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Flush-faced, architectural-grade wood doors as follows:

1. Solid-core doors with paint grade, faces.
2. Factory fitting flush wood doors to frames and factory machining for Finish Hardware.
3. Fire rated doors.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Finish Carpentry: Division 06.

C. Architectural Woodwork: Division 06.

D. Standard Hollow Metal Doors and Frames: Division 08.

E. Door Hardware: Division 08.

F. Glazing: Division 08.

G. Painting: Division 09.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Shop Drawings:

1. Show fabrication and installation of each door. Show elevations of each door type. Show details of construction, installation, connections, anchors, reinforcement, hardware preparation and floor and threshold clearances.
2. Schedule: Show each door and opening, unique for actual location, using room number, and sub number if more than one door or opening per room. Show, as a minimum, the same information as on schedule included herein. Show hardware group on schedule.
   a. Where doors or opening are indicated by generic type instead of unique mark for actual location, list all doors and openings by unique mark under each heading for the generic type indicated.

b. Provide one schedule for the entire project. Coordinate schedule for doors and openings of materials specified in other sections.
c. Indicate field dimensions from datum elevation established under Architectural Woodwork: Division 06.

C. Product Data: For each type of door, including details of core and edge construction, trim for openings and louvers, and factory-finishing specifications.

D. Samples: Two (2) sets of 8 1/2 inches by 11 inches by thickness of door for the following: Samples shall show core construction on two (2) edges and stile and rail construction on two (2) sides.

1. Doors for Field Finish: Minimum of two (2) Samples demonstrating full range of color variation for type of door and each species of veneer.

2. Doors with Factory Finish: Minimum of two (2) Samples demonstrating full range of color variation for type of door and each species of veneer. Include stepped layers of required finish.

3. Metal Louvers: Blade and frame in 6 inch lengths for each type and finish.

4. Glazing Stops: 6 inch lengths of each type and finish.

E. Qualifications: Manufacturer's and Installer's qualification data.

F. Certifications: Certification letters where indicated.

1. Submit certification that the doors and frames comply with NFPA 252 or UL 10C Positive Pressure Fire Door Test.

2. Certify compliance with NWWDA and AWI standards.

G. Closeout Submittals: Special Warranty: Draft of Warranty prior to start of fabrication or construction. Final Warranty after Date of Substantial Completion.

H. Sustainability Submittals: Provide the following in accordance with Sustainability Requirements: Division 01.

1. Materials Sustainability Documentation Form.

2. Product data, certification letter, and costs for materials with recycled content.

3. Product data and costs for regional materials.

4. Product data, costs, and chain-of-custody certificates for products containing certified wood.

5. Product data for adhesives and sealants indicating VOC content.

6. Product data for paints and coatings indicating VOC content and chemical composition.

7. Product data for products containing composite wood or agrifiber products or wood glues indicating that they do not contain urea-formaldehyde resin.

1.4 Quality Assurance

A. Manufacturer's Qualifications: Manufacturer shall have minimum five (5) years experience producing products similar to those required for this Project. Manufacturer shall have documented experience of successfully providing products for three (3) projects of scope, schedule and complexity similar to this Project within last two (2) years.

1. Company marketing primary products specified for this Section shall also be manufacturer. Companies marketing products which are manufactured for private labeling by marketing company are not acceptable.

2. Submit qualifications on manufacturer's letterhead. Include project descriptions with Owner and Design Professional contacts for previous experience.

B. Installer's Qualifications: Installer shall have minimum five (5) years experience installing products similar to those required for this Project. Installer shall have documented experience of successfully completing three (3) projects of scope, schedule and complexity similar to this Project within last two (2) years. Submit qualifications on Installer's letterhead. Include project descriptions with Owner and Design Professional contacts for previous experience.

C. Single Source Requirements: All doors required for Work of this Section shall be supplied by one (1) manufacturer. Accessory products including, for example, fasteners, sealants and anchors may be from other than primary manufacturer if approved in writing by primary manufacturer.

D. Regulatory Requirements: Comply with the following per Division 01.

1. Fire Rated Assemblies: Units shall comply with NFPA 80, shall be identical to assemblies whose fire resistance characteristics have been determined in accordance with ASTM E 152, and shall be labeled and listed by Underwriters Laboratories, Inc. (UL), Warnock Hersey, Inc. (WHI) or other Inspection and Testing Agency acceptable to code authorities having jurisdiction.

   a. Stairway Enclosure Doors: Labeled means of egress fire doors in stairway enclosures shall have a maximum transmitted temperature end point of not more than 450 degrees F above ambient at the end of 30 minutes of standard fire-test exposure.
   b. Oversize Fire-rated Assembly Certificate: Submit certificate that each assembly required to be fire rated, but exceeding sizes of tested assemblies has been constructed to conform to design, materials, and details of construction equivalent to requirements for labeled units.

E. Referenced Codes and Standards: Comply with the following in accordance with Division 01.

1. National Wood Window and Door Association (NWWDA)

I.S.1	"Industry Standard for Wood Flush Doors"
	"How to Store, Handle, Finish, Install and Maintain Wood Doors"

2. Architectural Woodwork Institute (AWI): “Architectural Woodwork Quality Standards”, including Section 1300 “Architectural Flush Doors”, Grade As Indicated

F. Certifications: Certify compliance with NWWDA and AWI standards.

G. Preinstallation Meetings: Coordinate with meeting for Architectural Woodwork: Division 06.

1.5 Delivery, Handling And Storage

A. Store, handle, and ship doors to prevent damage, soiling or deterioration and so as not to void manufacturer's warranty. Comply with NWWDA recommendations.

B. Package each door leaf prior to shipping. Keep package intact until time of installation.

C. Mark each door with individual opening number which correlates with designation on approved submittals.

1.6 Project Conditions

A. Environmental Requirements: Do not deliver or install doors until conditions for temperature and Relative Humidity have been stabilized and will be maintained. Comply with AWI Section 100-S-3 “Moisture Content”.

1.7 Maintenance

A. Extra Materials: Furnish stain, putty, filler and finish required to patch damaged doors, minimum one (1) gallon of each.

1.8 Special Warranty

A. Furnish door manufacturer's warranty providing for replacement, rehanging and refinishing, at no additional cost, of any door that becomes defective due to delamination, warpage in excess of referenced standard, telegraphing of core construction, or other defects of manufacture.

1. Interior Doors: Life of original installation.

Part 2 Products

2.1 Approved Manufacturers

A. Products of indicated manufacturers are acceptable, contingent upon conforming to indicated requirements. Equivalent product substitutions by other manufacturers may be acceptable, subject to requirements of Division 01.

1. Algoma Hardwoods, Inc.

2. Eggers Industries.

3. Ipik Door Company, Inc.

4. Mohawk Flush Doors, Inc.

5. Weyerhauser Commercial Door Division.

2.2 Materials

A. Provide recycled content materials in accordance with Sustainability Requirements: Division 01 and as indicated below.

B. Provide regional materials in accordance with Sustainability Requirements: Division 01.

C. Provide certified wood-based materials in accordance with Sustainability Requirements: Division 01.

D. Do not use products or adhesives that contain urea-formaldehyde resin.

E. Use adhesives and sealants that comply with the VOC limits specified in Sustainability Requirements: Division 01.

F. Use paints and coatings that comply with the VOC limits and chemical restrictions specified in Sustainability Requirements: Division 01.

G. Particle Board: ANSI A208.1, Grade M2 exterior glue with minimum 90 percent recycled and recovered wood fiber.

H. Crossbands: Minimum 1/16 inch thick engineered fiberboard or hardwood crossbands, free of defects and voids.

I. Edge Strips and Blocks: Laminated strand lumber with exposed face for stiles as follows: Stiles shall be tested for minimum screw withdrawal load of 700 pounds per ASTM D 1037.

1. Stiles for Opaque Finish Doors: Exposed face shall be mill-option hardwood or softwood, single piece without joints.

J. Astragals: UL listed metal edge guards and astragals where required to maintain fire-rating.

2.3 Doors

A. Door Grade: AWI paint grade.

B. Construction: Fully bonded core construction, five (5) plies consisting of core, two (2) cross-bands and two (2) faces as follows:

1. Non-rated and 20 Minute Rated Doors: Particle Board Core, AWI Type PC-5 or Stave Lumber Core, AWI Type SLC-5.

2. Fire-rated Doors Over 20 Minutes: Mineral Core, AWI Type FD-5.

2.4 Glazing Beads

A. Metal Beads: Fabricate from minimum 20 gage cold rolled steel hot-dipped galvanized at exterior, welded into rigid unit.

1. Mounting: Frames fastened to each other without screwing to or through door.

2. Product: Model “LoPro” by Anemostat, Model VLF-EZ by Air Louvers Inc. or approved equivalent.

2.5 Louvers

A. Metal Louvers: Fabricate from minimum 18 gage cold rolled steel hot-dipped galvanized at exterior, welded into rigid unit.

1. Blade Type: Inverted Y.

2. Mounting: Frames fastened to each other without screwing to door.

3. Product: Model AFDL by Anemostat, Model 800-A-1 by Air Louvers Inc. or approved equivalent.

2.6 Fabrication

A. Fabricate non-rated doors per AWI Quality Standards requirements.

B. Fabricate rated doors per AWI Quality Standards requirements and as required for label or code authority.

C. Edge Strips and Blocks:

1. Minimum Edge Strip Thickness:

a. Top and Bottom Rail: 1 1/8 inches each.
b. Stiles: 1 3/8 inch.
c. Mineral Core: Per label requirements.

2. Blocking: Provide minimum 5 inch wide blocking at the following locations:

a. Top Rail: Surface mounted or recessed closers, door coordinators, face mounted bolts, surface mounted vertical rod exit devices, rabbeted transom panels.
b. Hinge Stile: Intermediate pivot hinges, surface mounted panic hardware.
c. Lock Stile: Surface mounted panic hardware, rabbeted astragals.
d. Bottom Rail: Surface mounted or concealed automatic door bottoms, floor mounted door closers, surface mounted vertical rod exit devices.
e. Exceptions: Blocking may be eliminated where hardware on both faces of door will conceal throughbolts in finished work and where core can be demonstrated to resist 700 pound withdrawal load per ASTM D 1037.

D. Door Edges:

1. Bevel: Provide standard bevel on door edges.

a. Provide paralleled bevel on double egress doors.
b. Provide standard radius on double acting doors and meeting rails of pairs of doors.

2. Astragals: Install astragals and edge guards only where required to maintain fire-rating of pairs of doors.

3. Rabbets: Cut rabbets at vertical edges of pairs of doors and at horizontal edges of flush transom panels.

E. Glazed Openings: Cut openings and temporarily install beads for field glazing.

F. Louvers: Cut openings and install louvers.

G. Prefit and premachine doors at factory. Prefit for size; premachine for beveling, mortising and drilling for finish hardware except for surface-mounted finish hardware.

1. Prefit to comply with indicated clearances and tolerances.

2. Premachine according to proper finish hardware templates.

3. Prepare doors for electrical hardware as required.

4. Cut to dimensions verified in field from datum line established under Section 064000 or allow for bottom of each door to be field cut.

2.7 Fire Rated Assemblies

A. Provide appropriate label based on hourly fire ratings as indicated. Doors exceeding sizes for which label service is offered shall be inspected in accordance with NFPA 80.

1. Permanently attach labels to hinge side of labeled doors.

2. Where pairs of door are to be labeled, doors assemblies shall have passed appropriate UL test and NFPA criteria without use of astragals, except for A Labeled, 3 hour fire rated door assemblies.

B. Notwithstanding other indicated requirements, furnish method of construction, hardware preparation, glass size restriction, and other specifics required to obtain label. Label shall contain fire-resistance rating, for example, 20 minute, 30 minute, 45 minute, 1 hour, 1 1/2 hour and 3 hour.

2.8 Prefinishing

A. Opaque Finish: Apply primer and finish coats in shop.

B. Surface Preparation: Prepare surfaces as required to:

1. Make substrates ready for application of finish or system.

C. Refer to Painting: Division 09 for finishing opaque finished architectural woodwork.

Part 3 Execution

3.1 Examination

A. Project Site Verification of Conditions:

1. Examine installed door frames for suitability and conformance to specified tolerances, type, size, and swing.

2. Report deficiencies to Contractor prior to commencing Work.

3. Commencing Work constitutes acceptance of frames. Provide future work or re-work required because of deficient frames at no additional cost.

3.2 Installation

A. Install non-rated doors per AWI Quality Standards requirements.

B. Install rated doors per AWI Quality Standards requirements and as required for label or code authority.

1. Machine doors for hardware.

2. Seal cut surfaces after fitting and machining.

C. Prefit and Premachined Doors: Fit to frame within indicated tolerances. Install surface mounted hardware.

D. Hardware: Carefully fit and attach hardware securely, using only screws and other fasteners furnished with hardware. Location of hardware is generally established on Shop Drawings. Location of items of hardware not so established will be as directed.

E. Clearances and Tolerances: Comply with AWI recommendations and as follows:

1. Jamb and Head and Gap at Pairs of Doors: 1/8 inch plus or minus 1/32 inch.

2. Thresholds and Hard Floor Finishes: 1/4 inch plus or minus 1/16 inch.

3. Carpet: 1/8 inch plus or minus 1/16 inch.

4. Fire-rated Doors: Comply with NFPA 80.

3.3 Adjusting

A. Operation: Rehang or replace doors which do not operate freely.

B. Factory Finish: Touch-up damage to factory finish. Replace or completely refinish doors if touch-up is visible from 3 feet under normal lighting.

3.4 Protection

A. Protect doors from damage.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Molded fiberglass reinforced plastic (FRP) doors complete with accessories.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Standard Hollow Metal Doors and Frames: Division 08.

C. Door Hardware: Division 08.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Shop Drawings:

1. Include elevations, assembly methods, hardware reinforcement locations and preparations, and opening identification.

2. Schedule: Show each door and opening, unique for actual location, using room number, and sub number if more than one door or opening per room. Show, as a minimum, the same information as on schedule included herein. Show hardware group on schedule.

C. Product Data: Color charts for selection by Design Professional of preliminary door color.

D. Samples: Color chips, minimum 6 inches square, of manufacturer's standard colors for final color selection.

E. Sustainability Submittals: Provide the following in accordance with Sustainability Requirements: Division 01.

1. Materials Sustainability Documentation Form.

2. Product data, certification letter, and costs for materials with recycled content.

3. Product data and costs for regional materials.

4. Product data for adhesives and sealants indicating VOC content.

1.4 Quality Assurance

A. Manufacturer Qualifications: Manufacturer shall have minimum five (5) years experience producing molded fiberglass reinforced plastic products.

1.5 Delivery, Handling And Storage

A. Delivery clearly labeled, undamaged materials in a timely manner to allow for minimum storage time at Project Site.

B. Protect doors with resilient packaging. Deliver to Project Site in manufacturer's packaging. Inspect for damage.

C. Store materials on planks or dunnage in a clean, dry location, protected from weather and abuse. Store doors in a vertical position, spaced by blocking to permit air circulation between them.

1.6 Special Warranty

A. Manufacturer shall guarantee doors for a period of five (5) years from Date of Substantial Completion against failure due to workmanship, materials or corrosion.

Part 2 Products

2.1 Approved Manufacturer

A. Products of Warminster Fiberglass Company, Southampton, PA are specified as Basis of Design. Substitution of equivalent products will be considered in accordance with requirements of Division 01 and this Section.

2.2 Materials

A. Minimum physical properties shall be as follows:

Table A

	Laminate Properties	**Value**	**Test Method**
1.	Tensile Strength	9,000 psi	ASTM D 638
2.	Flexural Strength	20,000 psi	ASTM D 790
3.	Barcol Hardness	40 Min. Average	ASTM D 2583
4.	Impact Resistance	12 ft-lbs/inch	ASTM D 256
5.	Heat Distortion Point	175 degrees F	ASTM D 384
6.	Density/Specific Gravity	93.6 PCF/1.5	ASTM D 792

	Laminate Properties	Value	Test Method
7.	Burning Characteristics	<25 Flame Spread	ASTM E 84
		<200 Smoke Density	

Table B

	Core Properties	Value	Test Method
1.	Thermal Conductivity	0.13	ASTM C 518
2.	Density/Specific Gravity	1.9 PCF/.03	ASTM D 1622
3.	Burning Characteristics	<35 Flame Spread	ASTM E 84
		<240 Smoke Density	

B. Procedure used in determining minimum properties shall be in accordance with ASTM standards, using method designated. Test prepared in accordance with ASTM D 618 Test Method.

2.3 FRP Doors

A. Fiberglass reinforced plastic doors shall be 1 3/4 inch thick by width and height as indicated. Doors shall be molded in matched molds to produce doors which have a smooth finish. Doors shall be molded in one (1) piece creating a seamless monolithic composite consisting of gel-coat, fiberglass reinforcement, polyester resin, insulating core and internal reinforcements.

B. Door sub-surface shall be of gel-coat with a smooth low luster finish free from fiber pattern, roughness or other irregularities and color similar to finish laminate. Gel-coat shall be 0.025 inch thick and shall be resistant to moisture, ultraviolet degradation, and many acids, alkalies and solvents in both liquid and vapor form.

C. Exterior laminate which chemically bonds with gel-coat shall be a minimum of 1/8 inch thick. Laminate consists of halogenated polyester resin and continuous strand fiberglass reinforcement and shall contain a minimum glass content of 25 percent. Laminate shall be fire-retardant with a Class l rating, and shall not support combustion.

D. Core shall be 1 1/2 inch thick with a minimum insulating R-value of 11.5. Core material shall be rigid closed cell, self extinguishing polyisocyanurate foam with a density of 1.9 pounds per cubic foot. Core shall be perforated to form resin posts during molding process which tie exterior laminates together.

E. Internal reinforcements shall be a combination of structural grain Balsa core, 1/8 inch thick steel flats and 1/8 inch thick fiberglass ribs. All reinforcements shall be incorporated into doors during molding process. Structural Balsa core shall be located on doors latch side, and used in combination with steel flats where high stress loads are induced by surface applied hardware such as closers and surface bolts. A continuous steel flat shall be located on door hinge side for optimum mortised or continuous hinge screw retention. Vertical fiberglass rib reinforcements shall be located 6 inches in from door sides to structurally rigidize door and minimize thermal warpage. Vertical reinforcing ribs shall leave a slight sink line full length on both sides of door, which is acceptable.

F. Doors shall be produced seamless by molding in place all mortises, openings, recesses and pockets.

Part 3 Execution

3.1 Door Installation

A. Doors shall be installed plumb, level and square. Hardware shall be applied and adjusted to achieve quiet and smooth operation. Door shall fit snugly and close without sticking or binding. Door clearances shall not exceed 1/8 inch at jambs and heads and 1/4 inch at meeting stiles for pairs of doors. Clearance between door bottom and finished floor or threaded shall not exceed 1/4 inch.

3.2 Protection

A. Fiberglass doors and frames shall be protected from damage during delivery handling and storage. Doors and frames shall be protected (wrapped) after installation and kept free of, for example, paint, plaster, cement and scratches, by Contractor.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Access doors, including wall and ceiling units as follows:

1. Access doors in various sizes and types as required, whether or not indicated, for access to each valve, waterhammer arrestor, backflow preventer, air vent, cleanout damper, fire damper, control, and other device, where access is necessary. Access doors are not required where lay-in acoustical ceilings provide adequate access.

2. Coordinate location and quantity with work of respective Sections for proper installation.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Product Data:

1. Manufacturer's published technical data and installation instructions for each type of access door assembly, including setting drawings, templates, instructions, and directions for installation of anchorage devices.

2. Access Door Schedule: Include types, general locations, sizes, wall and ceiling construction details, finishes, latching or locking provisions, and other data pertinent to installation.

C. Closeout Submittals: Special Warranty, as indicated.

D. Sustainability Submittals: Provide the following in accordance with Sustainability Requirements: Division 01.

1. Materials Sustainability Documentation Form.

2. Product data, certification letter, and costs for materials with recycled content.

3. Product data and costs for regional materials.

1.4 Quality Assurance

A. Single-Source Responsibility: Obtain access doors for entire Project from one (1) source from a single manufacturer.

B. Fire Resistance Ratings: Wherever a fire resistance classification is indicated, provide access door assembly with panel door, frame, hinge, and latch from manufacturer listed in Underwriters Laboratories, Inc.'s "Building Materials Directory" for rating indicated. Provide UL label on each fire-rated access door.

C. Size Variations: Obtain Design Professional's acceptance of manufacturer's standard size units, which may vary slightly from sizes indicated.

1. Coordination: Coordinate specific locations and sizes for required access doors with work of other sections requiring access to concealed equipment and as indicated on Coordination Drawings. Furnish inserts and anchoring devices that must be built into other Work for installation of access doors.

1.5 Special Warranty

A. Installation shall be Warranted for five (5) years from Date of Substantial Completion against defects in materials and workmanship. Submit certificate of Special Warranty.

Part 2 Products

2.1 Approved Manufacturers

A. Products of indicated manufacturers are acceptable, contingent upon meeting indicated requirements. Equivalent products of other manufacturers will be evaluated as substitutions in accordance with requirements of Division 01.

1. The Williams Brothers Corporation.
2. Milcor, Inc.
3. Karp Associates, Inc.
4. Nystrom.
5. Babcock-Davis.
6. Acudor Products Inc.
7. The Bilco Company (floor units only).
8. Dur-Red Products (floor units only).

2.2 Wall And Ceiling Units

A. Integral access door unit shall consist of concealed hinged door, perimeter frame, anchors and cam locks. Hinges shall be spring type with loose pins permitting removal of door. Locks shall be screwdriver slot operated. Anchors shall be of type applicable to suit adjoining construction.

B. Provide labeled rated access doors matching rating of surface in which access door is located.

C. Finishes:

1. Prime coat units, unless otherwise indicated, with chemically bonded primer coat of baked enamel.

2. Stainless steel units shall have No. 4 satin finish.

D. Frames: Fabricate from 16 gauge primed steel, except stainless steel with No. 4 satin finish at ceramic tile with exposed flange nominal 1 inch wide around perimeter of frame.

1. For gypsum wallboard or gypsum veneer plaster, provide perforated frames with gypsum wallboard bead.

2. For installation in masonry construction, provide frames with adjustable metal masonry anchors.

E. Flush Panel Doors: Fabricate from not less than 14 gage primed sheet steel, except stainless steel at ceramic tile, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees. Finish with manufacturer's factory-applied prime paint.

1. For fire-rated units, provide manufacturer's standard insulated flush panel/doors, with continuous piano hinge and self-closing mechanism.

F. Locking Devices: Furnish flush, screwdriver head cam locks of quantity required to hold door in flush, smooth plane when closed.

Part 3 Execution

3.1 Installation

A. Comply with manufacturer's written instruction for installation of access doors.

B. Coordinate installation with Work of other Sections.

C. Set frames accurately in position and securely attach to supports with face panels plumb or level in relation to adjacent finish surfaces.

3.2 Adjust And Clean

A. Adjust hardware and panels after installation for proper operation.

B. Remove and replace panels or frames that are warped, bowed, or otherwise damaged.

C. Remove protective adhesive plastic/PVC film prior to Date of Substantial Completion.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes:

1. Aluminum entrance doors.
2. Vestibule doors match entrance doors.
3. Storefront framing.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Fluoropolymer Coatings: Division 05.

C. Exterior Enclosure, General: Division 07.

D. Joint Sealants: Division 07.

E. Glazing: Division 08.

F. Door Hardware: Division 08. refer to for hardware by Finish Hardware Section for installation by this Section.

1.3 Submittals

A. Submit per the requirements of Division 01.

1. Submittals will not be reviewed until satisfactory completion of mock-up testing. Submittals forwarded prior to completion of testing will be returned “Revise and Resubmit” or placed on hold until completion of testing. Allowable time period for Design Professional review of submittals will not begin until after completion of testing.

B. Shop Drawings: Show materials, gauges, finishes, anchorage, flashing, hardware preparation, trim and closures. Show how system complies with specified criteria including, but not limited to, accommodation of structural movement, thermal cycling and control of water penetration, air infiltration and vapor migration.

1. Elevations: Minimum 1/4 inch equals 1 foot scale elevations of each storefront frame and door.

2. Details: Minimum 3 inch equals 1 foot scale details of each assembly including heads, sills, mullions, corners, relationships with abutting construction attachments to adjacent construction and joints in system.

3. Show sufficient information to trace continuity of inner and outer line of seals, (rain screen and air barrier) and to trace continuity of vapor retarder if location differs from inner seal.

4. Schedule: Show each door and opening, unique for actual location, showing room number, and sub number if more than one door or opening per room. Show, as a minimum, the same information as on schedule included herein. Show hardware group on schedule.

   a. Where doors or opening are indicated by generic type instead of unique mark for actual location, list all doors and openings by unique mark under each heading for the generic type indicated.
   b. Provide one schedule for the entire project, coordinate schedule for doors and openings of materials specified in other sections.

C. Product Data: On framing system, doors, door hardware and accessories. Include structural capacity information showing product complies with indicated criteria. Submit test reports showing compliance with air and water infiltration criteria.

1. Condensation Resistance: Submit adequate data to establish compliance with specified criteria.

D. Samples:

1. Finish Samples: Three (3) sets of Samples, each piece 8 1/2 inches by 11 inches, demonstrating full range of variation in color, texture and finish.

E. Calculations: Performed by, or under direct personal supervision of, Manufacturer's Design Engineer. Shop Drawings will not be reviewed without associated calculations. Calculations shall demonstrate compliance with design criteria indicated. Submit the following calculations:

1. Member section properties, stresses, deflections and rotations.

2. Member to member connection detail forces and stresses.

3. Building anchorage detail forces and stresses.

4. Thermal movements.

F. Qualifications: Manufacturers, Designers and Installers qualifications.

G. Sustainability Submittals: Provide the following in accordance with Sustainability Requirements: Division 01.

1. Materials Sustainability Documentation Form.

2. Product data, certification letter, and costs for materials with recycled content.

3. Product data and costs for regional materials.

4. Product data for adhesives and sealants indicating VOC content.

5. Product data for paints and coatings indicating VOC content and chemical composition.

H. Closeout Submittals:

1. Special Warranty: As indicated.

2. Maintenance Data: For operable hardware.

1.4 System Description

A. Design: Engineer system to perform in compliance with indicated criteria and to comply with indicated design intent.

1. Maintain basic dimensions of system, sight lines, jointing, and profiles. Minor variation is allowable only with approval of Design Professional and if variations are identified on submittals.

2. Engineer components of system not fully detailed within a reasonable inference of design intent.

B. Structural Requirements: Withstand loading and deflection criteria in accordance with Exterior Enclosure, General: Division 07.

C. Movement: Accommodate movement criteria in accordance with Exterior Enclosure, General: Division 07.

D. Air and Water Requirements: Comply with criteria per Exterior Enclosure, General: Division 07 and the following.

1. Limit air infiltration at doors to 1.0 cfm per lineal foot of crack at a pressure differential of 10 psf as measured in accordance with ASTM E 283.

1.5 Quality Assurance

A. Manufacturer's Qualification: Manufacturer shall have minimum five (5) years experience producing products similar to those required for this Project. Manufacturer shall have documented experience of successfully providing products for three (3) projects of scope, schedule and complexity similar to this Project within last two (2) years.

1. Company marketing primary products specified for this Section shall also be manufacturer. Companies marketing products which are manufactured by third parties for private labeling by marketing company will not be allowed.

2. Manufacturer's Design Engineer: Professional Engineer, licensed in the State of North Carolina and having a minimum of five (5) years experience designing systems similar to those required for this Project. Design Engineer shall sign and seal calculations.

3. Submit qualifications on manufacturers letterhead. Include project descriptions with Owner and Design Professional contacts for previous experience.

B. Installer's Qualifications: Installer shall have minimum five (5) years experience installing products similar to those required for this Project. Installer shall have documented experience of successfully completing three (3) projects of scope, schedule and complexity similar to this Project within last two (2) years.

1. Welding shall be performed by certified welders, qualified or licensed in accordance with local building regulations and shall conform to recommended practices of American Welding Society.

2. Submit qualifications on Installer's letterhead. Include project descriptions with Owner and Design Professional contacts for previous experience.

C. Single Source Requirements: All primary products required for Work of this Section shall be supplied by one (1) manufacturer. Accessory products including, for example, fasteners, sealants and anchors may be from other than primary manufacturer if approved in writing by primary manufacturer.

D. Regulatory Requirements:

1. Comply with ANSI A 117.1.

E. Certifications: Comply with Exterior Enclosure, General: Division 07.

F. Mock-ups: Provide entrances and storefronts required for mock-up in accordance with Exterior Enclosure, General: Division 07.

G. Preinstallation Meeting: Refer to Exterior Enclosure, General: Division 07 prior to commencing this Work per requirements of Division 01.

H. Inspection and Testing: Services of and independent Inspection and Testing Agency are required in conjunction with Work of this Section: Refer to Division 01.

1.6 Delivery, Handling And Storage

A. Protect prefinished surfaces with wrapping or strippable coating. Do not use adhesives which bond or leave a residue.

1.7 Project Conditions

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

B. Verify that field measurements are as indicated on Shop Drawings.

1.8 Sequencing

A. Do not cover Work which is to be inspected or tested until directed.

1.9 Special Warranty

A. Provide three (3) year Warranty under provisions of Division 01 and Contract.

B. Warranty: Include coverage for complete system for failure to meet specified requirements.

Part 2 Products

2.1 Manufacturers

A. Products of indicated manufacturers are acceptable, contingent upon meeting all indicated requirements. No substitutions.

1. Basis of design: YKK YES 45TU.
2. Kawneer Company, Inc.
3. Oldcastle Glass Architectural Products.

2.2 Materials

A. Use adhesives and sealants that comply with the VOC limits specified in Sustainability Requirements: Division 01.

B. Use paints and coatings that comply with the VOC limits and chemical restrictions specified in Sustainability Requirements: Division 01.

C. Aluminum alloy and temper to suit intended purpose.

1. Extruded Shapes and Tubes: ASTM B 221.
2. Sheet and Plate: ASTM B 209.
3. Structural Shapes: ASTM B 308.
4. Drawn Seamless Tube: ASTM B 210.
5. Castings: ASTM B 26, B 108, B 85.
6. Welding Rod: AWS A 5.10.

D. Galvanized Steel Sheet: ASTM A 653, grade to suit intended purpose, galvanized per ASTM A653/A653M to coating designation G60.

E. Steel Sections: ASTM A 36, galvanized after fabrication per ASTM A 123.

F. Structural Steel Tubing: ASTM A 500, Grade B, galvanized after fabrication per ASTM A 123.

G. Anchorage Clips and Fabrications: High-strength aluminum or nonmagnetic stainless steel.

H. Concrete Inserts: Cast-iron, malleable iron or steel hot dip galvanized after fabrication per ASTM A 123.

I. Continuous Adjustable Concrete Inserts: stainless steel channels with welded anchor legs with special "tee" head bolts. Cap ends of channel or fill with foam to keep out wet concrete. Manufactured by Unistrut or Halfen.

J. Insulation: As specified in Thermal Insulation: Division 07.

K. Fasteners:

1. Contacting aluminum and dissimilar metals: Stainless steel, ASTM F 593 and F 594 Alloy Group 1, finish to match adjacent surface if exposed.

2. Contacting steel or galvanized steel only: Hot dip galvanized steel conforming with ASTM B 633, SC4 or ASTM A 153.

L. Coatings:

1. Shop primer for steel: SSPC-Paint 20.

2. Touch-up primer for galvanized steel: Primer with minimum 80 percent zinc in dry film complying with SSPC 20.

3. Dissimilar Metal Coating: Cold-applied asphalt mastic or other non-conductive, non-absorptive material.

M. Foam Tape: Nine (9) pcf density, self-adhesive, foam tape with flame retardants to meet FMVSS 302 flammability standard. Norton V 780 or approved substitution. Provide tape 1 inch wide, unless otherwise indicated, by the following thickness.

1. Provide 1/8 inch thick at metal panels, concrete or other smooth substrate.

2. Provide 1/4 inch thick at masonry or similar rough substrate.

N. Butyl Coated Foam Tape: Soft, compressible PVC foam core encapsulated with 100 percent solids butyl. "Norex" by Norton or approved substitution. Provide 1/8 inch by 1/2 inch tape, unless otherwise indicated.

2.3 Storefront

A. System design is based on YES 45TU manufactured by YKK, subject to conformance to specified criteria. Modify standard system as required to comply.

B. Two (2) Stage Weatherproofing: System shall provide redundant weatherproofing (both internal to system and at interface of system with adjacent construction) to control infiltration of water and air which may bypass outer weatherseal and to maintain continuity of vapor retarder.

1. System shall be weathertight at interior face of glazing and interior face of glazing pocket. Water which may penetrate outer glazing seal shall be weeped to exterior.

2. Systems which require blind seals, seals that cannot be tooled in their final location, or other seals which do not comply with SWRI recommendations and which are required to maintain the performance of the air barrier, even if such conditions have adequately passed laboratory testing, will not be allowed.

3. Do not allow water to puddle or stand. Surfaces shall be pitched towards drains or weeps.

4. System shall be capable of accepting an inner line of membrane flashing at the rear of the glazing pocket and sheet metal flashing or metal panel system trim at the outer face of the glazing pocket.

5. Sills shall have watertight sub-sills to direct water penetrating outer glazing seal or primary exterior sealant to exterior.

   a. No penetrations are allowed in horizontal portions of sub-sill.
   b. Sub-sill shall have watertight enddams which intercept downward flow of water from space between inner and outer seals at jambs.

C. Vapor Retarder: Inner glazing forms a portion of vapor retarder for building envelope. Provide continuity of vapor retarder across inner face of glazing pocket. Where vapor retarder is at a location other than the inside face of glass, detail system to maintain continuity of vapor retarder across framing members. Detail system and connection to adjacent vapor retarder materials.

D. Frame: Tubular and channel shaped extruded aluminum sections with minimum wall thickness of 0.080 inches for main members.

1. Furnish accessories, clips, stops, fillers.

2. Reinforce internally for structural performance and hardware.

3. Steel embedded within any portion of curtainwall which may be exposed to moisture shall be galvanized.

E. Exterior frames shall be thermally improved to meet specified criteria. Interior frames need not be thermally improved if dimensions and profiles exactly match exterior frames.

F. Glazing System:

1. Stops shall be removable from exterior.

2. Glazing shall be located as indicated.

G. Accessories:

1. Provide filler panels to allow for back-up of full depth of sealant and backer rod where sealant is indicated or required to meet specified criteria.

2. Receivers: Provide extruded aluminum thermally broken head and jamb receiver channels with weatherstripping.

3. Sub-Sills: Provide extruded aluminum thermally broken sub-sills below sill member of each frame.

2.4 Doors

A. Standard duty extruded aluminum tubular frames with minimum wall thickness of 0.125 inch and depth of 1 3/4 inch.

B. Heavy duty extruded aluminum tubular frames with minimum wall thickness of 0.188 inch and depth of 2 inches.

C. Thermal extruded aluminum frame with minimum wall thickness of 0.125 inch and depth of 2 inches. Exterior aluminum shall be separated from interior aluminum with a rigid, structural thermal barrier.

D. Profiles:

1. Medium:

a. Stiles: 3 1/2 inches.
b. Head: 3 1/2 inches.
c. Bottom Rail: 12 inches minimum for ADA requirements.

E. Stops shall be square

2.5 Glass And Glazing

A. In accordance with Glazing: Division 08.

2.6 Flashing And Brake Metal

A. Flashing concealed with system shall be aluminum.

B. Concealed flashing where system abuts dissimilar materials shall be minimum 20 gage stainless steel.

C. Exposed flashing shall be aluminum, finished to match system, minimum 0.062 inch.

D. Brake metal and other similar formed sheet fillers and trim shall be minimum 0.125 inch aluminum, finished to match system. At joints in brake metal, fold back edges or weld on concealed 1/8 inch aluminum angles to provide minimum 1 1/2 inch deep support for sealants backer.

2.7 Sealants

A. Sealants within system shall be ASTM C 920 silicone or epoxy as recommended in writing by manufacturer.

B. Sealants for use in field shall be in accordance with Joint Sealants: Division 07.

2.8 Hardware (Refer To Hardware Specification For Additional Requirements)

A. Provide hardware units as indicated, scheduled, or required for operation of each door, including the following items of sizes, number, and type recommended in writing by manufacturer for service required; finished to match door, unless otherwise indicated.

B. Automatic door operators in accordance with Division 08. Coordinate requirements for operators with Work of this Section.

C. Hanging Devices:

1. Offset Pivot Sets: Comply with ANSI A156.4, Grade 1. Provide exposed parts of cast aluminum alloy. Provide an intermediate pivot for doors over 7 feet 6 inches high.

D. Closers:

1. Single-Acting, Independently Hung, Concealed Overhead Closers: Comply with ANSI A156.4, Grade 2. Provide concealed arm and track. Comply with manufacturer's written recommendations for closer size, depending on door size, exposure to weather and anticipated frequency of use.

E. Holders:

1. Concealed Overhead Holders: Adjustable, shock-absorbing type concealed overhead holders; comply with ANSI A156.8.

F. Cylinders are supplied under Door Hardware: Division 08.

G. Deadlocks: Mortised maximum security deadlock, with minimum 1 inch long pivoted bolt and stainless steel strike box: comply with ANSI A156.5, Grade 1.

H. Panic Devices:

1. Panic Hardware: Rim-type, center latch bolt type panic exit device activated by a full-width crash bar. Comply with UL 305.

I. Push/Pulls:

1. Pull: Offset solid round pull, 3/4 inch diameter, 2 1/2 inch projection, 3 inch offset and 12 inch center-to-center base, no escutcheons or roses, align top with push bar on opposite side of door.

2. Push-solid round push bar, 3/4 inch diameter, 2 1/4 inch projection, full width of door, no escutcheons or roses align with top of pull on opposite side of door

J. Thresholds: Extruded aluminum, one (1) piece per opening, ADAAG compliant, ribbed, non-slip,

K. Weatherstripping:

1. Jambs and heads to have continuous nylon pile weatherstripping at stops. Bottom of floor shall have a concealed mounted nylon pile weather-strip in bottom channel.

2. Double acting doors shall have nylon pile weatherstripping mounted to doors on all four (4) sides. Door head and sill weatherstripping shall be concealed mounted in door channels. Stiles shall have a integral groove in frame member to accept weatherstripping.

2.9 Fabrication

A. Fabricate entrance and storefront components to designs, sizes and thicknesses indicated and as required to comply with specified performance requirements. Match approved Samples mock-ups. Comply with approved submittals.

B. Prefabrication: Complete fabrication, assembly, finishing, hardware application and preparation and other Work to greatest extent possible before shipment to Project Site. Disassemble components only as required for shipment and installation. Shipping of stock lengths of frame member components for cutting to length on Project Site is not acceptable.

C. Perform fabrication operations, including cutting, fitting, forming, drilling and grinding of metal work to prevent damage to exposed finish surfaces.

D. Welding: Comply with AWS recommendations. Exposed welds are not acceptable. Welding behind finished surfaces shall be performed to avoid distortion or discoloration of finish.

E. Reinforcing: Install reinforcing as required for hardware and performance requirements.

F. Weathertightness: Fabricate so that sealant is not foremost or only means to furnish a watertight assembly and to direct water out of system through weepholes.

G. Dissimilar Metals: Separate dissimilar metals with SSPC 20 paint, sealant or gasket.

H. Continuity: Maintain accurate relation of planes and angles with hairline fit of contacting members.

I. Uniformity: Abutting members shall not have an integral texture or color variation greater than half the range indicated in approved Samples.

J. Anchorage: Prepare members for attachment to adjacent structure and each other. Fabricate, for example, anchors, clips and cleats.

K. Fasteners: Fasteners shall be concealed from eye level view in Finished Work.

L. Receivers and Sub-sills: Fabricate to required dimensions. Weld on end dams at all sub-sills. Fabricate joints to allow for movement without affecting water-tightness.

M. Flashing: Fabricate in accordance with Flashing and Sheet Metal: Division 07.

N. Doors: Fabricate with mechanical joints using heavy inserted reinforcing plate and concealed tie rods or J-bolts. Fabricate to facilitate replacement of glass without disassembly of door frame using removable interior stops and concealed fastened exterior stops.

2.10 Finishes

A. General:

1. Shop finish Work including priming of surfaces not to be exposed to view in Final Work.

2. Finish aluminum entrance and storefront to match other adjacent aluminum curtainwall components.

3. Finish: Refer to Fluoropolymer Coatings: Division 05.

2.11 Source Quality Control

A. Comply with applicable tolerances listed under written installation instructions of this Section for shop fabrication.

B. Comply with Exterior Enclosure, General: Division 07.

Part 3 Execution

3.1 Examination

A. Examine existing and new substrates and supports, with Installer present, for compliance with requirements indicated, installation tolerances, and other conditions that affect installation of aluminum entrances and storefronts.

B. Do not proceed with installation until unsatisfactory conditions are corrected. Proceeding with installation constitutes acceptance of substrates and supports.

3.2 Preparation

A. Isolation: Separate substrates and supports which could cause corrosion or electrolytic action with aluminum storefront by painting, gaskets or similar method.

3.3 Installation

A. General: Comply with manufacturer's written instructions and recommendations for installation. Comply with approved submittals and Mock-up.

1. Installation of coating system components shall comply with requirements of all applicable local, state and national code jurisdictions.

B. Sub-Sill: Set sub-sill flashing in a triple row of sealant. Anchor sub-sill using clips or anchors without penetrating horizontal portion of sub-sill. Seal watertight. Provide foam tape between sub-sill and frame.

C. Receivers: Set receiver channels with concealed anchors to adjacent construction. Seal all penetrations and anchorage points.

D. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

E. Provide alignment attachments and shims to permanently fasten system to building structure.

F. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

G. Provide thermal isolation where components penetrate or disrupt building insulation.

H. Separate aluminum and other corrodible metal surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

1. Zinc or cadmium plate steel anchors and other unexposed fasteners after fabrication.

2. Paint dissimilar metals where drainage from them passes over aluminum.

3. Paint aluminum surfaces in contact with mortar, concrete or other masonry with alkali resistant coating.

4. Paint wood and similar absorptive material in contact with aluminum and exposed to elements or otherwise subject to wetting, with two (2) coats of aluminum house paint. Seal joints between materials with sealant.

I. Drill and tap frames and doors and apply surface-mounted hardware items. Comply with hardware manufacturer's written instructions and template requirements. Use concealed fasteners wherever possible. Set thresholds in a bed of mastic and secure.

J. Glazing: Refer to Glazing: Division 08.

K. Sealants: Refer to Joint Sealants: Division 07.

3.4 Erection Tolerances

A. Limit variations from plumb, level or dimensioned angle to the following:

1. 1/8 inch maximum deviation in any story height, or in any 10 feet vertical or angular run, or in any 20 foot horizontal run, non-cumulative.

2. 1/4 inch maximum deviation in any 40 foot run, any direction, non-cumulative.

B. Limit variations from ideal location (theoretical calculated positions in plan or elevation based on established floor lines and column lines), including variations from plumb and level, to the following:

1. 1/4 inch total maximum deviation for any element at any location, non-cumulative.

2. 1/4 inch maximum change in deviation for any element for any 10 foot run, any direction, non-cumulative.

C. Limit offset in end-to-end or edge-to-edge alignments of adjoining consecutive elements indicated to be flush, continuous or planar to the following:

1. Interior: 1/32 inch.

2. Exterior: 1/16 inch.

D. Limit variation from indicated position in end-to-end or edge-to-edge alignments of adjoining consecutive elements indicated to be less than 1/2 inch out-of-plane or are separated by a maximum 2 1/2 inch wide member to the following:

1. Interior: 1/16 inch.

2. Exterior: 1/8 inch.

E. Limit variation from indicated position in end-to-end or edge-to-edge alignments of adjoining consecutive elements indicated to be 1/2 inch or more out-of-plane or are separated by a member wider than 2 1/2 inches to the following:

1. Interior: 1/8 inch.

2. Exterior: 3/16 inch.

F. Limit maximum width of a hairline joint as follows:

1. Interior: 0.020 inch.

2. Exterior: 0.050 inch.

G. Limit maximum variation is width of a hairline joint as follows:

1. Interior: 0.005 inch.

2. Exterior: 0.020 inch.

H. Limit difference in diagonal measurements to 1/8 inch.

I. Comply with stricter tolerances if required for glazing or to meet specified performance criteria.

3.5 Field Quality Control

A. Comply with Exterior Enclosure, General: Division 07.

3.6 Adjusting

A. Adjust operating hardware to function properly, for smooth operation without binding, and for weather tight closure.

3.7 Cleaning

A. Remove protective material from pre-finished aluminum surfaces.

B. Wash down new surfaces including refinished frames and doors (after curing of field applied coating system)with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Remove dirt from corners. Wipe surfaces clean.

C. Remove excess sealant by method approved in writing by sealant manufacturer.

3.8 Protection

A. Institute protective measures required throughout remainder of Construction Period to ensure that interior aluminum entrances and storefronts will be without damage or deterioration, other than normal weathering, at Date of Substantial Completion.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: A glazed aluminum curtainwall system as follows:

1. Curtainwall framing system.
2. Metal spandrel panels and other nonglass panels.
3. Soffits, sills, copings, trim and similar border and filler items.
4. Interior curtainwall to match exterior.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Inspection and Testing of Exterior Enclosure: Division 01.

C. Exterior Enclosure, General: Division 07.

D. Thermal Insulation: Division 07.

E. Firestopping: Division 07.

F. Flashing and Sheet Metal: Division 07.

G. Joint Sealants: Division 07.

H. Aluminum Entrances and Storefronts: Division 08, refer to for door assemblies.

I. Glazing: Division 08.

1.3 Submittals

A. Submit per the requirements of Division 01.

1. Submittals will not be reviewed without receipt of Preliminary Certification letters indicated in Inspection and Testing of Exterior Enclosure: Division 01.
2. Submittals will not be reviewed until satisfactory completion of mock-up and laboratory testing. Submittals forwarded prior to completion of testing will be returned “Revise and Resubmit” or placed on hold until completion of testing. Allowable time period for review of submittals will not begin until after completion of testing.

B. Shop Drawings: Show fabrication and installation details, materials, dimensions, gauges, trim, fasteners, closures and finishing including all attachments and joint sealants to surrounding construction. Show how system complies with specified criteria including, but not limited to accommodation of structural movement, thermal cycling and control of water penetration, air infiltration and vapor migration.

1. Elevations: Minimum 1/4 inch equals 1 foot scale elevation of each area of curtainwall.

2. Details: Full size details of each assembly including heads, sills, mullions, corners, intersection with abutting construction and joints in system.

   a. Assembly Details: Multiple, exploded, isometric, three-dimensional details showing the sequential assembly of typical intersections including but not limited to corners, tee intersections and cross intersections. Show each sealant, gasket and accessory required for the system to function in compliance with indicated requirements.

3. Show sufficient information to trace continuity of inner and outer line of seals, (rain screen and air barrier) and to trace continuity of vapor retarder if location differs from inner seal.

4. Shop Drawings shall be prepared directly by the manufacturer with manufacturer's logo and bearing the name and contact information and signature of manufacturer's design engineer.

   a. Shop Drawings may be prepared by licensed or otherwise approved installers or fabricators, and shall be accompanied by a certification letter on manufacturers letterhead, signed by manufacturers design engineer, stating that the manufacturers engineering department has reviewed the shop drawings and Contract Documents and verifies that systems represented in the shop drawings are compliant with manufacturers recommendations, contain sufficient detail to direct construction in compliance with manufacturers recommendations, are suitable for intended application and that the shop drawings are of a level of quality and completeness as if the manufacturer prepared the shop drawings themselves.

C. Product Data: Manufacturer's published specifications for joint sealants, materials and fabrication and installation instructions. Furnish test reports indicating compliance with specified criteria.

1. Structural Silicone Glazing Reports: Comply with Glazing: Division 08.

D. Samples:

1. Finish Samples: Three (3) sets of Samples, each piece 8 1/2 inches by 11 inches, demonstrating full range of variation in color, texture and finish.

E. Calculations: Performed by, or under direct personal supervision of, Manufacturer's Design Engineer. Shop Drawings will not be reviewed without calculations. Calculations shall demonstrate compliance with design criteria indicated. Submit the following calculations:

1. Member section properties, stresses, deflections and rotations.

2. Member to member connection detail forces and stresses.

3. Building anchorage detail forces and stresses.

4. Thermal movements.

F. Qualifications: Proof of compliance with indicated qualifications.

G. Quality Control Procedures:

1. Independent Test Reports: Reports from independent laboratories, AAMA certified or otherwise qualified to perform the required test as acceptable to Design Professional, documenting compliance with indicated criteria.

a. Submit a certification letter from the manufacturer stating that the tested mock-up is essentially identical to the system proposed for use on this Project, and that any deviations or differences between the tested mock-up and the Project system would not have resulted in a reduction in the performance of the tested mock-up.
b. Test reports shall include adequate data for comparison of tested system to system being proposed for project including but not limited to; detailed description, mock-up shop drawings, material cut sheets for each product used in the mock-up, installation instructions used for the mock-up, any deviation in material, detail or assembly methods from the proposed system, and other data as requested by the Design Professional.
c. Test reports shall include a description of the testing procedure including: every pre-test and test performed (whether passed or failed) step-by-step through the testing program, identification of reason for failure, any repair or remediation procedures performed after failed tests, any information collected from examination of mock-up after testing and during disassembly, and other data as requested by Design Professional. If the tested mock-up passed tests on initial attempt, indicate so in writing.

2. Show compliance with indicated criteria:

a. Quality Control Program.
b. Quality Control Documentation.
c. Welding qualifications and procedures.
d. Factory Test Procedures.
e. Factory Test Reports.
f. Field Test Procedures.
g. Field Test Reports.

H. Certifications: Indicated certification letters.

I. Sustainability Submittals: Provide the following in accordance with Sustainability Requirements: Division 01.

1. Materials Sustainability Documentation Form.

2. Product data, certification letter, and costs for materials with recycled content.

3. Product data and costs for regional materials.

4. Product data for adhesives and sealants indicating VOC content.

5. Product data for paints and coatings indicating VOC content and chemical composition.

J. Closeout Submittals: Intent to Warrant Letter and draft of Warranty prior to start of fabrication or construction. Final Warranty after Date of Substantial Completion.

1.4 System Description

A. Design: Engineer system to perform in compliance with indicated criteria and to comply with indicated design intent.

1. Maintain basic dimensions of system, sight lines, jointing, and profiles. Minor variation is allowable only with approval of Design Professional and if variations are identified on submittals.

2. Engineer components of system not fully detailed within a reasonable inference of design intent.

B. Movement Requirements: Accommodate movement criteria per Exterior Enclosure, General: Division 07.

1. Structural Silicone Glazing: Comply with requirements of Glazing: Division 08.

C. Air and Water Requirements: Comply with criteria per Exterior Enclosure, General: Division 07.

D. Condensation Resistance:

1. Document conformance with the following criteria through independent testing provided by manufacturer. Testing shall have been performed on systems substantially identical to system proposed for this Project. Manufacturer may use previous tests if suitable and current. If previous tests are unsuitable, provide test per referenced standard. Computer modeling may be acceptable in lieu of physical testing as acceptable to Design Professional.

2. System; including but not limited to, frames, mullions, glass, shadow boxes, sub-sills, brake metal, trim, panels, door frames or sub-frames, filler strips and spandrel panels, shall not allow condensation on interior surfaces under the following conditions.

E. Provide a system which eliminates the following:

1. Vibration harmonics, wind whistles or noises caused by thermal movement.

2. Thermal stress transmitted to other building elements.

3. Loosening, weakening, or fracturing of attachments or components of system.

4. Sealant or glazing gasket failure.

5. Transfer of stresses including those caused by thermal and structural movement to glass.

1.5 Quality Assurance

A. Manufacturer's Qualifications:

1. Experience: Minimum five (5) years producing products similar to those required for this Project. Provided products for three (3) projects of scope, schedule and complexity similar to this Project within last two (2) years as acceptable to Design Professional.

2. Manufacturing: Products shall be manufactured by company marketing product. Products manufactured by third parties for private labeling, by marketing company will not be allowed. Accessory products, as approved in writing by Design Professional, may be manufactured by Others.

3. Manufacturer's Design Engineer: Professional Engineer, licensed in State of NC and having a minimum of five (5) years experience designing systems similar to those required for this Project. Design Engineer shall sign and seal calculations.

4. Single Source Requirements: Products shall be supplied by one (1) manufacturer. Accessory products including, for example, fasteners, sealants and anchors may be from other than primary manufacturer if approved in writing by primary manufacturer and Design Professional.

5. Certify compliance. Include project descriptions with Owner and Design Professional contacts for previous experience and resume for designer.

B. Installer's Qualifications:

1. Experience: Minimum five (5) years installing products similar to those required for this Project.

   a. Completed three (3) projects of scope, schedule and complexity similar to this Project using manufacturer's similar system as required for this Project within last two (2) years as acceptable to Design Professional.
   b. Adequately trained by manufacturer and recommended in writing by manufacturer for type of installation required for this Project.

2. Certify compliance. Include project descriptions with Owner and Design Professional contacts for previous experience.

C. Welder's Qualifications:

1. Welding Procedures and Qualifications: In accordance with "Structural Welding Code, Steel", AWS D1.1.

2. Welders shall be qualified to perform the type of Work required.

3. Identification: Each welder shall be assigned an identification symbol and shall mark his identification at each shop and field weld.

D. Regulatory Requirements: Perform Work in compliance with AAMA: Aluminum Curtainwall Design Guide Manual.

E. Certifications: Manufacturer shall certify in writing the following:

1. Compliance with requirements of Exterior Enclosure, General: Division 07.

2. Use and Compatibility Certification: Certify that materials are appropriate for indicated use and that substrates and adjacent materials are compatible.

3. Certify installer qualifications.

4. Certify single source responsibility.

5. Certify acceptance of products manufactured by others.

6. Certify that curtainwall systems comply with specified requirements.

7. Certify that the system represented in the shop drawings and other submittals will result in, if installed as detailed, performance substantially the same as it did in the tests on which the manufacturer bases their predictions of performance for air and water resistance, thermal performance, condensation resistance, structural capacity and other salient performance criteria in compliance with the Contract Documents. Include the primary products, all accessories, interface and anchorage to adjacent construction and all other work of this section included in the submittals.

8. For structural silicone glazed systems, certify that the substrate for adhesion of the silicone is manufactured exactly the same as in the Approved SSG test reports, and that substrate is protected during fabrication and prepared immediately prior to glazing to maintain an exact match to the tested assembly.

F. Mock-ups: Provide curtainwall required for mock-up specified in Exterior Enclosure, General: Division 07.

G. Manufacturer's Quality Control Program: Manufacturer shall establish a quality control program to ensure compliance with requirements. Submit plan for approval by Design Professional. Include dates for all testing procedures and notify Design Professional one (1) week in advance. Manufacturer's existing quality control program may be acceptable if all requirements listed below are met.

1. Document each aspect of quality control plan including statistical data regarding compliance to tolerances. Plan shall include names of approved inspectors who shall initial each quality control inspection or check. Include qualifications of inspectors.

2. Manufacturer shall determine frequency of each type of inspection and checking, unless otherwise indicated.

3. Program shall include procedures which provide for the following:

a. Manufacturers inspection and checking at each phase of Work including, but not limited to, checking of the following to assure compliance with Contract Documents, submittals and as required to match approved Samples and Shop Drawings.

1) Raw materials upon delivery.

2) Shipping, storage and handling of raw materials.

3) Tolerance of materials cut to size and formed for fabrication.

4) Sub-assemblies and fabricated units.

5) Welds and welding procedures.

6) Bolted or screwed mechanical anchors.

7) Glazing procedures.

8) Final assemblies before shipping.

9) Packing, crating and shipping, storage and handling procedures.

10) Materials as they are received, stored and handled at site.

11) Substrates and structures to which curtainwall is attached.

12) Each phase of installation.

b. Record Keeping:

1) Maintain a log and drawings of each assembly and its installed location.

2) Maintain a log of the shipping weights of each assembly. Include the weight when the assembly was loaded for shipping at the factory and the weight of the assembly immediately before being installed.

c. Manufacturers testing of assemblies in factory including, but limited to, testing of the following:

1) Structural silicone glazing to destruction, minimum two (2) panes selected at random.

2) Watertight connections of framing members at inside face of glazing pocket (before glazing) by temporarily damming and flooding, minimum two (2) panels selected at random.

3) Unitized panels for air and water penetration, minimum of five (5) panels selected at random.

d. Manufacturers testing of assemblies in field.

1) Test watertight sub-sill flashing and sill members before installation of remaining framing by hosing all members continuously for approximately 10 minutes.

H. Preinstallation Meeting: Refer to Exterior Enclosure, General: Division 07.

I. Independent Inspection and Testing: Services of an independent Inspection and Testing Agency will be required in conjunction Work of this Section. Refer to Division 01.

1. Do not cover Work which is to be inspected or tested until directed.

1.6 Delivery, Handling And Storage

A. Protect prefinished surfaces with wrapping or strippable coating. Do not use adhesives which bond or leave a residue.

B. Ship and store under conditions which will not have a deleterious effect on the finished work. Comply with written instructions of manufacturer of glass, glazing or other accessory product manufacturers.

C. Protect panels during shipping and storing to eliminate water from standing in locations which are not designed to hold standing water in the installed position.

D. Wrap panels to protect from weather and soiling during shipping and storing.

1.7 Project Conditions

A. Verify that field measurements are as indicated on Shop Drawings.

1.8 Special Warranty

A. General: Warranty shall not deprive Owner of rights under other provisions of Contract and shall be in addition to, and run concurrent with, other Warranties made by Contractor under requirements of Contract Documents.

B. Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of curtainwall that fail in materials or workmanship or fail to perform in accordance with specified criteria within specified Warranty Period.

1. Specified Warranty Period: 3 years from Date of Substantial Completion.

2. System Includes: Curtainwall, trim, brake metal, internal flashing, anchors, glass and glazing, accessories, and accessories and miscellaneous components.

3. Intent to Warranty: Submit certification of manufacturer’s intent to provide Special Warranty at completion of construction and Sample of manufacturer’s Warranty Form.

Part 2 Products

2.1 Approved Manufacturers

A. Products of indicated manufacturers are acceptable, contingent upon conformance to indicated requirements. No substitutions.

1. Basis of design: YKK YCW750 O.G.

2. Oldcastle Glass.

3. Kawneer Company, Inc.

2.2 Materials

A. Use adhesives and sealants that comply with the VOC limits specified in Sustainability Requirements: Division 01.

B. Use field applied paints and coatings that comply with the VOC limits and chemical restrictions specified in Sustainability Requirements: Division 01.

C. Aluminum: Alloy and temper to suit application.

1. Extruded Shapes and Tubes: ASTM B 221.

2. Sheet and Plate: ASTM B 209.

3. Structural Shapes: ASTM B 308.

4. Drawn Seamless Tube: ASTM B 210.

5. Castings: ASTM B 26, B 108 or B 85.

6. Welding Rod: AWS A 5.10.

D. Galvanized Steel Sheet: galvanized per ASTM A653/A653M to coating designation G60.

E. Steel Sections: ASTM A 36, galvanized after fabrication per ASTM A 123.

F. Structural Steel Tubing: ASTM A 500, Grade B, galvanized after fabrication per ASTM A 123.

G. Anchorage Clips and Fabrications: High-strength aluminum or nonmagnetic stainless steel.

H. Concrete Inserts: Cast-iron, malleable iron or steel hot dip galvanized after fabrication per ASTM A 123.

I. Continuous Adjustable Concrete Inserts: Hot rolled steel channels with welded anchor legs with special “tee” head bolts. Cap ends of channel or fill with foam to keep out wet concrete. Manufactured by Unistrut or Halfen.

J. Insulation: As specified in Thermal Insulation: Division 07.

K. Fasteners:

1. Contacting Aluminum and Dissimilar Metals: Stainless steel, ASTM F 593 and F 594, Alloy Group 1, finish to match adjacent surface if exposed.

2. Contacting Steel or Galvanized Steel Only: Hot dip galvanized steel conforming with ASTM B 633, SC 4 or ASTM A 153.

L. Coatings:

1. Shop Primer for Steel: SSPC-Paint 20.

2. Touch-up Primer for Galvanized Steel: Primer with minimum 80 percent zinc in dry film complying with SSPC-Paint 20.

3. Dissimilar Metal Coating: Cold-applied asphalt mastic or other non-conductive, non-absorptive material.

M. Foam Tape: 9 pcf density (self-adhesive) foam tape with flame retardants to meet FMVSS 302 flammability standard. Norton V 780 or approved substitution. Provide tape 1 inch wide, unless otherwise indicated by the following thickness.

1. Provide 1/8 inch thick at metal panels, concrete or other smooth substrate.

2. Provide 1/4 inch thick at masonry or similar rough substrate.

N. Butyl Coated Foam Tape: Soft, compressible PVC foam core encapsulated with 100 percent solids butyl. "Norex" by Norton or approved substitution. Provide 1/8 inch by 1/2 inch tape, unless otherwise indicated.

O. Double Stick Tape: Closed-cell foam tape for structural bonding, 3M "VHB" Tapes or approved equivalent. Minimum peel adhesion of 15 pounds per inch. Use minimum thickness tape to provide hairline joints where exposed.

1. Primers, cleaning agents and accessories as recommended in writing by tape manufacturer.

2.3 Curtainwall Framing, General

A. System design is based on YCW750 by YKK subject to conformance to specified criteria. Modify standard system as required to comply.

B. Two (2) Stage Pressure-equalized Rainscreen Weatherproofing: System shall provide redundant weatherproofing (both internal to system and at interface of system with adjacent construction) to control infiltration of water and air which may bypass outer rainscreen weatherseal and to maintain continuity of inner air barrier/vapor retarder by means of pressure-equalized cavities.

1. System shall be weathertight at interior face of glazing and interior face of glazing pocket. Water that may penetrate outer glazing seal shall be weeped to exterior.

2. Systems which require blind seals, seals that cannot be tooled in their final location, or other seals which do not comply with SWRI recommendations and which are required to maintain the performance of the air barrier, even if such conditions have adequately passed laboratory testing, will not be allowed.

3. Do not allow water to puddle or stand. Surfaces shall be pitched towards drains or weeps.

4. Where abutting adjacent construction, the system shall be capable of:

a. Accepting an inner line of air barrier membrane flashing at the rear of the glazing pocket.

b. Accepting sheet metal flashing and metal panel system trim rainscreen at the outer face of the glazing pocket.
c. Sealing of outer rainscreen independent of glazing, snap-on mullion caps or other exterior trim.

5. Sills shall have watertight sub-sills to direct water penetrating outer glazing seal or primary exterior sealant to exterior.

a. No penetrations are allowed in horizontal portions of sub-sill.
b. Sub-sill shall have watertight enddams which intercept downward flow of water from space between inner and outer seals at jambs.

6. Air Barrier/Vapor Retarder: Inside face of glazing pocket and glazing forms a portion of air barrier/vapor retarder system for building envelope. Provide continuity of air barrier/vapor retarder across inner face of glazing pocket. Where vapor retarder is at a location other than the inside face of glass, detail system to maintain continuity of air barrier/vapor retarder across framing members, system and connection to adjacent air barrier/vapor retarder materials.

C. Frame: Tubular shaped extruded aluminum sections with minimum wall thickness of 0.125 inches for main members.

1. Furnish, for example, accessories, clips, stops and fillers.

2. Reinforce for structural performance and hardware.

3. Steel embedded within any portion of the curtainwall which may be exposed to moisture shall be galvanized.

D. Exterior frames shall be thermally improved to meet specified criteria. Interior frames need not be thermally broken if dimensions and profiles exactly match exterior frames.

2.4 Vertical Glazing

A. Glazing System:

1. Glazing shall be removable from exterior.

2. Glazing shall be supported by frame and stops on four (4) sides.

B. Provide filler panels to allow for back-up of full depth of sealant and backer rod where sealant is indicated or required to meet specified criteria.

C. Provide approximately 8 inch long alignment tabs in extruded bosses or other similar devices acceptable to the Design Professional at the intersections of members to ensure alignment within indicated tolerances.

2.5 Exterior Trim

A. Exterior trim shall be extruded aluminum, minimum wall thickness 0.080 inch**,** except where indicated as "Brake Metal", profiles as indicated on Drawings.

B. Brake metal and other similar formed sheet fillers and trim shall be minimum 0.125 inch aluminum.

C. Column and Beam Covers: Form from brake metal to profiles and shapes indicated. Furnish reveals, joints, base details and head details as indicated. Furnish framing to support covers as required to meet specified criteria.

2.6 Interior Trim

A. Interior trim shall be extruded aluminum minimum wall thickness 0.080 inch**,** finish to match exterior, unless otherwise indicated.

B. Furnish, for example, mullion covers, head trim, sill, stools, gypsum wallboard beads, acoustical ceiling edge angles, as indicated. Individual pieces shall be fabricated to snap together forming hairline joints.

2.7 Doors

A. Doors are specified in Division 08.

B. Frame at doors in curtainwall shall match profile of adjacent mullions and as indicated. Provide an extrusion to accept hinges and stops not more than 1 inch wide. When doors are indicated to be thermally broken provide a thermally broken extrusion. Do not set an additional sub-frame inside of curtainwall mullions. Reinforce curtainwall framing members for door and door Finish Hardware.

2.8 Glazing

A. Glass and glazing are specified in Glazing: Division 08.

2.9 Flashing

A. Flashing concealed within system shall be aluminum or stainless steel.

B. Concealed flashing where system abuts dissimilar materials shall be minimum 20 gage stainless steel.

C. Exposed flashing shall be aluminum, finished to match system, minimum 0.062 inch.

2.10 Sealants

A. Sealants within system shall be ASTM C 920 silicone or epoxy as recommended in writing by manufacturer.

B. Sealants for use where system abuts other construction shall be as specified in Joint Sealants: Division 07.

2.11 Fabrication

A. Fabricate in compliance with approved submittals and mock-up. Fabricate in compliance with specified criteria.

B. Form and assemble Work in shop to fullest extent possible. Indicate extent of such Work on Shop Drawings.

C. Fabricate Work to properly fit field-measured openings, without use of unscheduled closures or filler members. Wherever glazed, Work shall be suitable for glass and glazing. Use templates to prepare surfaces for Door Hardware: Division 08, verifying hardware to final approved Hardware Schedule.

D. Coordinate this Work with glass and glazing work as specified in Glazing: Division 08.

1. Where feasible, install non-glazed panels in prefabricated frames at manufacturer's shop.

2. Where feasible and at Contractor's option, install glass in prefabricated frames at manufacturer's shop.

E. Fabricate curtainwall system to allow for adequate clearances around perimeter of system to enable proper installation.

F. Fabricate curtainwall components allowing for accurate and rigid fit of joints and corners. Match components carefully ensuring continuity of line and design. Comply with tolerances specified herein.

G. Fabricate curtain wall to accept sealing of air/vapor barrier membrane flashing into perimeter of glazing pocket. Mill out tongue of mullions and other interruptions to provide a continuous flat surface to bed membrane.

H. Flashing: Fabricate per Flashing and Sheet Metal: Division 07.

I. Allow moisture entering joints and condensation occurring within framing members to drain to exterior.

J. Conceal fastenings and reinforcements in Finished Work.

K. Grind welds smooth on exposed surfaces prior to finishing.

L. Uniformity: Abutting members shall not have an integral texture or color variation greater than half the range indicated in approved Samples.

2.12 Finishes

A. General:

1. Shop finish Work, including priming of surfaces not to be exposed to view in Final Work.

2. Finish: Finish to match Aluminum Entrances and Storefronts. Refer to Fluoropolymer Coatings: Division 05.

2.13 Source Quality Control

A. Fabrication Tolerances:

1. General: Fabricate to tolerances as required to:

a. Match approved Mock-up.
b. Comply with performance criteria.
c. Comply with manufacturer's written instructions.
d. Achieve tolerances indicated for Final Work.
e. Align with other supported or adjacent Work with more stringent tolerances.

B. Independent Inspection and Testing: Comply with requirements of Exterior Enclosure, General: Division 07.

C. Comply with Quality Control Program.

Part 3 Execution

3.1 Examination

A. Project Site Verification of Conditions:

1. Verify dimensions, tolerances, and method of attachment with other work.

2. Verify sills, wall openings and adjoining air and vapor seal materials are ready to receive Work of this Section.

3. Verify accurate benchmarks and layout control points.

B. Commencing installation of curtainwall constitutes acceptance of substrates.

3.2 Preparation

A. Provide items to be imbedded in concrete or welded to structural steel and coordinate required locations.

B. Attach anchor clips to structure per approved submittals and to maintain structural capacity of anchors. Shim clips only to allow for proper alignment. Do not shim excessively to accommodate inadequate range of adjustment in clip. Use shims large enough to not reduce structural capacity of anchor clip.

C. Isolate dissimilar metal surfaces with asphalt mastic; tape or gasket acceptable to Design Professional.

D. Isolate aluminum from contact with mortar, concrete or other masonry materials with an alkali-resistant material acceptable to Design Professional.

E. Isolate aluminum from contact with pressure preservative-treated wood with an alkali-resistant material acceptable to Design Professional.

F. Install base or sill flashing per Flashing and Sheet Metal: Division 07.

G. Sub-Sill: Set sub-sill flashing in a triple row of sealant. Anchor sub-sill using clips or anchors without penetrating horizontal portion of sub-sill. Seal all penetrations and anchorage points. Sub-sill shall be watertight. Provide foam tape between sub-sill and frame.

3.3 Installation

A. General: Install curtainwall as required to:

1. Comply with manufacturer's written instructions.
2. Comply with approved submittals.
3. Match approved Mock-ups.
4. Comply with indicated criteria.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities and to allow for movement criteria. Weld or otherwise permanently secure adjustable anchors after final alignment.

C. Coordinate attachment and seal of perimeter air and vapor barrier materials.

D. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

E. Install doors.

F. Install tapes per manufacturers written instructions. Prepare and prime substrates.

G. Firesafing: Refer to Firestopping: Division 07.

H. Glass and Glazing: Refer to Glazing: Division 08.

I. Joint Sealants and Joint Fillers: Refer to Joint Sealants: Division 07.

J. Install components plumb, level, accurately aligned, and located in reference to column lines and floor levels within tolerances indicated.

3.4 Erection Tolerances

A. General: Comply with more stringent tolerances than those listed below, if required to:

1. Match approved Mock-ups.
2. Comply with performance criteria.
3. Comply with manufacturer's written instructions.
4. Align with other supported or adjacent Work with more stringent tolerances.

B. Limit variations from plumb, level or dimensioned angle to the following:

1. 1/8 inch maximum deviation in any story height, or in any 10 feet vertical or angular run, or in any 20 foot horizontal run, non-cumulative.

2. 1/4 inch maximum deviation in any 40 foot run, any direction, non-cumulative.

C. Limit variations from location (theoretical calculated positions in plan or elevation based on established floor lines and column lines), including variations from plumb and level, to the following:

1. 1/4 inch total maximum deviation for any element at any location, non-cumulative.

2. 1/4 inch maximum change in deviation for any element for any 10 foot run, any direction, non-cumulative.

D. Limit offset in end-to-end or edge-to-edge alignments of adjoining consecutive elements indicated to be flush, continuous or planar to the following:

1. Interior: 1/32 inch.

2. Exterior: 1/16 inch.

E. Limit variation from indicated position in end-to-end or edge-to-edge alignments of adjoining consecutive elements indicated to be less than 1/2 inch out-of-plane or are separated by a maximum 2 1/2 inch wide member to the following:

1. Interior: 1/16 inch.

2. Exterior: 1/8 inch.

F. Limit variation from indicated position in end-to-end or edge-to-edge alignments of adjoining consecutive elements indicated to be 1/2 inch or more out-of-plane or are separated by a member wider than 2 1/2 inches to the following:

1. Interior: 1/8 inch.

2. Exterior: 3/16 inch.

G. Limit maximum width of a hairline joint as follows:

1. Interior: 0.020 inch.

2. Exterior: 0.050 inch.

H. Limit maximum variation in width of a hairline joint as follows:

1. Interior: 0.005 inch.

2. Exterior: 0.020 inch.

I. Limit difference in diagonal measurements to 1/8 inch.

J. Metal panels, trim and brake metal shall not have visible oil canning, pinching, dimples or other surface irregularity or deformation visible when viewed under the following conditions:

1. Viewed at any angle.

2. Viewed from a distance of 10 feet from exterior surfaces and 3 feet from interior surfaces.

3. Viewed between two (2) hours after sunrise and two (2) hours before sunset for exterior surfaces.

4. Interior work shall be viewed under normal building lighting (natural or artificial) conditions.

K. Comply with stricter tolerances if required for glazing or to meet specified performance criteria.

3.5 Field Quality Control

A. Comply with requirements of Quality Control Program.

3.6 Adjusting

A. Adjust doors for smooth operation.

B. Touchup damage to prefinished surfaces.

3.7 Cleaning

A. Clean completed system, inside and out, promptly after erection and installation of glass and sealants, allowing for nominal curing of liquid sealants.

B. At Date of Substantial Completion, clean curtainwall system thoroughly and polish glass. Demonstrate proper cleaning methods and materials to Owner's maintenance personnel.

3.8 Protection

A. Protect Finished Work from damage.

END

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. This Section includes commercial door hardware for the following:

1. Swinging doors.
2. 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. Automatic operators.
4. Cylinders specified for doors in other sections.

C. Related Sections:

1. Division 08 Section “StandardHollow Metal Doors and Frames”.
2. Division 08 Section “Wood Doors”.
3. Division 08 Section “Aluminum Entrances and Storefronts”.
4. Division 28 Section “Access Control”.

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:

1. ANSI/BHMA Certified Product Standards - A156 Series

2. UL10C – Positive Pressure Fire Tests of Door Assemblies

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. Proof of Certification: Provide copy of manufacturer(s) official certification or accreditation document indicating proof of status as a qualified and authorized provider of the primary Integrated Wiegand Access Control Products.

E. Proof of Certification: Provide copy of manufacturer(s) official certification or accreditation document indicating proof of status as a qualified installer of Windstorm assemblies.

F. 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.

G. 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.

H. 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, Operation and Maintenance Data.

1.4 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. Installer Qualifications: A minimum three (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.

C. 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.

D. 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.

E. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.

F. 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.

G. 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.

H. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

1.5 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".

1.6 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 Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.

C. 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.

1.7 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. Standard Warranty Period: One (1) year from Date of Substantial Completion, unless otherwise indicated.

D. Special Warranty Periods:

1. Ten years for mortise locks and latches.
2. Five years for exit hardware.
3. Twenty five years for manual surface door closer bodies.
4. Two years for electromechanical door hardware.

1.8 Maintenance Service

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

Part 2 Products

2.1 Scheduled Door Hardware

A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.

B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3.

C. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.

D. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Product Substitution Procedures. Approval of requests is at the discretion of the Architect, Owner, and their designated consultants.

2.2 Hanging Devices

A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity, unless otherwise indicated:

    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 where indicated in the Hardware Sets or on Drawings:

    a. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.

5. Acceptable Manufacturers:

    a. Hager Companies (HA).
    b. McKinney Products (MK).
    c. Stanley Hardware (ST).

B. Pivots: ANSI/BHMA A156.4, Grade 1, certified. Space intermediate pivots equally not less than 25 inches on center apart or not more than 35 inches on center for doors over 121 inches high. Pivot hinges to have oil impregnated bronze bearing in the top pivot and a radial roller and thrust bearing in the bottom pivot with the bottom pivot designed to carry the full weight of the door. Pivots to be UL listed for windstorm where applicable.

1. Acceptable Manufacturers:

    a. Rixson Door Controls (RF).

2.3 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. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Acceptable Manufacturers:

    a. Hager Companies (HA) - ETW-QC (# wires) Option.
    b. McKinney Products (MK) - QC (# wires) Option.
    c. Stanley Hardware (ST) – C Option.

B. Electrified Quick Connect Intermediate Transfer Pivots: Provide electrified offset intermediate transfer pivot 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. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Acceptable Manufacturers:

    a. Rixson Door Controls (RF) - E-M19-QC (# wires).

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 Products (MK) - Electrical Connecting Kit: QC-R001.
   b. McKinney Products (MK) - Connector Hand Tool: QC-R003.

2. Acceptable Manufacturers:

   a. McKinney Products (MK) – QC-C Series.
   b. Stanley Hardware (ST) – WH Series.

2.4 Door Operating Trim

A. Flush Bolts and Surface Bolts: ANSI/BHMA A156.3 and A156.16, Grade 1, certified.

1. Manual flush bolts to be furnished with top rod of sufficient length to allow bolt location approximately six feet from the floor.

2. Furnish dust proof strikes for bottom bolts.

3. Surface bolts to be minimum 8” in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.

4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.

5. Acceptable Manufacturers:

   a. Door Controls International (DC).
   b. Rockwood Manufacturing (RO).
   c. Trimco (TC).

B. Door Push Plates and Pulls: ANS/BHMA A156.6 certified door pushes and pulls 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. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.

5. Acceptable Manufacturers:

   a. Hiawatha, Inc. (HI).
   b. Rockwood Manufacturing (RO).
   c. Trimco (TC).

2.5 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.

B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.

C. Cylinders: Original manufacturer cylinders complying with the following:

1. Mortise Type: Threaded cylinders with rings and cams to suit hardware application.

2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.

3. Bored-Lock Type: Cylinders with tailpieces to suit locks.

4. 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.

5. Keyway: Match Facility Restricted Keyway.

D. Patented Cylinders: ANSI/BHMA A156.5, Grade 1, certified cylinders employing a utility patented and restricted keyway requiring the use of patented controlled keys. Provide bump resistant, fixed core cylinders as standard with solid recessed cylinder collars. Cylinders are to be factory keyed where permanent keying records will be established and maintained.

1. Provide a 6 pin multi-level master key system comprised of patented controlled keys and security and high security cylinders operated by one (1) key of the highest level. Geographical exclusivity to be provided for all security and high security cylinders and UL437 certification where specified.

   a. Level 1 Cylinders: Provide utility patented controlled keyway cylinders that are furnished with patented keys available only from authorized distribution.
   b. Level 2 Cylinders: Provide utility patented controlled keyway and side bar locking incorporating unique angled bottom pins for geographical exclusivity. Cylinders constructed to provide protection against bumping and picking.
   c. Level 3 Cylinders: Provide utility patented controlled keyway and side bar locking incorporating unique angled bottom pins for geographical exclusivity. Cylinders to be UL437 certified and constructed to provide protection against bumping, picking, and drilling.
   d. Refer to hardware sets for specified levels.

2. Acceptable Manufacturers:

   a. Corbin Russwin (RU) – Access 3 Series.
   b. No Substitution.

E. 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).

F. Construction Keying: Provide construction master keyed cylinders.

G. 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.

2.6 Mechanical Locks And Latching Devices

A. Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 certified. Locksets are to be manufactured with a corrosion resistant steel case and be field-reversible for handing without disassembly of the lock body.

1. Mortise locks to be certified Security Grade 1.

2. Extended cycle test: Locks to have been cycle tested in ordinance with ANSI/BHMA 156.13 requirements to 10 million cycles.

3. Acceptable Manufacturers:

   a. Corbin Russwin Hardware (RU) – ML2000 Series.
   b. Sargent Manufacturing (SA) – 8200 Series.
   c. Schlage (SC) – L9000 Series.

B. Knurling: Where required by local code provide knurling or abrasive coating to all levers on doors leading to hazardous areas such as mechanical rooms, boiler and furnace rooms, janitor closets, and as otherwise required or specified.

2.7 Electromechanical Locking Devices

A. Electromechanical Mortise Locksets, Grade 1 (Heavy Duty): Subject to same compliance standards and requirements as mechanical mortise locksets, electrified locksets to be of type and design as specified below.

1. Electrified Lock Options: Where indicated in the Hardware Sets, provide electrified options including: outside door lock/unlock trim control, latchbolt and lock/unlock status monitoring, deadbolt monitoring, and request-to-exit signaling. Support end-of-line resistors contained within the lock case. Unless otherwise indicated, provide electrified locksets standard as fail secure.

2. Energy Efficient Design: Provide lock bodies which have a holding current draw of 15mA maximum, and can operate on either 12 or 24 volts. Locks are to be field configurable for fail safe or fail secure operation.

3. Acceptable Manufacturers:

   a. Corbin Russwin Hardware (RU) - ML20900 Series.
   b. Sargent Manufacturing (SA) - 8200 Series.
   c. Schlage (SC) - L9000 EL/EU/RX 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 A156.5.

4. Dustproof Strikes: BHMA A156.16.

2.9 Electromagnetic Locking Devices

A. Surface Electromagnetic Locks (Heavy Duty): Electromagnetic locks to be surface mounted type conforming to ANSI A156.23, Grade 1 with minimum holding force strength of 1,100 pounds. Locks to be capable of either 12 or 24 voltage and be UL listed for use on fire rated door assemblies. Locks are to have an integrated door position switch and lock bond sensor. Locks are to have integrated motion

sensor and/or security camera as indicated in the hardware sets. Provide mounting accessories as needed to suit opening conditions. Power supply to be by the same manufacturer as the lock with combined products having a lifetime replacement warranty.

1. Acceptable Manufacturers:
    a. Securitron (SU) – M680 Series.

2.10 Conventional Exit Devices

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. 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.

2. 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.

3. 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.

4. 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.

5. Electromechanical Options: Subject to same compliance standards and requirements as mechanical exit devices, electrified devices to be of type and design as specified in hardware sets. Include any specific controllers when conventional power supplies are not sufficient to provide the proper inrush current.

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. Extended cycle test: Devices to have been cycle tested in ordinance with ANSI/BHMA 156.2 requirements to 9 million cycles.

11. Rail Sizing: Provide exit device rails factory sized for proper door width application.

12. 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 panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Exit device latch to be stainless steel, pullman type, with deadlock feature.

1. Acceptable Manufacturers:

   a. Corbin Russwin Hardware (RU) - ED4000 / ED5000 Series.
   b. Sargent Manufacturing (SA) - 80 Series.
   c. Stanley Precision (PR) - Apex 2000 Series.

2.11 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 including installation and adjusting information on inside of cover.

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. Cycle Testing: Provide closers which have surpassed 15 million cycles in a test witnessed and verified by UL.

4. 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 physically handicapped, provide units complying with ANSI ICC/A117.1.

5. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.

6. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.

7. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates, and through-bolt and security type fasteners as required for proper installation.

B. Door Closers, Surface Mounted (Large Body Cast Iron): ANSI/BHMA A156.4, Grade 1 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 body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control.

1. Acceptable Manufacturers:

a. Corbin Russwin Hardware (RU) - DC8000 Series.
b. LCN Closers (LC) - 4040XP Series.
c. Sargent Manufacturing (SA) - 281 Series.

2.12 Automatic Door Operators

A. General: Provide operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for compliance with UL 325. Coordinate operator mechanisms with door operation, hinges, and activation devices.

1. Fire-Rated Doors: Provide door operators for fire-rated door assemblies that comply with NFPA 80 for fire-rated door components and are listed and labeled by a qualified testing agency.

B. Brackets and Reinforcements: Manufacturer's standard, fabricated from aluminum with nonferrous shims for aligning system components.

C. Standard: Certified ANSI/BHMA A156.19.

1. Performance Requirements:

a. Opening Force if Power Fails: Not more than 15 lbf required to release a latch if provided, not more than 30 lbf required to manually set door in motion, and not more than 15 lbf required to fully open door.
b. Entrapment Protection: Not more than 15 lbf required to prevent stopped door from closing or opening.

D. Configuration: Surface mounted. Door operators to control single swinging and pair of swinging doors.

E. Operation: Power opening and spring closing operation capable of meeting ANSI A117.1 accessibility guideline. Provide time delay for door to remain open before initiating closing cycle as required by ANSI/BHMA A156.19. When not in automatic mode, door operator to function as manual door closer with fully adjustable opening and closing forces, with or without electrical power.

1. On-off switch to control power to be key switch operated.

F. Features: Operator units to have full feature adjustments for door opening and closing force and speed, backcheck, motor assist acceleration from 0 to 30 seconds, time delay, vestibule interface delay, obstruction recycle, and hold open time from 0 up to 30 seconds.

G. Provide outputs and relays on board the operator to allow for coordination of exit device latch retraction, electric strikes, magnetic locks, card readers, safety and motion sensors and specified auxiliary contacts.

H. Activation Devices: Provide activation devices in accordance with ANSI/BHMA A156.19 standard, for condition of exposure indicated and for long term, maintenance free operation under normal traffic load operation. Coordinate activation control with electrified hardware and access control interfaces. Activation switches are standard SPST, with optional DPDT availability.

I. Signage: As required by cited ANSI/BHMA A156.19 standard for the type of operator.

1. Acceptable Manufacturers:

a. Norton Door Controls (NO) - 6000 Series.
b. Stanley Access (ST) - Magic Force Series.

2.13 Electromechanical Door Operators – Self Powered

A. Standard: Certified ANSI/BHMA A156.19.

B. Performance Requirements: Capable of operating doors up to 48” wide and weighing up to 250 pounds.

C. Cycle Testing: Successfully tested to a minimum one million automatic cycles.

D. Configuration: Surface mounted. Door operators to control single swinging and pair of swinging doors.

1. Furnish complete with two jamb mounted push button transmitters with required signage.

E. Operation: Power opening and spring closing operation capable of meeting ANSI A117.1 accessibility guideline. Provide time delay for door to remain open before initiating closing cycle as required by ANSI/BHMA A156.19.

1. When operated manually a clutch mechanism disengages the motor gearbox upon opening, and then re-engages during the closing cycle to control spring force.

2. Optional Push-and-Go: Door movement activates the door opening cycle or recycles the door.

3. Optional Power Close: Motor closes the door if held open by wind, stack pressure, or latchbolt binding.

F. Features: Operator units to have full feature adjustments for door opening and closing force and speed, backcheck, motor assist acceleration from 0 to 30 seconds, time delay, vestibule interface delay, obstruction recycle, and hold open time from 0 up to 30 seconds.

1. Provide units which are self adjusting for door size and weight, and using on-board diagnostics, continually maintain control of doors in wind or abusive environments.

2. Provide manual adjustments for opening/closing speed, hold open time, backcheck, and opening/closing force.

3. Provide units which have a regenerative drive system which charges the on-board battery pack when the door is operated manually, and which requires no external electrical power.

4. Provide integral RF receiver paired with the included RF push buttons.

5. Provide optional external power supply.

G. Provide outputs and relays on board the operator to allow for coordination of exit device latch retraction, electric strikes, magnetic locks, card readers, safety and motion sensors and specified auxiliary contact.

H. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Norton Door Controls (NO) - 5800 Series.

2.14 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. Protection Plates: ANSI/BHMA A156.6 certified protection plates (kick, armor, or mop), fabricated from the following:

a. Stainless Steel: 300 grade, 050-inch thick.

4. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.

5. Acceptable Manufacturers:

a. Burns Manufacturing (BU).
b. Rockwood Manufacturing (RO).
c. Trimco (TC).

2.15 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 certified 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. Acceptable Manufacturers:

    a. Ives (IV).
    b. Rockwood Manufacturing (RO).
    c. Trimco (TC).

C. Overhead Door Stops and Holders: ANSI/BHMA A156.6, Grade 1 certified 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. Acceptable Manufacturers:

    a. Glynn Johnson (GJ).
    b. Rixson Door Controls (RF).
    c. Rockwood Manufacturing (RO).

2.16 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 UBC 7-2, 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. Acceptable Manufacturers:

1. National Guard Products (NG).

2. Pemko Manufacturing (PE).

3. Reese Enterprises, Inc. (RE).

2.17 Electronic Accessories

A. Power Supplies: Provide Nationally Recognized Testing Laboratory Listed 12VDC or 24VDC (field selectable) filtered and regulated power supplies. Include battery backup option with integral battery charging capability in addition to operating the DC load in event of line voltage failure. Provide the least number of units, at the appropriate amperage level, sufficient to exceed the required total draw for the specified electrified hardware and access control equipment.

1. Acceptable Manufacturers:

a. Corbin Russwin Hardware (RU) – 782.

2.18 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.

2.19 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. Shop Installation: Install hardware on the doors prior to shipment to the jobsite. Field installed hardware will only be permitted as itemized below. Comply with all other Part 3 installation requirements.

1. Extent of shop installed hardware shall include, but is not limited to:

    a. Hanging devices.
    b. Latching devices.
    c. Operating trim.
    d. Through-door wiring cables.
    e. Door closers and overhead stops.
    f. Flush bolts, surface bolts, and coordinating accessories.
    g. Protective trim – protection plates, edge guards, trim protectors.
    h. Coat hooks, viewers, and all other door mounted accessories.

2. Hardware items which are permitted to be installed in the field include:

    a. Door stops (wall, floor, other mounting).
    b. Frame mounted closer brackets.
    c. Lock and latch strike plates.
    d. Frame wiring cables.

3. Bench test shop installed work. This includes both mechanical and electrical components. Replace defective items.

4. Ship field installed hardware items clearly labeled with the door number and attached to the door using shrink wrap. Include all templates and instructions which are required to complete the installation.

B. 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.

C. 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. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."

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.

D. Integrated Wiegand access control products are required to be installed through current members of the ASSA ABLOY "Certified Integrator" (CI) program.

E. Power Operator products and accessories are required to be installed through current members of the manufacturer's "Power Operator Preferred Installer" program.

F. 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 09 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

G. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

H. 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 Field Quality Control

A. Field Inspection: Supplier will perform a final inspection of installed door hardware and state in report whether work complies with or deviates from requirements, including whether door hardware is properly installed, operating and adjusted.

3.5 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.

3.6 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.

3.7 Demonstration

A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 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.

B. Manufacturer’s Abbreviations:

1. MK – McKinney.
2. RF – Rixson.
3. RO – Rockwood.
4. SU – Securitron.
5. RU - Corbin Russwin.
6. NO – Norton.
7. PE – Pemko.
8. 00 – Other.

Hardware Schedule

Set: 1.0

Doors: 100B, 113, 204A, 204B

Description: Exterior Aluminum Entry / Exit

1	Pivot Set	195	626	RF
2	Pivot	M19	626	RF
1	Exit Device (rim, exit only)	ED4200	630	RU
1	Cylinder	3500 CMK GMK	626	RU
1	Pull	RM3431- MP - Full Height	US32	RO
1	Closer (surface)	DC8210 A11 M75 M77	689	RU
1	Threshold	171AK WS10SS		PE
1	Sweep	315CN TKSP8		PE

Notes: Perimeter gasket by frame manufacturer.

Set: 1.1

Doors: 100A

Description: Card Access / Exit with ADA Operator

1	Pivot Set	195	626	RF
1	Pivot (electric)	EM19 QC-12	626	RF
1	Pivot	M19	626	RF
1	Exit Device (rim, elect latch)	ED4200 M92 M94	630	RU
1	Cylinder	3500 CMK GMK	626	RU
1	Pull	RM4412-24 Mtg-Type 13	US32D	RO
1	Door Operator	6070 D SN-134	689	NO
1	Threshold	171AK WS10SS		PE
1	Sweep	315CN TKSP8		PE
1	ElectroLynx Harness	QC-C1500P		MK
1	ElectroLynx Harness	QC-C012		MK
1	Wall Smart Card Reader	PP40 By Security Contractor		00
1	Controller	782		RU
1	Wall Actuator	505		NO

Notes: NOTE: Remainder of electronic access control components and software by Division 28 Contractor. Prep door and hinge jamb for electromechanical device. Provide flex conduit and in door & hinge jamb.
OPERATION:
After hours: Card Reader outside temporarily retracts latchbolt: automatic relock. Inside wall actuator retracts latchbolt and cycles operator.
Open hours: Electronic exit device is put in passage mode by access control panel. Wall actuator either side cycle operator.
Electronic device function is fail-secure with inside RX switch in rail. Device has outside key override. Inside rail always allows egress.

Set: 2.0

Doors: 124

Description: Exterior Aluminum Card Access / Exit

1	Pivot Set	195	626	RF
1	Pivot (electric)	EM19 QC-12	626	RF
1	Pivot	M19	626	RF
1	Exit Device (rim, elect latch)	ED4200 M92 M94	630	RU
1	Pull	RM3431- MP - Full Height	US32	RO
1	Threshold	171AK WS10SS		PE
1	Wall Smart Card Reader	RP40 - By Security Contractor		00
1	Controller	782		RU

Notes: Perimeter gasket by frame manufacturer.
NOTE: Remainder of electronic access control components and software by Division 28 Contractor.
Prep door and hinge jamb for electromechanical device. Provide flex conduit in door.
OPERATION: Card reader outside temporarily retracts latchbolt - auto relock. Device is fail-secure with inside RX switch and outside key override. Inside pushbar always allows egress.

Set: 3.0

Doors: 100D

Description: Aluminum Vestibule - Push-Pull

1	Pivot Set	195	626	RF
1	Pivot	M19	626	RF
1	Pull	RM3431-96 Mtg-Type 13 MP	US32	RO
1	Closer (surface)	DC8210 A11 M75	689	RU

Notes: Balance of hardware by door manufacturer.

Set: 3.1

Doors: 100C

Description: Aluminum Vestibule - Push Pull with ADA Operator

1	Pivot Set	195	626	RF
1	Pivot	M19	626	RF
1	Pull	RM3431-96 Mtg-Type 13 MP	US32	RO
1	Door Operator	6070 D SN-134	689	NO
1	Wall Actuator	505		NO

Set: 3.2

Doors: 119B

Description: Exterior Exit Only

3	Hinge (heavy weight)	T4A3386 NRP 4-1/2" x 4-1/2"	US32D	MK
1	Exit Device (rim, exit only)	ED5200A	630	RU
1	Closer (surface)	DC8210 A11 M75	689	RU
1	Kick Plate	K1050 12" high	US32D	RO
1	Threshold	171AK WS10SS		PE
1	Gasketing	S88D		PE
1	Sweep	315CN TKSP8		PE

Set: 4.0

Doors: 115B

Description: Classroom Function

3	Hinge	TA2714 NRP 4-1/2" x 4-1/2"	US26D	MK
1	Mortise Lock (classroom)	ML2055 102X AP CMK GMK	626	RU
1	Wall Stop	406	US32D	RO
3	Silencer	608		RO

Set: 5.0

Doors: 102

Description: Card Access

2	Hinge	TA2714 NRP 4-1/2" x 4-1/2"	US26D	MK
1	Hinge	TA2714 QC12 4-1/2" x 4-1/2"	US26D	MK
1	Electrified Mortise Lock	ML20906-SEC 102X M92 AP CMK GMK	626	RU
1	Closer (surface)	DC8200	689	RU
1	Kick Plate	K1050 12" high	US32D	RO
1	Wall Stop	406	US32D	RO
3	Silencer	608		RO
1	ElectroLynx Harness	QC-C1500P		MK
1	ElectroLynx Harness	QC-C300		MK

Notes: NOTE: Remainder of electronic access control components and software by Division 28 Contractor. Prep door and hinge jamb for electronic device. Furnish wiring harness in door per specifications. OPERATION: Outside integral smart card reader temporarily unlocks outside lever: auto-relock. Electronic function is fail-secure with outside key override. Inside lever always allows egress and includes REX. Lock includes door position switch and latchbolt monitor switch.

Set: 5.1

Doors: 117

Description: Keypad Access

2	Hinge	TA2714 NRP 4-1/2" x 4-1/2"	US26D	MK
1	Hinge	TA2714 QC12 4-1/2" x 4-1/2"	US26D	MK
1	Electrified Mortise Lock	ML20906-SEC 102X M92 AP CMK GMK	626	RU
1	Closer (surface)	DC8200	689	RU
1	Kick Plate	K1050 12" high	US32D	RO
1	Wall Stop	406	US32D	RO
3	Silencer	608		RO
1	ElectroLynx Harness	QC-C1500P		MK
1	ElectroLynx Harness	QC-C300		MK
1	Wall Keypad	By Div 28 Subcontractor		00

Notes: NOTE: Remainder of electronic access control components and software by Division 28 Contractor. Prep door and hinge jamb for electronic device. Furnish wiring harness in door per specifications. OPERATION: Outside wall keypad temporarily unlocks outside lever: auto-relock. Electronic function is fail-secure with outside key override. Inside lever always allows egress and includes REX. Lock includes door position switch and latchbolt monitor switch.

Set: 6.0

Doors: 117B

Description: Exterior Keypad Access

2	Hinge	TA2314 NRP 5" x 4-1/2"	US32D	MK
1	Hinge	TA2314 QC12 5" x 4-1/2"	US32D	MK
1	Electrified Mortise Lock	ML20906-SEC 102X M92 AP CMK GMK	626	RU
1	Closer (surface)	DC8210 A11 M75	689	RU
1	Kick Plate	K1050 12" high	US32D	RO
1	Threshold	1715AK WS10SS		PE
1	Rain Guard	346C TKSP8		PE
1	Gasketing	303AS TKSP8		PE
1	Sweep	315CN TKSP8		PE
1	ElectroLynx Harness	QC-C1500P		MK
1	ElectroLynx Harness	QC-C306		MK

Notes: NOTE: Remainder of electronic access control components and software by Division 28 Contractor. Prep door and hinge jamb for electronic device. Furnish wiring harness in door per specifications. OPERATION: Outside integral smart card reader temporarily unlocks outside lever: auto-relock. Electronic function is fail-secure with outside key override. Inside lever always allows egress and includes REX. Lock includes door position switch and latchbolt monitor switch.

Set: 7.0

Doors: 119, 201B, 202, 203, 211

Description: Card Access

2	Hinge (heavy weight)	T4A3786 NRP 4-1/2" x 4-1/2"	US26D	MK
1	Hinge (heavy weight)	T4A3786 QC12 4-1/2" x 4-1/2"	US26D	MK
1	Electrified Mortise Lock	ML20906-SEC 102X M92 AP CMK GMK	626	RU
1	Closer (surface)	DC8200	689	RU
1	Kick Plate	K1050 12" high	US32D	RO
1	Wall Stop	406	US32D	RO
1	Gasketing	S88D		PE
3	Silencer	608		RO
1	ElectroLynx Harness	QC-C1500P		MK
1	ElectroLynx Harness	QC-C300		MK

Notes: NOTE: Remainder of electronic access control components and software by Division 28 Contractor. Access control panel and security management software by security integrator.
Prep door and hinge jamb for electronic device. Furnish wiring harness in door per specifications.
OPERATION: Outside keypad temporarily unlocks outside lever: auto-relock. Electronic function is fail-secure with outside key override. Inside lever always allows egress and includes REX. Lock includes door position switch and latchbolt monitor switch.

Set: 8.0

Doors: 201, 207

Description: Card Access

2	Hinge (heavy weight)	T4A3786 NRP 4-1/2" x 4-1/2"	US26D	MK
1	Hinge (heavy weight)	T4A3786 QC12 4-1/2" x 4-1/2"	US26D	MK
1	Electrified Mortise Lock	ML20906-SEC 102X M92 AP CMK GMK	626	RU
1	Closer (surface)	DC8210 A3	689	RU
1	Kick Plate	K1050 12" high	US32D	RO
1	Wall Stop	406	US32D	RO
3	Silencer	608		RO
1	ElectroLynx Harness	QC-C1500P		MK
1	ElectroLynx Harness	QC-C300		MK

Notes: NOTE: Remainder of electronic access control components and software by Division 28 Contractor.
Prep door and hinge jamb for electronic device. Furnish wiring harness in door per specifications.
OPERATION: Outside integral smart card reader temporarily unlocks outside lever: auto-relock. Electronic function is fail-secure with outside key override. Inside lever always allows egress and includes REX. Lock includes door position switch and latchbolt monitor switch.

Set: 9.0

Doors: 101A, 104B

Description: Card Access

2	Hinge (heavy weight)	T4A3786 NRP 4-1/2" x 4-1/2"	US26D	MK
1	Hinge (heavy weight)	T4A3786 QC12 4-1/2" x 4-1/2"	US26D	MK
1	Electrified Mortise Lock	ML20906-SEC 102X M92 AP CMK GMK	626	RU
1	Closer (surface)	DC8210 A11	689	RU
1	Kick Plate	K1050 12" high	US32D	RO
3	Silencer	608		RO
1	ElectroLynx Harness	QC-C1500P		MK
1	ElectroLynx Harness	QC-C300		MK

Notes: NOTE: Remainder of electronic access control components and software by Division 28 Contractor. Prep door and hinge jamb for electronic device. Furnish wiring harness in door per specifications. OPERATION: Outside integral smart card reader temporarily unlocks outside lever: auto-relock. Electronic function is fail-secure with outside key override. Inside lever always allows egress and includes REX. Lock includes door position switch and latchbolt monitor switch.

Set: 9.1

Doors: 101B, 114, 115, 208

Description: Card Access

2	Hinge (heavy weight)	T4A3786 NRP 4-1/2" x 4-1/2"	US26D	MK
1	Hinge (heavy weight)	T4A3786 QC12 4-1/2" x 4-1/2"	US26D	MK
1	Access Control Mort Lock	ML20607 x SELP10-SEC 102X IPS AP CMK	626	RU
1	Concealed Overhead Stop	6-X36	630	RF
1	Closer (surface)	DC8200	689	RU
1	Kick Plate	K1050 12" high	US32D	RO
3	Silencer	608		RO
1	ElectroLynx Harness	QC-C1500P		MK
1	ElectroLynx Harness	QC-C300		MK

Notes: NOTE: Remainder of electronic access control components and software by Division 28 Contractor. Prep door and hinge jamb for electronic device. Furnish wiring harness in door per specifications. OPERATION: Outside integral smart card reader temporarily unlocks outside lever: auto-relock. Electronic function is fail-secure with outside key override. Inside lever always allows egress and includes REX. Lock includes door position switch and latchbolt monitor switch.

Set: 10.0

Doors: 119C

Description: Rated Passage / Exit

3	Hinge (heavy weight)	T4A3786 NRP 4-1/2" x 4-1/2"	US26D	MK
1	Exit Device (rim, passage)	ED5200A 102910	630	RU
1	Closer (surface)	DC8200	689	RU
1	Kick Plate	K1050 12" high	US32D	RO
1	Wall Stop	406	US32D	RO
1	Gasketing	S88D		PE

Set: 11.0

Doors: 116, 212

Description: Office

3	Hinge	TA2714 NRP 4-1/2" x 4-1/2"	US26D	MK
1	Office Lock	ML2051 102X AP CMK GMK	626	RU
1	Wall Stop	406	US32D	RO
3	Silencer	608		RO
1	Coat Hook	796	US26D	RO

Set: 12.0

Doors: 105, 106, 111, 112

Description: Push-Pull

3	Hinge (heavy weight)	T4A3786 NRP 4-1/2" x 4-1/2"	US26D	MK
1	Push Plate	70F	US32D	RO
1	Pull Plate	BF 111x70C	US32D	RO
1	Closer (surface)	DC8200	689	RU
1	Kick Plate	K1050 12" high	US32D	RO
1	Mop Plate	K1050 6" high	US32D	RO
1	Wall Stop	406	US32D	RO
3	Silencer	608		RO

Set: 13.0

Doors: 206

Description: Storeroom Function

3	Hinge	TA2714 NRP 4-1/2" x 4-1/2"	US26D	MK
1	Storeroom Lock	ML2057 102X AP CMK GMK	626	RU
1	Wall Stop	406	US32D	RO
3	Silencer	608		RO
1	Coat Hook	796	US26D	RO

Set: 14.0

Doors: 107, 108

Description: Storeroom Function

3	Hinge	TA2714 NRP 4-1/2" x 4-1/2"	US26D	MK
1	Storeroom Lock	ML2057 102X AP CMK GMK	626	RU
1	Surface Overhead Holder	10-X26	652	RF
3	Silencer	608		RO

Set: 15.0

Doors: 109

Description: Electrical Room + Closer

3	Hinge	TA2714 NRP 4-1/2" x 4-1/2"	US26D	MK
1	Storeroom Lock	ML2057 102X M25 AP CMK GMK	626	RU
1	Surface Overhead Holder	10-X26	652	RF
1	Closer (surface)	DC8200	689	RU
1	Kick Plate	K1050 12" high	US32D	RO
1	Gasketing	S88D		PE

Set: 16.0

Doors: 209

Description: Mechanical Room + Closer

3	Hinge	TA2714 NRP 5" x 4-1/2"	US26D	MK
1	Storeroom Lock	ML2057 102X M25 AP CMK GMK	626	RU
1	Closer (surface)	DC8210 A11	689	RU
1	Kick Plate	K1050 12" high	US32D	RO
1	Gasketing	S88D		PE

Set: 17.0

Doors: 201A, 207B

Description: Storeroom Function Pair

6	Hinge	TA2714 NRP 4-1/2" x 4-1/2"	US26D	MK
2	Flush Bolt	555	US26D	RO
1	Dust Proof Strike	570	US26D	RO
1	Storeroom Lock	ML2057 102X AP CMK GMK	626	RU
2	Surface Overhead Holder	10-X26	652	RF
1	Astragal	357SS TKSP8		PE
2	Silencer	608		RO

Set: 18.0

Doors: 207A

Description: Electrical Closet Pair

6	Hinge	TA2714 NRP 4-1/2" x 4-1/2"	US26D	MK
1	Flush Bolt	555	US26D	RO
1	Dust Proof Strike	570	US26D	RO
1	Storeroom Lock	ML2057 102X M25 AP CMK GMK	626	RU
2	Surface Overhead Holder	10-X26	652	RF
1	Gasketing	S88D		PE
1	Astragal	357SS TKSP8		PE

Notes: Apply adhesive gasket at frame perimeter and at meeting stile.

Set: 19.0

Doors: 122

Description: Exterior Mechanical Room

3	Hinge	TA2314 NRP 5" x 4-1/2"	US32D	MK
1	Mortise Lock (security storeroom)	ML2059 102X M25 AP CMK GMK	626	RU
1	Closer (surface)	DC8210 A12 M75	689	RU
1	Threshold	1715AK WS10SS		PE
1	Rain Guard	346C TKSP8		PE
1	Gasketing	303AS TKSP8		PE
1	Sweep	315CN TKSP8		PE

Set: 20.0

Doors: 103A, 103B, 114B, 116B, 120, 204, 210

Description: Cased Opening Frame

1	No hardware Required		00

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Shop or Project Site installed glazing for exterior and interior applications not otherwise specified, as follows.

1. Vision lites, including interior doors, borrowed lites, side lites, transoms and clerestories.
2. Glazed curtainwalls.
3. Entrance doors.
4. Storefront construction.
5. Unframed mirrors.
6. Fire resistant glazing.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Exterior Enclosure, General: Division 07.

C. Standard Hollow Metal Doors and Frames: Division 08.

D. Wood Doors: Division 08.

E. Mirrors: Division 08

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Product Data:

1. For Each Glass Type Specified: Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements, and published installation instructions.
2. For Each Glazing Material Specified: Provide published chemical, functional, and environmental characteristics, installation instructions, limitations, and special application requirements. Identify available colors.

3. For Fully Tempered Glass: Manufacturers certification that fully tempered units are either warranted without heat soaking or heat soaking is provided.

C. Samples:

1. Two Samples, 12 inches by 12 inches for each type and thickness of glass. Insulated units shall be fabricated in accordance with Specifications.

2. Identify each Sample, marks shall match Glazing Schedule.

D. Qualifications: Proof of compliance with indicated qualifications.

E. Quality Control Procedures:

1. Test Reports:

a. Compatibility and Adhesion Test Reports: From manufacturer indicating that glazing materials and structural silicone glazing materials were tested for compatibility and adhesion. Include manufacturer's published interpretation of test results relative to sealant performance and recommendations for primers and substrate preparation needed for adhesion.
b. Compatibility test report from manufacturer of insulating glass edge sealant indicating that glass edge sealants were tested for compatibility with other glazing materials including sealants, glazing tape, gaskets, setting blocks, and edge blocks.

2. Test Reports and Procedures indicating compliance with indicated criteria:

a. Factory Quality Control Procedures.
b. Factory Test Procedures.
c. Factory Test Reports.
d. Field Test Procedures.
e. Field Test Reports.

F. Certifications: Product certificates signed by glazing materials manufacturers certifying that products comply with specified requirements, meet structural criteria and are appropriate for intended use.

G. Sustainability Submittals: Provide the following in accordance with Sustainability Requirements: Division 01.

1. Materials Sustainability Documentation Form.

2. Product data and costs for regional materials.

3. Product data for adhesives and sealants indicating VOC content.

H. Closeout Submittals:

1. Warranty: Intent to Warrant Letter and draft of Warranty prior to start of fabrication or construction. Final Warranty after Date of Substantial Completion.

2. Maintenance Data: For glass and other materials to be included in Operating and Maintenance Manuals specified in Division 01.

1.4 Definitions

A. Interspace: Space between lites of an insulating glass unit.

B. Deterioration of All Glass Types: Defects developed from normal use that are attributed to manufacturing process or installation methods. Defects include (non-inclusive) flatness and other dimensional tolerances, distortion, tong marks, roller wave, bulls eyes, edge chips, cracks and other visible defects beyond those allowed by reference standard. Additional criteria (non-inclusive):

1. Deterioration of Fully Tempered Glass: Defects include spontaneous breakage caused by nickel sulfide inclusion.

2. Deterioration of Coated Glass: Defects include adhesion failure, peeling, cracking, and other indications of deterioration in coating.

3. Deterioration of Laminated Glass: Defects include edge separation, delamination, color change, and blemishes.

4. Deterioration of Insulating Glass: Defects include failure of structural sealant, failure of hermetic seal, obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1.5 System Description

A. Design: Provide Final Design and engineering of glass and glazing in compliance with indicated design intent and criteria.

1. Maintain basic dimensions of system, sight lines, jointing, and profiles. Minor variation is allowable only when variations are identified on submittals and are approved by Design Professional.

2. Design and engineer components of system not fully detailed within a reasonable inference of design intent.

B. Glass Design: Glass thicknesses indicated are minimums for detailing convenience only. Confirm glass thicknesses by analyzing in-service conditions, thermal stresses and loading criteria indicated. Provide glass lights for various size openings in thicknesses and strengths (annealed or heat-treated) to meet or exceed the following criteria:

1. Determine minimum thickness of monolithic annealed glass according to ASTM E 1300. For other than monolithic annealed glass, determine thickness per glass manufacturer's standard method of analysis including applying adjustment factors to ASTM E 1300 based on type of glass.

2. Minimum glass thickness, nominally, of lights in exterior walls is 0.23 inch.

3. Glass thicknesses, including glass used to make up insulating units, shall be same throughout Project to provide color and optical uniformity.

4. Probability of Breakage for Vertical Glazing: Maximum eight lights per 1000 for lights set vertically or not over 15 degrees off vertical and under wind action.
    a. Load Duration: 60 seconds.
5. Probability of Breakage for Sloped Glazing: Maximum one light per 1000 for lights set over 15 degrees off vertical and under wind and snow action.
    a. Load Duration: 60 seconds for wind and 30 days for snow.

C. Structural and Thermal Movement Criteria: In accordance with Exterior Enclosure, General: Division 07.

D. Thermal and Optical Performance Properties: Provide glass with performance properties based on manufacturer's published test data, as determined according to the following procedures:

1. For monolithic glass lites, properties are based on units with lites 1/4 inch thick.
2. For laminated glass lites, properties are based on products of construction indicated.
3. For insulating glass lites, properties are based on units with 1/4 inch thick lites and a nominal 1/2 inch wide interspace.
4. Center of Glass U-values: NFRC 100 methodology using LBL-35298 WINDOW 4.1 computer program, expressed as Btu/ square foot by hour by degree F.
5. Center of Glass Solar Heat Gain Coefficient: NFRC 200 methodology using LBL-35298 WINDOW 4.1 computer program.
6. Solar Optical Properties: NFRC 300.

1.6 Quality Assurance

A. Manufacturer's Qualifications:

1. Experience: Minimum five (5) years producing products similar to those required for this Project.
    a. Provided products for three (3) projects of scope, schedule and complexity similar to this Project within last two (2) years as acceptable to Design Professional.
    b. Manufacturer of glass products shall be certified to ASTM ASQC 9001 or ISO 9001.
2. Manufacturer's Designer: Professional Engineer with minimum five (5) years experience designing systems similar to those required for this Project.
3. Single Source Responsibility for Glass: Obtain tinted float glass and coated float glass and insulating glass from single source from single manufacturer for each glass type.
4. Single Source Responsibility for Glazing Materials: Obtain glazing materials and accessories from one source for each product and installation method indicated.

5. Certify compliance. Include project descriptions with Owner and Design Professional contacts for previous experience and resume for designer.

B. Installer's Qualifications:

1. Experience: Minimum five (5) years installing products similar to those required for this Project.

a. Completed three (3) projects of scope, schedule and complexity similar to this Project using manufacturer's similar system as required for this Project within last two (2) years as acceptable to Design Professional.
b. Adequately trained by manufacturer and recommended in writing by manufacturer for type of installation required for this Project.

2. Certify compliance. Include project descriptions with Owner and Design Professional contacts for previous experience.

C. Glass Testing Agency's Qualifications: Obtain glass test reports from an independent Testing Agency with experience and capability to conduct testing indicated, as documented according to ASTM E 548.

D. Regulatory Requirements:

1. Safety Glazing: Comply with applicable codes, ANSI Z97.1 and CPSC 16 CFR, Part 1201 for all glazing in areas subject to human impact, including wire glass.

2. Fire Resistant Glazing: Provide products listed by UL (or other agency acceptable to authorities having jurisdiction) appropriate for intended use. Comply with NFPA 80 based on testing according to NFPA 257.

3. Labeling: Each individual light shall bear manufacturer's etched or fired label designating type, thickness and size, standard compliance and SGCC identification number (where applicable).

a. Labels shall not be omitted, unless approved and an affidavit is furnished by Contractor certifying that each light is glazed in accordance with Contract Documents.
b. Labels shall not be omitted from safety glazing materials, except for spandrel glass which shall be affixed with a removable paper label in lieu of etched or fired labels.

E. Referenced Codes and Standards: Comply with the following in accordance with Division 01.

1. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, except where more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in Referenced Standards.

a. GANA Publications:

1) "Glazing Manual".

b. IGMA Publications:

1) TM-3000: "Vertical Glazing Guidelines".

2. American Architectural Manufacturers Association (AAMA)

    a. CW 13: Structural Sealant Glazing Systems (A Design Guide)

F. Certifications: Manufacturer shall certify in writing the following:

1. Compliance with requirements of Exterior Enclosure, General: Division 07.

2. Use and Compatibility Certification: Certify that materials are appropriate for indicated use and that substrates and adjacent materials are compatible.

3. Certify Installer's qualifications.

4. Certify single source responsibility.

5. Certify that glazing products comply with specified requirements.

6. Insulating Glass Certification Program: Provide insulating glass units permanently marked either on spacers or at least one component light of units with appropriate certification label of Inspecting and Testing Agency indicated below:

    a. Insulating Glass Manufacturers Alliance (IGMA).

G. Mock-ups: Provide glazing required for mock-up specified in Exterior Enclosure, General: Division 07.

H. Glazier's Quality Control Program: Glazier shall establish a quality control program to ensure compliance with requirements. Submit plan for approval by Design Professional. Include dates for all testing procedures and notify Design Professional one week in advance. Glaziers quality control program may be incorporated into Manufacturers Quality Control Program specified in Glazed Aluminum Curtainwall: Division 08.

1. Document each aspect of quality control plan, including statistical data regarding compliance to tolerances. Plan shall include names of approved inspectors who shall initial each quality control inspection or check. Include qualifications of inspectors.

2. Manufacturer shall determine frequency of each type of inspection and checking, unless otherwise indicated.

3. Program shall include procedures which provide for the following:

    a. Glaziers inspection and checking at each phase of Work including, but not limited to, the following:

        1) Checking of raw materials upon delivery.

        2) Checking as materials are cut to size and formed for fabrication.

        3) Checking substrates for preparation, cleaning and priming.

        4) Checking of glazing procedures.

        5) Checking of each phase of installation.

I. Preconstruction Compatibility and Adhesion Testing: Glazing sealant manufacturer shall conduct compatibility and adhesion testing. Submit to glazing sealant manufacturers Samples of each glass, gasket, glazing accessory, and glass-framing member that will contact or affect glazing sealants as indicated below:

1. Structural silicone glazing products manufacturer shall perform adhesion tests as specified herein.

2. Use test methods standard with sealant manufacturer to determine if priming and other specific preparation techniques are required for rapid, optimum glazing sealants adhesion to glass and glazing channel substrates.

3. Perform tests under normal environmental conditions during installation.

4. Submit not less than nine pieces of each type and finish of glass-framing members and each type, class, kind, condition, and form of glass (monolithic, laminated, insulating units) for adhesion testing, as well as one Sample of each glazing accessory (gaskets, setting blocks and spacers) for compatibility testing.

5. Schedule sufficient time to test and analyze results to prevent delay in Work.

6. Investigate materials failing compatibility or adhesion tests and get sealant manufacturer's written recommendations for corrective measures, including using special primers.

7. Testing is not required when glazing sealant manufacturer can submit required preparation data that is acceptable to Design Professional and is based on previous testing of current sealant products for adhesion to and compatibility with submitted glazing materials.

J. Preinstallation Conference: Conduct conference at Project Site to comply with requirements of Division 01.

K. Inspection and Testing: Services of an Inspection and Testing Agency are required in conjunction with Work of this Section. Refer to Division 01.

1.7 Delivery, Handling And Storage

A. Protect glazing materials to comply with manufacturer's written directions and as required to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Where insulating glass units shall be exposed to substantial altitude changes, comply with insulating glass fabricator's written recommendations for venting and sealing to avoid hermetic seal ruptures.

C. Mark each piece of glass before shipping with a removable label to identify glass type, exterior side (if applicable) and installation location.

1.8 Project Conditions

A. Environmental Requirements: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits recommended by glazing materials manufacturer or when glazing channel substrates are wet from rain, frost, condensation or other causes.

B. Install liquid sealants at ambient and substrate temperatures above 40 degrees F.

1.9 Special Warranty

A. General: Warranty shall not deprive Owner of rights under other provisions of Contract and shall be in addition to, and run concurrent with, other Warranties made by Contractor under requirements of Contract Documents.

B. Manufacturer's Warranty on Coated Glass Products: Provide written Warranty signed by coated glass manufacturer agreeing to furnish replacements for coated glass units that deteriorate as defined in Article, Definitions.

1. Warranty Period: Ten (10) years after Date of Manufacture.

C. Manufacturer's Warranty on Laminated Glass: Provide written Warranty signed by insulating glass manufacturer agreeing to furnish replacements for those laminated glass units that deteriorate as defined in Article, Definitions:

1. Warranty Period: Five (5) years after Date of Manufacture.

D. Manufacturer's Warranty on Insulating Glass: Provide written Warranty signed by manufacturer of insulating glass agreeing to furnish replacements for insulating glass units that deteriorate as defined in Article, Definitions:

1. Warranty Period: Ten (10) years after Date of Manufacture.

E. Manufacturer's Warranty on Structural Silicone Glazing: Provide written Warranty signed by manufacturer of structural silicone agreeing to replace structural silicone sealants not performing to specified criteria.

1. Warranty Period: Five (5) years after Date of Substantial Completion.

F. Installer's Warranty: Provide written Warranty signed by installer of glass agreeing to install replacements for glass units that deteriorate as defined in Article, Definitions or units that are chipped, broken or otherwise defective because of faulty installation.

1. Warranty Period: Three (3) years after Date of Substantial Completion.

1.10 Maintenance

A. Extra Materials: Furnish two panes of each glass size and type specified. Provide adequate setting and glazing materials to reinstall each of extra panes.

1. Except for panes in doors, extra panes are not required for glass sizes when aggregate area of glass size does not exceed 10 percent of total glazed area.

2. Crate extra panes in boxes with solid wood or plywood on six sides and spacers between each pane. Clearly label outside of box for type of glass and pane size.

3. Deliver extra materials to storage location directed by Owner.

Part 2 Products

2.1 Manufacturers

A. Any manufacturer complying with indicated criteria.

B. Basis of Design: Manufacturers and products listed as Basis of Design are included to establish salient characteristics and not intended to limit or exclude other manufacturers. Equivalent products of other manufacturers will be evaluated as substitutions in accordance with requirements of Division 01.

2.2 Flat Glass Materials

A. Flat Glass: ASTM C 1036 Type I (transparent glass, flat), Class 1 (clear), Quality q3 (glazing select).

B. Tinted Flat Glass: ASTM C 1036, Type I transparent glass, flat, Class 2 (tinted, heat-absorbing and light reducing) and Class 3 (tinted, light).

2.3 Heat-Treated Flat Glass Materials

A. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed, unless otherwise indicated.

B. Fabrication Process: By vertical (tong-held) or horizontal (roller-hearth) process, at manufacturer's option, except provide horizontal process where indicated as tongless or free of tong marks.

1. Fully Tempered Units: Contractor's Option, either provide fully tempered units that are heat soaked to eliminate spontaneous breakage from nickel sulfide inclusion or warrant fully tempered units without heat soaking.

C. Heat-Treated Flat Glass: ASTM C 1048, Kind HS (heat strengthened), Condition A (uncoated surfaces), Type I (transparent, flat), Class 1 (clear), Quality q3 (glazing select).

D. Heat-Treated Flat Glass, Tempered Safety: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated surfaces), Type I (transparent, flat), Class 1 (clear), Quality q3 (glazing select).

E. Tinted Heat-Treated Flat Glass: ASTM C 1048, Kind HS (heat strengthened), Condition A (un-coated surfaces), Type I (transparent, flat), Class 2 (tinted, heat-absorbing and light reducing), 3 (tinted, light reducing), Quality q3 (glazing select).

F. Tinted Heat-Treated Flat Glass, Tempered, Safety: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated surfaces), Type I (transparent, flat), Class 2 (tinted heat absorbing and light reducing), 3 (tinted, light reducing), Quality q3 (glazing select).

2.4 Coated Glass Materials

A. Sputter-Coated, (Low-E) Glass: Flat Glass with metallic oxide or metallic nitride coating deposited by magnetic sputtering process after manufacture and heat treatment (if any). Comply with ASTM C 1376.

1. Class: Class 1 (transparent) and Class 2 (tinted, heat-absorbing and light reducing) and Class 3 (tinted and light reducing).

B. Ceramic-Coated Spandrel Glass: Flat Glass Kind HS (heat-strengthened Condition B (spandrel glass).

1. Class: Class 1 (transparent) and Class 2 (tinted, heat-absorbing and light reducing) and Class 3 (tinted and light reducing).

2. Fallout Resistance: Provide spandrel units identical to those passing fallout resistance test for spandrel glass specified in ASTM C 1048.

3. Opacifier: Apply manufacturer's standard opacifier film to coated second surface of lites with resulting products complying with GTA 89-1-6.

2.5 Sealed Insulating Glass Units

A. General: Preassembled units consisting of sealed lights of glass separated by dehydrated air spaces complying with ASTM E 2190 units and with other requirements indicated.

1. For properties of individual glass lights making up units, refer to requirements specified elsewhere in this Section applicable to types, classes, kinds, and conditions of glass products comprising lights of insulating glass units.

B. Gas Filling: Fill air space with argon.

C. Sealing System: Dual seal, primary and secondary sealants: Manufacturer's standard sealants.

D. Spacer: Manufacturer's standard metal.

1. Desiccant: Low nitrogen absorbing molecular sieve.

2. Corner Construction: Soldered or welded corner construction.

3. Color of Spacer: Color as selected by Design Professional from manufacturer's standard colors.

2.6 Glazing Materials

A. Use adhesives and sealants that comply with the VOC limits specified in Sustainability Requirements: Division 01.

B. Colors: Exposed sealant shall be selected by Design Professional from manufacturer's full range of standard colors.

C. Exposed Sealant: Silicone, neutral cure, low modulus:

1. Hardness (Shore A): 25 to 30.

2. Tensile Strength: Minimum 250 psi.

3. Dynamic Movement Capability: Minimum plus or minus 50 percent.

4. Comply with ASTM C 920, TT-S-01543 and TT-S-00230.

D. Concealed Sealant: Butyl or polyisobutylene, non-curing, non-skinning minimum 75 percent solid, comply with AAMA 809.2.

E. Glazing Tape: Preformed, nonstaining and nonmigrating in contact with nonporous surfaces, with spacer rod; as recommended in writing by tape and glass manufacturers for application indicated, and complying with AAMA 800 Series.

F. Glazing Materials for Fire-resistance Glazing Products: Identical to product used in test assembly to obtain fire-resistive rating.

2.7 Glazing Accessories

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials involved for glazing application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers and Sealers: Type recommended in writing by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore A durometer hardness of 85 plus or minus 5. Use silicone if required by any coating manufacturer.

D. Spacers: Elastomeric continuous extrusions with a Shore A durometer hardness required by glass manufacturer to maintain glass lights in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side-walking).

F. Plastic Foam Joint Fillers: Preformed, compressible, resilient, nonstaining, nonextruding, non-out-gassing, strips of closed-cell plastic foam of density, size, and shape to control sealant depth and otherwise contribute to produce optimum sealant performance.

G. Spring Wire Clips and Glazier Clips: Aluminum or stainless steel.

H. Mirror Support: Continuous stainless steel “J” shaped channel with No. 4 finish.

2.8 Fabrication Of Glass And Other Glazing Products

A. Fabricate glass and other glazing products in sizes required to glaze openings indicated, with edge and face clearances, edge and surface conditions, and bite complying with written recommendations of product manufacturer and referenced glazing standard as required to comply with system performance requirements.

B. Clean cut or flat grind vertical edges of butt-glazed monolithic lights in a manner that produces square edges with slight kerfs at junctions with indoor and outdoor faces.

C. All four-sided structural glazing shall be performed in fabricators shop in accordance with requirements of Part 3 Execution of this Specification.

2.9 Source Quality Control

A. Fabrication Tolerance: Comply with requirements of ASTM C 1036 and C 1048 and comply with lock-strip gasket manufacturers published tolerances if more restrictive.

B. Inspection and Testing: Comply with Exterior Enclosure, General: Division 07.

Part 3 Execution

3.1 Examination

A. Project Site Verification: Examine glass framing, with all interested parties present, for compliance with the following:

1. Published manufacturing and installation tolerances, including those for size, squareness, 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. Do not proceed with glazing until unsatisfactory conditions have been corrected. Commencing glazing constitutes acceptance of glass framing members.

3.2 Preparation

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings that are not firmly bonded to substrates.

3.3 Glazing: General

A. Comply with combined written recommendations of manufacturers of glass, sealants, gaskets, and other glazing materials, except where more stringent requirements are indicated, including those in referenced glazing publications.

B. Protect glass from edge damage during handling and installation as follows:

1. Use a rolling block in rotating glass units to prevent damage to glass corners. Do not impact glass with metal framing. Use suction cups to shift glass units within openings. Do not raise or drift glass with a pry bar. Rotate glass lights with flares or bevels on bottom horizontal edges so edges are located at top of opening, unless otherwise indicated, by manufacturer's label.

2. 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, 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. Primers are always required at structural silicone glazing.

D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing standard, unless otherwise required, by glass manufacturer. Set blocks in thin course of compatible sealant.

E. Do not exceed edge pressures recommended in writing by glass manufacturers for installing glass lights.

F. Provide spacers for glass sizes as follows:

1. Locate spacers continuously inside, and outside, and directly opposite each other. Install correct size to preserve required face clearances.

2. Where gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and comply with system performance requirements, separate spacers are not required.

G. Provide edge blocking to comply with requirements of referenced glazing publications, unless otherwise required in writing by glass manufacturer.

H. Set glass lights 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 subject to movement.

J. Square cut overlength at corners and install gaskets in manner recommended in writing by gasket manufacturer to prevent corners from pulling away; seal corner joints with sealant recommended in writing by gasket manufacturer.

3.4 Exterior Exposure - Dry Pressure Plate Method

A. Cut glazing gasket to length; install on fixed stop. Seal corners.

B. Install shop fabricated, one-piece glazing gasket on fixed stop.

C. Place setting blocks and edge blocks.

D. Rest glazing on setting blocks and push against fixed stop with sufficient pressure to attain full contact.

E. Install removable stops complete with glazing gaskets. Exert pressure for full continuous contact.

3.5 Exterior Exposure - Dry Method (Wedge Gasket)

A. Cut glazing gasket to length; install on fixed stop. Seal corners.

B. Install shop-fabricated, one-piece glazing gasket on fixed stop.

C. Place setting blocks and edge blocks.

D. Hold glazing slightly above setting blocks and push against fixed stop with sufficient pressure to attain full contact.

E. Install dense wedge gaskets. Install wedge at sill first, let glazing down on to setting blocks and complete wedge gasket on remaining three sides.

3.6 Field Quality Control

A. Comply with requirements of Exterior Enclosure, General: Division 07.

B. Glass and glazing product manufacturers to provide field surveillance of installation of their products under provisions of Inspection and Testing requirements of Division 01 Sections.

C. Monitor and report installation procedures and unacceptable conditions.

D. Do not cover Work which is to be inspected or tested until directed.

3.7 Cleaning

A. Clean Work under provisions of Division 01.

B. Remove glazing materials from finish surfaces.

C. Remove non-permanent labels after Work is complete.

D. Clean glass and mirrors.

3.8 Protection Of Finished Work

A. After installation, mark pane with an “X” by using removable plastic tape or streamers attached to framing and held away from glass. Do not attach markers to glass.

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 in accordance with written recommendations 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, alkali deposits, or stains, and remove in accordance with written recommendations 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.

3.9 Schedule

A. General:

1. Glass Types indicated in Schedule shall comply with indicated requirements.

2. Whether indicated in Schedule or not, provide heat-treated glass, Kind HS, heat strengthened, where required to comply with system performance criteria. Provide Kind FT, fully-tempered, only where safety glass is designated or required.

3. Glass Schedule:

a. IGU-1: 1” insulated vision

1) Basis of Design - SN 68 on Clear by Guardian (Others: PPG Solarban 70XL on Starphire; Viracon VE1-2M on Clear).

a) Visible Light 68%.

b) UV 29%.

c) Solar Energy 33%.

d) Visible Out 11%.

e) Visible In 12%.

f) Winter U value 0.29 / Summer U-value 0.28.

g) SC 0.43.

h) SHGC 0.36.

b. IGU-2: 1” insulated vision, tempered.

1) Basis of Design - SN 68 on Clear by Guardian (Others: PPG Solarban 70XL on Starphire; Viracon VE1-2M on Clear).

a) Visible Light 68%.

b) UV 29%.

c) Solar Energy 33%.

d) Visible Out 11%.

e) Visible In 12%.

f) Winter U value 0.29 / Summer U-value 0.28.

g) SC 0.43.

h) SHGC 0.36.

c. SP-1: 1” insulated spandrel similar to IGU-2 with warm gray color coating on #4 surface.

d. GL-4: Laminated glass at ticket window shall consist of two layers of ¼” low iron ultraclear (such as Starphire) heat strengthened glass with a clear 0.60 PVB interlayer.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section includes the following types of silvered flat glass mirrors:

1. Annealed monolithic glass mirrors.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Architectural Woodwork: Division 06.

C. Rough Carpentry: Division 06.

D. Glazing: Division 08.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Product Data: For each type of product.

1. Mirrors: Include description of materials and process used to produce each type of silvered flat glass mirror specified that indicates sources of glass, glass coating components, edge sealer, and quality-control provisions.

C. Shop Drawings: Include mirror elevations, edge details, mirror hardware, and attachment details.

D. Samples: For each type of the following:

1. Mirror Trim: 12 inches long.

E. Product Certificates: For each type of mirror and mirror mastic.

F. Sustainability Submittals: Provide the following in accordance with Sustainability Requirements: Division 01.

1. Materials Sustainability Documentation Form.

2. Product data and costs for regional materials.

3. Product data for adhesives and sealants indicating VOC content.

G. Closeout Submittals: Maintenance Data: For mirrors to include in maintenance manuals.

1.4 Delivery, Storage, And Handling

A. Protect mirrors according to mirror manufacturer's written instructions and as needed to prevent damage to mirrors from moisture, condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with mirror manufacturer's written instructions for shipping, storing, and handling mirrors as needed to prevent deterioration of silvering, damage to edges, and abrasion of glass surfaces and applied coatings. Store indoors.

1.5 Field Conditions

A. Environmental Limitations: Do not install mirrors until ambient temperature and humidity conditions are maintained at levels indicated for final occupancy.

1.6 Warranty

A. Special Warranty: Manufacturer agrees to replace mirrors that deteriorate within specified warranty period. Deterioration of mirrors is defined as defects developed from normal use that are not attributed to mirror breakage or to maintaining and cleaning mirrors contrary to manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.

1. Warranty Period: Five years from date of manufacture.

Part 2 Products

2.1 Manufacturers

A. Products of indicated manufacturers are acceptable, contingent upon conformance to indicated requirements. Equivalent products of other manufacturers will be evaluated as substitutions in accordance with requirements of Division 01.

1. Guardian Industries Corp.
2. Walker Glass Co. Ltd.
3. Glasswerks L.A. Inc.

B. Source Limitations for Mirrors: Obtain mirrors from single source from single manufacturer.

C. Source Limitations for Mirror Accessories: Obtain mirror glazing accessories from single source.

2.2 Silvered Flat Glass Mirrors

A. Annealed Monolithic Glass Mirrors: Mirror Select Quality, ultraclear (low-iron) float glass with a minimum 91 percent visible light transmission.

1. Nominal Thickness: 6.0 mm.

2.3 Miscellaneous Materials

A. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

B. Edge Sealer: Coating compatible with glass coating and approved by mirror manufacturer for use in protecting against silver deterioration at mirrored glass edges.

C. Mirror Mastic: An adhesive setting compound, asbestos-free, produced specifically for setting mirrors and certified by both mirror and mastic manufacturer as compatible with glass coating and substrates on which mirrors will be installed.

1. C.R. Laurence Co.
2. Palmer Products Corp.
3. Royal Adhesives and Sealants.

2.4 Mirror Hardware

A. Aluminum J-Channels: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover edges of mirrors in a single piece.

1. Bottom Trim: J-channels formed with front leg and back leg not less than 5/8 and 7/8 inch in height, respectively, and a thickness of not less than 0.04 inch.
2. Top Trim: J-channels formed with front leg and back leg not less than 5/8 and 1 inch in height, respectively, and a thickness of not less than 0.04 inch.
3. Finish: Clear bright anodized.

B. Aluminum J-Channels and Cleat: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover edges of mirrors in a single piece.

1. Bottom Trim: J-channels formed with front leg and back leg not less than 5/16 and 3/4 inch in height, respectively.
2. Top Trim: Formed with front leg with a height matching bottom trim and back leg designed to fit into the pocket created by wall-mounted aluminum cleat.
3. Finish: Clear bright anodized.

C. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.

D. Anchors and Inserts: Provide devices as required for mirror hardware installation. Provide toothed or lead-shield, expansion-bolt devices for drilled-in-place anchors. Provide galvanized anchors and inserts for applications on inside face of exterior walls and where indicated.

2.5 Fabrication

A. Fabricate mirrors in the shop to greatest extent possible.

B. Fabricate cutouts for notches and holes in mirrors without marring visible surfaces. Locate and size cutouts so they fit closely around penetrations in mirrors.

C. Mirror Edge Treatment: Rounded polished.

1. Seal edges of mirrors with edge sealer after edge treatment to prevent chemical or atmospheric penetration of glass coating.

Part 3 Execution

3.1 Examination

A. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation tolerances, substrate preparation, and other conditions affecting performance of the Work.

B. Verify compatibility with and suitability of substrates, including compatibility of existing finishes or primers with mirror mastic.

C. Proceed with installation only after unsatisfactory conditions have been corrected and surfaces are dry.

3.2 Preparation

A. Comply with mastic manufacturer's written installation instructions for preparation of substrates, including coating substrates with mastic manufacturer's special bond coating where applicable.

3.3 Installation

A. General: Install mirrors to comply with mirror manufacturer's written instructions and with referenced GANA publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.

1. GANA Publications: “Glazing Manual" and "Mirrors, Handle with Extreme Care: Tips for the Professional on the Care and Handling of Mirrors."

B. Provide a minimum airspace of 1/8 inch between back of mirrors and mounting surface for air circulation between back of mirrors and face of mounting surface.

C. Install mirrors with mastic and mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.

1. Aluminum J-Channels: Provide setting blocks 1/8 inch thick by 4 inches long at quarter points. To prevent trapping water, provide, between setting blocks, two slotted weeps not less than 1/4 inch wide by 3/8 inch long at bottom channel.

2. Aluminum J-Channels and Cleat: Fasten J-channel directly to wall and attach top trim to continuous cleat fastened directly to wall.

3. Install mastic as follows:

   a. Apply barrier coat to mirror backing where approved in writing by manufacturers of mirrors and backing material.
   b. Apply mastic to comply with mastic manufacturer's written instructions for coverage and to allow air circulation between back of mirrors and face of mounting surface.
   c. After mastic is applied, align mirrors and press into place while maintaining a minimum airspace of 1/8 inch between back of mirrors and mounting surface.

3.4 Cleaning And Protection

A. Protect mirrors from breakage and contaminating substances resulting from construction operations.

B. Do not permit edges of mirrors to be exposed to standing water.

C. Maintain environmental conditions that prevent mirrors from being exposed to moisture from condensation or other sources for continuous periods of time.

D. Clean exposed surface of mirrors not more than four days before date scheduled for inspections that establish date of Substantial Completion. Clean mirrors as recommended in writing by mirror manufacturer.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Shop fabricated wall louvers, frames, screening.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Fluoropolymer Coatings: Division 05.

C. Metal Fabrications: Division 05.

D. Exterior Enclosure, General: Division 07.

E. Flashing and Sheet Metal: Division 07.

F. Joint Sealants: Division 07.

G. Air Duct Accessories: Division 23.

H. Electrical: Division 26.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Shop Drawings: Show fabrication, dimensions, materials, interface with other construction, anchoring, and installation. Indicate provisions for conformance with indicated criteria. Indicate extent of shop fabrication versus field work.

1. Plans and Elevations: Minimum 1/4 inch equals 1 foot scale.

2. Details: Minimum 1 1/2 inch equals 1 foot scale.

C. Product Data: Describe design characteristics, maximum recommended air velocity, pressure drop curve, design free area, water infiltration curve, materials and finishes for each louver specified.

D. Samples:

1. Finish samples for verification.

E. Calculations: Structural calculations signed and sealed by Design Engineer certifying compliance with specified criteria. Calculations shall include the following:

1. Analysis of applicable loads on framing members.
2. Analysis of loads on anchors including anchors embedded in concrete.

F. Certifications: Indicated certification letters.

1. Manufacturer's certification that louvers are licensed to bear AMCA seal based on tests and procedures performed in accordance with AMCA 511 and comply with the requirements of AMCA Certified Ratings program.
2. Manufacturer's certification that louvers meet specified requirements.

G. Sustainability Submittals: Provide the following in accordance with Sustainability Requirements: Division 01.

1. Materials Sustainability Documentation Form.
2. Product data, certification letter, and costs for materials with recycled content.
3. Product data and costs for regional materials.
4. Product data for adhesives and sealants indicating VOC content.
5. Product data for paints and coatings indicating VOC content and chemical composition.

H. Closeout Submittals:

1. Special Warranty: Final Warranty after Date of Substantial Completion.
2. Operation and Maintenance Manuals: Prior to Date of Substantial Completion.

1.4 System Description

A. Design Requirements: Perform final engineering of louver and support system.

1. Contract Documents indicate design intent and salient functional and aesthetic criteria.
2. Engineer system to maintain design intent and conform to criteria indicated.
3. Maintain basic dimensions of system, sight lines, jointing, and profiles. Minor variation is allowable only with approval by Design Professional and if variations are identified on submittals.
4. Engineer components of system not fully detailed, within a reasonable inference of design intent.

B. Structural Requirements: Design and size components to withstand loading and deflection criteria per Exterior Enclosure, General: Division 07.

C. Movement Requirements: Design system to accommodate movement criteria per Exterior Enclosure, General: Division 07.

1. Anchorage and support framing shall be designed to accommodate thermal and building movements without any harmful effect to assemblies herein specified.

D. Provide a system which eliminates the following:

1. Vibration harmonics, wind whistles or noises caused by thermal movement.

2. Thermal stress transmitted to other building elements.

3. Loosening, weakening, or fracturing of attachments or components of system.

4. Transfer of stresses including those caused by thermal and structural movement.

1.5 Quality Assurance

A. Manufacturer's Qualifications:

1. Experience: Minimum five (5) years producing products similar to those required for this Project.

a. Provided products for three (3) projects of scope, schedule and complexity similar to this Project within last two (2) years as acceptable to Design Professional.

2. Single-Source Requirements: Products shall be supplied by one (1) manufacturer. Accessory products including, for example, fasteners, sealants and anchors may be from other than primary manufacturer if approved by primary manufacturer and Design Professional.

B. Installer's Qualifications:

1. Experience: Minimum five (5) years installing products similar to those required for this Project.

a. Completed three (3) projects of scope, schedule and complexity similar to this Project using manufacturer's similar system as required for this Project within last two (2) years as acceptable to Design Professional.

C. Welder's Qualifications:

1. Welding Procedures and Qualifications: In accordance with "Structural Welding Code, Steel" and AWS D1.1. "Structural Welding Code, Aluminum", AWS D1.2.

2. Welders shall be qualified to perform type of work required.

3. Identification: Each welder shall be assigned an identification symbol and shall mark his identification at each shop and field weld.

4. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories, Inc. or testing agency acceptable to code official having jurisdiction as suitable for purpose specified and indicated.

D. Referenced Codes and Standards: Comply with the following in accordance with Division 01.

1. Air Movement Control Association, Inc. (AMCA)

500	Test Methods for Louvers, Dampers, and Shutters
511	Certified Ratings Program for Air Control Devices

E. Certifications: Manufacturer shall certify in writing the following:

1. Compliance with requirements of Exterior Enclosure, General: Division 07.

2. Use and Compatibility Certification: Certify that materials are appropriate for indicated use and that substrates and adjacent materials are compatible.

3. Certify that louvers comply with specified requirements.

1.6 Delivery, Handling And Storage

A. Protect prefinished surfaces with wrapping or strippable coating. Do not use adhesives which bond or leave a residue.

B. Handle louvers in positions consistent with their shape and design. Do lifting and supporting only from support points indicated on Shop Drawings.

1.7 Project Conditions

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

1.8 Coordination

A. Coordinate Work with mechanical work.

1.9 Special Warranty

A. General: Warranty shall not deprive Owner of rights under other provisions of Contract and shall be in addition to, and run concurrent with, other Warranties made by Contractor under requirements of Contract Documents.

B. Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of louver that are defective in materials or workmanship or fail to perform in accordance with specified criteria within specified Warranty Period.

1. Specified Warranty Period: Three (3) years from Date of Substantial Completion.

C. Defects shall include, but not be limited to, the following:

1. Noticeable corrosion or finish deterioration.

2. Loose or missing parts.

3. Noticeable deflection.

4. Less than required net free area.

5. Leaking water in excess of performance requirements.

Part 2 Products

2.1 Manufacturers

A. Provide products of the following contingent upon meeting indicated requirements. Equivalent products of other manufacturers will be evaluated as substitutions in accordance with requirements of Division 01.

1. Construction Specialties, Inc.

2. Airolite Company.

3. Industrial Louvers.

4. Ruskin.

2.2 Materials

A. Use adhesives and sealants that comply with the VOC limits specified in Sustainability Requirements: Division 01.

B. Use field applied paints and coatings that comply with the VOC limits and chemical restrictions specified in Sustainability Requirements: Division 01.

C. Aluminum: Alloy and temper to suit application.

1. Extruded Shapes and Tubes: ASTM B 221.

2. Sheet and Plate: ASTM B 209.

3. Structural Shapes: ASTM B 308.

4. Drawn Seamless Tube: ASTM B 210.

5. Castings: ASTM B 26, B 108 or B 85.

6. Welding Rod: AWS A 5.10.

D. Screens: Inside mounted type in removable aluminum frames.

1. Insect Screens: 14 by 18 mesh, aluminum wire, mill finish.

E. Galvanized Steel Sheet: ASTM A653/A653M coating designation G60.

F. Steel Sections: ASTM A 36, galvanized after fabrication per ASTM A 123.

G. Structural Steel Tubing: ASTM A 500, Grade B, galvanized after fabrication per ASTM A 123.

H. Anchorage Clips and Fabrications: High-strength aluminum or nonmagnetic stainless steel.

I. Insulation: As specified in Thermal Insulation: Division 07.

J. Fasteners:

1. Contacting Aluminum and Dissimilar Metals: Stainless steel, ASTM F 593 and F 594, Alloy Group 1, finish to match adjacent surface if exposed.

2. Contacting Steel or Galvanized Steel Only: Hot dip galvanized steel conforming with ASTM B 633, SC 4 or ASTM A 153.

K. Coatings:

1. Shop Primer for Steel: SSPC-Paint 20.

2. Touch-up Primer for Galvanized Steel: Primer with minimum 80 percent zinc in dry film complying with SSPC-Paint 20.

3. Dissimilar Metal Coating: Cold-applied asphalt mastic or other non-conductive, non-absorptive material.

L. Butyl-Coated Foam Tape: Soft, compressible PVC foam core encapsulated with 100 percent solids butyl. “Norex” by Norton or approved substitution. Provide 1/8 inch by 1/2 inch tape, unless otherwise indicated.

2.3 Louvers

A. Blade Configuration: Rain proof and sightproof.

B. Frame: Extruded aluminum minimum wall thickness of 1/8 inch**,** unless otherwise indicated.

C. Louver Blade: Extruded aluminum, minimum thickness of 1/8 inch**,** unless otherwise indicated.

D. Size:

1. As indicated on Drawings.

2. Drainable Louver and Sill.

E. Vertical Mullions: Of type and at spacings indicated, but not further apart than recommended in writing by manufacturer.

F. Provide sill extensions and loose sills made of same material as louvers, where indicated, or required for drainage to exterior and to prevent water penetrating to interior.

G. Sills shall have watertight sub-sill flashing to direct water harmlessly to exterior.

1. No penetrations are allowed in horizontal portions of sub-sill flashing.

2. Sub-sill flashing shall have watertight enddams which intercept downward flow of water from space between dual sealant at jambs.

2.4 Exterior Trim

A. All exterior trim shall be extruded aluminum, minimum wall thickness 0.080 inch except where indicated as “Brake Metal”, profiles as indicated on Drawings.

B. Brake metal and other similar formed sheet fillers and trim shall be minimum 0.125 inch aluminum.

C. Column and Beam Covers: Form from brake metal to profiles and shapes indicated. Furnish reveals, joints, base details and head details as indicated. Furnish framing to support covers as required to meet specified criteria.

2.5 Flashing

A. Flashing concealed within system shall be aluminum or stainless steel.

B. Concealed flashing where system abuts dissimilar materials shall be minimum 20 gage stainless steel.

C. Exposed flashing shall be aluminum, finished to match system, minimum 0.062 inch.

2.6 Sealants

A. Sealants within system shall be ASTM C 920 silicone or epoxy as recommended in writing by manufacturer.

B. Sealants for use where system abuts other construction shall be as specified in Joint Sealants: Division 07.

2.7 Fabrication

A. Fabricate in compliance with approved submittals. Fabricate in compliance with specified criteria.

B. Form and assemble louvers in shop to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

C. Fabricate Work to properly fit field-measured openings, without use of unscheduled closures or filler members.

D. Join frame members to one another and to fixed louver blades as follows, unless otherwise indicated, or size of louver assembly makes bolted connections between frame members necessary.

1. With fillet welds, concealed from view; or mechanical fasteners; or a combination of these methods; as standard with louver manufacturer.

2. Self-tapping fasteners for connections is not acceptable.

E. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.

F. Allow for adequate clearances around perimeter of system to enable proper installation.

G. Fabricate with hairline fit of joints and corners. Match components carefully ensuring continuity of line and design.

H. Reinforce joints to prevent deformation and misalignment.

I. Flashing: Fabricate per Flashing and Sheet Metal: Division 07.

J. Conceal fastenings and reinforcements in Finished Work.

K. Grind welds smooth on exposed surfaces prior to finishing.

L. Uniformity: Abutting members shall not have an integral texture or color variation greater than half the range indicated in approved Samples.

2.8 Finishes

A. General:

1. Shop finish all Work including priming of surfaces not to be exposed to view in Final Work.

2. Finish aluminum louver assembly to match other adjacent wall components.

B. High-Performance Organic Coating: As specified in Fluoropolymer Coatings: Division 05.

Part 3 Execution

3.1 Examination

A. Verify dimensions, tolerances, and method of attachment with other Work.

B. Verify sills, wall openings and adjoining materials are ready to receive Work of this Section.

C. Verify accurate benchmarks and layout control points.

D. Commencing installation of louvers constitutes acceptance of substrates.

3.2 Preparation

A. Furnish items to be and coordinate required locations.

B. Attach anchor clips to structure per approved submittals and to maintain structural capacity of anchors. Shim clips only to allow for proper alignment. Do not shim excessively to accommodate inadequate range of adjustment in clip. Use shims large enough to not reduce structural capacity of anchor clip.

C. Isolate dissimilar metal surfaces with asphalt mastic, tape or gasket acceptable to Design Professional.

D. Isolate aluminum from contact with mortar, concrete or other masonry materials with an alkali-resistant material acceptable to Design Professional.

E. Isolate aluminum from contact with pressure preservative-treated wood with an alkali-resistant material acceptable to Design Professional.

F. Install flashing per Flashing and Sheet Metal: Division 07.

G. Sub-Sill Flashing: Set sub-sill flashing in a triple row of sealant. Anchor sub-sill using clips or anchors without penetrating horizontal portion of sub-sill. Seal all penetrations and anchorage points. Sub-sill shall be watertight. Provide foam tape between sub-sill and frame.

1. Coordinate installation of sub-sill flashing with ductwork and plenum. Duct or plenum shall lap over upturned leg of sub-sill flashing and be sealed watertight.

3.3 Installation

A. General: Install louver assembly as required to:

1. Comply with manufacturer's written instructions.

2. Comply with approved submittals.

3. Comply with indicated criteria.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities and to allow for movement criteria. Weld or otherwise permanently secure adjustable anchors after final alignment.

C. Joint Sealants and Joint Fillers: Refer to Joint Sealants: Division 07.

3.4 Erection Tolerances

A. General: Comply with more stringent tolerances than those listed below if required to:

1. Comply with performance criteria.

2. Comply with manufacturer's written instructions.

3. Align with other supported or adjacent Work with more stringent tolerances.

B. Limit variations from plumb, level or dimensioned angle to the following:

1. 1/8 inch maximum deviation in any story height, or in any 10 feet vertical or angular run, or in any 20 foot horizontal run, non-cumulative.

2. 1/4 inch maximum deviation in any 40 foot run, any direction, non-cumulative.

C. Limit variations from location (theoretical calculated positions in plan or elevation based on established floor lines and column lines), including variations from plumb and level, to the following:

1. 1/4 inch total maximum deviation for any element at any location, non-cumulative.

2. 1/4 inch maximum change in deviation for any element for any 10 foot run, any direction, non-cumulative.

D. Limit offset in end-to-end or edge-to-edge alignments of adjoining consecutive elements indicated to be flush, continuous or planar to the following:

1. Interior: 1/32 inch.

2. Exterior: 1/16 inch.

E. Limit variation from indicated position in end-to-end or edge-to-edge alignments of adjoining consecutive elements indicated to be less than 1/2 inch out-of-plane or are separated by a maximum 2 1/2 inches wide member to the following:

1. Interior: 1/16 inch.

2. Exterior: 1/8 inch.

F. Limit variation from indicated position in end-to-end or edge-to-edge alignments of adjoining consecutive elements indicated to be 1/2 inch or more out-of-plane or are separated by a member wider than 2 1/2 inches to the following:

1. Interior: 1/8 inch.

2. Exterior: 3/16 inch.

G. Limit maximum width of a hairline joint as follows:

1. Interior: 0.020 inch.

2. Exterior: 0.050 inch.

H. Limit maximum variation in width of a hairline joint as follows:

1. Interior: 0.005 inch.

2. Exterior: 0.020 inch.

I. Limit difference in diagonal measurements to 1/8 inch.

J. Metal panels, trim and brake metal shall not have visible oil canning, pinching, dimples or other surface irregularity or deformation visible when viewed under the following conditions:

1. Viewed at any angle.

2. Viewed from a distance of 10 feet from exterior surfaces and 3 feet from interior surfaces.

3. Viewed between two (2) hours after sunrise and two (2) hours before sunset for exterior surfaces.

4. Interior work shall be viewed under normal building lighting (natural or artificial) conditions.

K. Comply with stricter tolerances if required to meet specified performance criteria.

3.5 Adjusting

A. Adjust for smooth operation.

B. Touchup damage to pre-finished surfaces.

3.6 Cleaning

A. Clean completed system, promptly after erection and installation of sealants, allowing for nominal curing of liquid sealants.

3.7 Protection

A. Protect finished Work from damage.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes:

1. Gypsum board for partitions, ceiling, fascias, exterior soffit and fire protection.
2. Nonload-bearing (axial) steel framing.
3. Acoustical insulation and sealants for gypsum board.
4. Cement board.
5. Finishing of gypsum board and shaft wall assemblies.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Rough Carpentry: Division 06.

C. Air/Vapor Barriers: Division 07.

D. Thermal Insulation: Division 07.

E. Firestopping: Division 07.

F. Joint Sealants: Division 07.

G. Access Doors and Panels: Division 08.

H. Tiling: Division 09.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Product Data: For each material, anchor and accessory and miscellaneous product. Show provisions for conformance with indicated criteria. Include Span Tables: Manufacturer's pre-printed span tables signed and sealed by a Professional Engineer licensed in the State of North Carolina.

C. Calculations: If manufacturer Span Tables are not available, submit calculations signed and sealed by a Professional Engineer licensed in the State of North Carolina.

D. Certifications: Certificates showing components and assembly required to comply with indicated fire-resistance. Show name of Testing Agency and test number. Substantiate required STC rating for each gypsum board shaft wall assembly. Indicate for which partition type that submitted assembly applies.

E. Sustainability Submittals: Provide the following in accordance with Sustainability Requirements: Division 01.

1. Materials Sustainability Documentation Form.

2. Product data, certification letter, and costs for materials with recycled content.

3. Product data and costs for regional materials.

4. Product data for adhesives and sealants indicating VOC content.

1.4 System Description

A. General: Select gypsum partition systems from manufacturers' published standard assemblies that comply with requirements indicated. All components of system by one (1) manufacturer.

1.5 Terminology

A. Term “gypsum board” is generic, and as such refers to preformed board type materials specified in this Section. Provide product specified for its indicated use.

1.6 Quality Assurance

A. Referenced Codes and Standards: Comply with the following in accordance with Division 01.

1. Gypsum Association Publications (GA)

201	Using Gypsum Board for Walls and Ceilings
216	Application and Finishing of Gypsum Board
214	Levels of Gypsum Board Finish
226	Application of Gypsum Board to Curved Surfaces
505	Gypsum Board Terminology
600	Fire Resistance Design Manual

B. Regulatory Requirements: Components of fire rated assembly shall comply with a listed assembly of required fire rating of Underwriters Laboratories, Inc. or other independent Testing Agency approved by Building Code Official having jurisdiction.

1.7 Delivery, Handling And Storage

A. Package or palletize rigid board materials to avoid permanent deflection and damaged edges.

B. Store materials in a dry location, out of weather. Store water-based joint finishing materials and adhesives at temperatures above freezing and within range specified in writing by manufacturer.

1.8 Project Conditions

A. Environmental Requirements: Maintain environmental conditions in compliance with ASTM C 840 and manufacturer's written recommendation.

B. Maintain temperatures between 50 degrees F and 95 degrees F for 48 hours prior to application and continuously until dry.

C. Ventilate spaces to eliminate excessive moisture from building during and after period of gypsum board installation.

D. When gypsum board is erected prior to completion of weather tight enclosure and compliance with requirements above, provide paperless, glass mat faced, water resistant gypsum core board.

Part 2 Products

2.1 General

A. Provide recycled content materials in accordance with Sustainability Requirements: Division 01 and as indicated below.

B. Provide regional materials in accordance with Sustainability Requirements: Division 01.

C. Use adhesives and sealants that comply with the VOC limits specified in Sustainability Requirements: Division 01.

2.2 Steel Framing Components

A. Component Sizes and Spacings:

1. Provide framing components of minimum sizes indicated. If sizes indicated do not conform to required conditions, provide components sized and spaced in accordance with criteria indicated.

2. At Contractor's option, in lieu of minimum sizes indicated, provide components as required to comply with the following criteria.

    a. Walls and Partitions: Size and space components as required for a maximum deflection of L/240 under a 5 psf uniform lateral load per ASTM C 754.
    b. Ceilings and Soffits: Size and space components as required for a maximum deflection of L/240 under twice dead load plus a 10 psf live load per ASTM C 754.
    c. Engineering: Select components from manufacturer's pre-printed span tables or provide calculations signed and sealed by a Professional Engineer licensed in the State of North Carolina.

B. Finishes:

1. Interior Exposures: Manufacturer's standard corrosion resistant coating.

2. Components in Exterior Walls and Soffits: G40 hot-dipped galvanized per ASTM A653/A653M.

C. Studs and Runners: ASTM C 645, with flange edges of studs bent back 90 degrees and doubled over to form 3/16 inch wide minimum return lip, depth as indicated.

1. Minimum Thickness of Uncoated Base Metal: 0.0329 inch/20 gage except where heavier gages are indicated.

2. Maximum stud height, as follows:

	Stud Spacing inches	**Stud Width inches**	**Maximum Stud Height feet-inches**
a.	16	2 1/2	11-6
b.	16	3 5/8	15-0
c.	16	4	16-0
d.	16	6	18-0
e.	24	2 1/2	10-6
f.	24	3 5/8	13-6
g.	24	4	14-6
h.	24	6	16-0

a. Notes for stud height tables:

1) Studs must have gypsum board on both sides full height or unsupported flanges shall be braced as indicated.

2) Studs rigidly braced at or below maximum height may be increased 50 percent in height.

3) Bracing: Suspended gypsum board or plaster ceiling or separate bracing as required for the top of partitions that do not extend to structure.

3. Fire rated partitions shall comply with indicated requirements for each fire-rated assembly which may exceed stud gage, width, and spacing in tables.

D. Rigid Furring Channels: ASTM C 645, hat-shaped.

1. Depth: 7/8 inch and 1 1/2 inch.

2. Thickness of Uncoated Metal: 0.0179 inch/25 gage, unless otherwise indicated.

E. Furring Brackets: Serrated-arm type, adjustable, complying with ASTM C 645, minimum thickness of base (uncoated) metal of 0.0329 inch/20 gage, designed for screw attachment to steel studs and steel rigid furring channels used for furring.

F. Resilient Furring Channels: Hat shaped channel with slotted leg(s) designed to reduce sound transmission, fabricated from steel sheet complying with ASTM A653/A653M or ASTM A 568, 1/2 inch deep.

1. Single-leg or double-leg configuration, minimum 0.0179 inch/25 gage thickness of uncoated base metal.

G. Z-Furring Members: Z-shaped furring members fabricated from steel sheet complying with ASTM A653/A653M or ASTM A 568; with a minimum base metal (uncoated) thickness of 0.0179 inch/25 gage, face flange of 1 1/4 inch, wall-attachment flange of 7/8 inch and of depth required to fit insulation thickness indicated.

H. Channels: Cold-rolled steel, 0.055 inch minimum thickness of base (uncoated) metal and 1/2 inch wide flanges.

1. For Suspended Ceilings: 1 1/2 deep.

2. For Bridging and Furring: 3/4 inch deep.

I. Grid Suspension System for Interior Ceilings: ASTM C 645, manufacturer's standard direct-hung grid suspension system composed of main beams and cross furring members that interlock to form a modular supporting network.

J. Miscellaneous Metal Framing Components: Match material and finish of studs.

1. Framing and Reinforcing Angles: 2 inch by 2 inch, minimum 0.0329 inch/20 gage.

2. Plates and Strapping: Sizes as indicated and required.

2.3 Steel Framing Accessories

A. Screws: Corrosion-resistant coated steel drill screws.

1. For wood and steel less than 0.03 inch: ASTM C 1002.

2. For steel over 0.03 inch: ASTM C 954.

B. Anchors in Concrete: Cast-in-place, chemical or expansion type anchors fabricated from corrosion-resistant materials. For anchors suspending ceilings, select based on load capacity of six (6) times imposed load determined per ASTM E 488.

C. Powder-Actuated Fasteners: Corrosion-resistant fastener plus clip or washer as required to suit application. For fasteners suspending ceilings, select based on load capacity of ten (10) times imposed load determined per ASTM E 1190.

D. Wire for Hanger and Ties: ASTM A 641, Class 1 zinc coating, soft-temper, minimum 8 gage for hangers and 16 gage for ties.

2.4 Wallboard Panels

A. General: thickness, as indicated, by longest possible lengths; long edges tapered, ends square cut. Refer to installation instruction for use of each type.

1. Recycled Content Gypsum Board: Minimum 10 percent total recycled content, including recovered "flue gas" gypsum and post-consumer scrap paper and gypsum.

2. Facing Paper for Gypsum Board: 100 percent recycled newsprint.

B. Gypsum Board, Contractor's Option: Select appropriate type of wallboard based on level of protection for environmental conditions.

1. Weather Exposure: Where installation of gypsum board occurs before completion of exterior enclosure or temporary protection is not in place to protect gypsum board from moisture, provide paperless gypsum board panels with water resistant treated cores, complying with ASTM C 1177 or C 1178 and C 630, score of 10 when tested according to ASTM D 3273, in lieu of standard or fire-rated wallboard listed below.

   a. Product: DensArmor Plus by Georgia Pacific or Fiberock Aqua-Tough Panels by USG or approved equivalent.
   b. Fire-resistive type, UL rated when indicated for rated assemblies.

2. Protected: Where environmental conditions are maintained in accordance with Article 1, provide standard gypsum board complying with ASTM C 1396. Fire-resistive type, UL rated when indicated for rated assemblies.

C. Moisture Resistant Gypsum Board: Paperless gypsum board panels with water resistant treated cores, complying with ASTM C 1177 or C 1178 and C 630, score of 10 when tested according to ASTM D 3273.

1. Product: DensArmor Plus by Georgia Pacific or Fiberock Aqua-Tough Panels by USG or approved equivalent.

2. Fire-resistive type, UL rated when indicated for rated assemblies.

D. Cement Board (Tile Backer Board): Contractor's Option: Select from products listed, select appropriate type and coordinate other components at fire rated assemblies requiring cement board. 1/2 inch thick except use 5/8 inch portland cement board or paperless gypsum board where required to match adjacent panels.

1. Portland Cement Board: ANSI A118.9. Durock Brand Cement Boards by USG.

2. Paperless gypsum board panels, water resistant coating and with water resistant treated cores, complying with ASTM C 1178.

   a. Product: DensShield Tile Backer by Georgia Pacific or Fiberock Tile Backerboard by USG.
   b. Fire-resistive type, UL rated when indicated for rated assemblies.

3. Wood Fiber Cement Board: Hardi Backer 500 by James Hardi.

2.5 Trim Accessories

A. Standard Trim: Comply with ASTM C 1047 zinc-coated steel with perforated or expanded wings or flanges of the type to be concealed with joint finishing material. Profiles to match Gypsum Association types:

1. Cornerbead: CB Series.

2. Edge Trim: "LC" Bead.

3. Control Joint: V-shaped slot with removable paper strip.

2.6 Joint Treatment Materials

A. Compounds: Comply with ASTM C 475 and as recommended in writing gypsum board manufacturer, drying or setting type as indicated.

B. Joint Tape for Gypsum Board: Paper reinforcing tape.

C. Joint Tape for Cement Board: Glass-fiber mesh tape recommended in writing by gypsum board manufacturer.

D. Cement Board Mortar: ANSI A 118.1, dry set mortar or ANSI A 118.4, latex-modified mortar.

2.7 Acoustical Materials

A. Acoustical Sealant: Refer to Joint Sealants: Division 07.

B. Sound Attenuation Blankets: ASTM C 665, Type I, Fibers manufactured from slag.

C. Compressible Filler: Sound Attenuation Blankets or if required to support acoustic sealant, provide compressible foam backer material compatible with the acoustic sealant.

2.8 Miscellaneous Materials

A. Fastening Adhesive: As recommended in writing by panel manufacturer for laminating gypsum board panel to appropriate substrate.

Part 3 Execution

3.1 Examination

A. Examine substrates to which gypsum board assemblies attach or abut, installed hollow metal frames, cast-in-anchors, and structural framing for compliance with installation tolerances and other conditions affecting performance of assemblies indicated.

B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 Preparation

A. Ceiling Anchorages: Coordinate installation of ceiling suspension systems with installation of overhead structural assemblies to ensure that inserts and other provisions for anchorages to building structure have been properly installed.

B. Furnish concrete inserts and other devices indicated to Work specified in other Sections for installation well in advance of time needed for coordination with other construction.

C. Before Sprayed Fire-Resistive Material is applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive Sprayed Fire-Resistive Material. Where offset anchor plates are required, provide continuous units fastened to building structure not more than 24 inches on center.

D. After Sprayed Fire-Resistive Material has been applied, remove only as much Sprayed Fire-Resistive Material as required to complete installation of gypsum board assemblies without reducing thickness of Sprayed Fire-Resistive Material below that is required to obtain fire-resistive rating indicated. Protect remaining Sprayed Fire-Resistive Material from damage.

E. At partitions parallel to flutes of metal deck, fill affected flutes with mineral wool and cover with flat plate attached at each edge minimum 24 inches on center.

3.3 Installing Steel Framing: General

A. Installation Standards: Comply with indicated requirements and with ASTM C 754.

1. Contractor may provide alternate systems described in ASTM C 754 in lieu of requirements if approved by Design Professional.

B. Isolate steel framing from building structure to attain lateral support and prevent axial loading. Provide slip or cushioned type joints. Comply with details indicated and with manufacturer's written instructions.

C. Do not bridge building expansion and control joints with steel framing or furring members. Independently frame both sides of joints.

D. Install supplementary framing, and bracing at terminations in gypsum board construction. Install plates, angles or miscellaneous framing to support gypsum board.

3.4 Installing Steel Framing For Suspended And Furred Ceilings

A. Suspend ceiling hangers from building structural members and as follows:

1. Install hangers sloped not more than 1 in 6 from plumb and free from contact with objects that are not part of supporting structural or ceiling suspension system. Splay hangers beyond 1 in 6 only where required to avoid obstructions and offset resulting horizontal forces by bracing, counter-splaying, or other equally effective means.

2. Where obstructions interfere with the location of hangers, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers per referenced standards.

3. Secure wire hangers by looping and wire-tying, directly to structure, inserts or anchors

4. Do not attach hangers to steel roof deck.

5. Do not connect or suspend steel framing from ducts, pipes or conduit or their supports.

B. Install suspended steel framing as follows (Contractor's Option):

1. Runners and Furring:

   a. Wire Hangers: 4 feet on center.
   b. Carrying Channels (Main Runners): 4 feet on center.
   c. Rigid and Resilient Furring Channels (Furring Members): 16 inches and 24 inches on center.
   d. Wire-tie or clip furring members to main runners and to other structural supports as indicated.

2. Grid Suspension System: Attach perimeter wall track or angle where grid suspension system meets vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

3. Metal Studs:

   a. Fasten runner track to perimeter construction.
   b. Install studs 24 inches on center with webs vertical and both flanges fastened to runner.
   c. Provide 2 inch cold rolled channels with 1 inch by 3/16 inch mild steel flat hanger at 3 feet on center for studs beyond indicated span.

C. Sway brace framing at maximum 10 feet on center each direction with pairs of in-line wire ties sloped at approximately 45 degrees. Alternating pairs of ties shall be perpendicular to each other.

D. Reduce spacing of framing members for attachment of moisture resistant boards, cement board and other panels within span limits recommended by manufacturer.

3.5 Installing Steel Framing For Walls And Partitions

A. Provide framing of widths indicated to coordinate with hollow metal work.

B. Install runners (track) at floors, ceilings, structural walls, columns and where gypsum board stud assemblies abut other construction. Anchor runners within 2 inches of each end and at maximum 24 inches on center.

1. At fire resistive rated partitions, install single deep-leg deflection tracks and anchor to building structure, or install double deep-leg deflection tracks and anchor outer track to building structure.

C. Install studs 16 inches on center or 24 inches on center, except 16 inches on center at cement board.

D. Extend partition framing full height to structural supports or substrates above, unless otherwise indicated.

1. Cut studs 1/2 inch short of full height and friction fit only at head.

2. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.

3. For fire resistive rated partitions and partitions indicated to have full gypsum board coverage above suspended ceiling, install framing around structural and other members extending below floor/roof decks, as provided, to support continuous gypsum board closures.

4. At fire resistive rated partitions with Single Deflection Track, install row of horizontal bridging within 2 inches of single deflection track (for perimeter attachment of panel).

E. Terminate partition framing at suspended ceiling where indicated and brace to structure.

F. Terminate partition framing above suspended ceilings where indicated and brace to structure.

G. Bracing: Brace top of partitions that do not extend to structure as follows:

1. Brace shall be studs matching partition, sloped at 40 to 50 degrees and oriented within 10 degrees of perpendicular to partition.

2. Anchor brace to structural members or to concrete floor or roof slab with minimum two (2) explosive set nails or No. 8 self-drilling screws.

3. Locate anchors at each unsupported end and at maximum 4 feet on center along each unsupported length of partitions. Tee and cross intersections may be used as a brace if legs of intersecting partition are minimum of 3 feet long.

4. Where partitions support furniture, shelving or other wall mounted elements over 10 pounds per lineal foot increase spacing of bracing to match stud spacing of partition.

5. Brace partitions at door and other openings as described below:

a. Frame door openings to comply with GA-219. Provide double 20 gage studs at both jambs. Provide 20 gage runner track section, for cripple studs, at head and secure to jamb studs.
b. Extend jamb studs through suspended ceilings and attach to structure above or provide diagonally stud bracing to structure at each jamb as described for bracing above.

c. Frame openings other than door openings in same manner as required for door openings. Install framing below sills of openings to match framing required above door heads.

3.6 Wall Furring Installation

A. Erect wall furring directly attached to concrete block concrete walls.

1. Erect furring channels horizontally or vertically. Secure in place on alternate channel flanges at maximum 24 inches on center.

2. Space furring channels maximum 16 inches and 24 inches on center, not more than 4 inches from floor and ceiling lines and abutting walls.

B. Erect thermal insulation and Z-furring channels directly attached to concrete block and concrete walls in accordance with manufacturer's written instructions.

1. Erect insulation vertically and hold in place with Z-furring channels spaced a maximum of 24 inches on center, not more than 3 inches at external corners and 12 inches at internal corners.

2. Secure Z-furring channels at maximum 24 inches on center.

C. Erect braced 1 5/8 inch metal stud furring as directed for wall framing.

1. Install adjustable furring brackets spaced as follows:

a. Horizontally: Maximum 6 inche**s** from floor and ceiling and maximum 4 feet on center.
b. Vertically: Maximum 4 inches from corners and interruptions and maximum 3 feet on center.

2. Wire tie continuous horizontal 3/4 inch cold rolled channels to brackets. Channels shall be a continuous plane located at back face of metal studs.

3. Erect metal studs in contact with channels. Wire, tie or screw studs to channels.

3.7 Installation Of Supplementary Strapping, Blocking And Bracing

A. Brace each face of studs not covered with gypsum board or other panels at maximum 8 inches from unsupported ends and 4 feet on center including studs used in soffit and ceiling assemblies.

1. At chase walls brace between walls with studs or 12 inch wide scraps of gypsum board

2. At other locations provide 1 inch strapping.

B. Provide support for each door stop, wall-mounted hook and other light- weight element with notched runner track, 3/4 inch plywood or with minimum 4 inch wide by 25 gage strap.

C. Provide support for wall-hung shelves, cabinets, handrail brackets and all other elements hung from or attached to wall with 2 inch by 6 inch pressure treated wood blocking, continuous 6 inch by 16 gage flat strapping or continuous 6 inch by 20 gage runner channel, notched at each stud.

D. Provide support at joint between cement board and gypsum board with continuous 4 inch by 25 gage strap or 25 gage runner notched at each stud.

3.8 Erection Tolerances For Steel Framing

A. Limit variations from plumb, level or dimensioned angle to the following:

1. 1/4 inch maximum deviation in any 40 foot run, any direction, non-cumulative.

B. Limit variations from location (theoretical calculated positions in plan or elevation based on established floor lines and column lines), including variations from plumb and level, to the following:

1. 1/4 inch total maximum deviation for any element at any location, non-cumulative.

3.9 Gypsum Board Installation

A. Application Standards: Comply with ASTM C 840 and GA-216.

B. Panel Types and Usage:

1. Standard Gypsum Board: Provide unless otherwise indicated.

2. Fire-Rated Gypsum Board: Provide in fire rated assemblies.

3. Cement Board: Where indicated on Drawings, provide cement board to comply with ANSI A108.11. Provide water resistant membrane of double layer 30 lb building paper or other membrane compliant with Tile Council of America behind Portland Cement Board and Wood Fiber Cement Board as recommended by manufacturer. Tape and fill joints with setting type compound.

4. Moisture Resistant Gypsum Board, Fire-Rated Where Required: Walls and ceilings where indicated.

C. Sound Attenuation Blankets: Provide where indicated prior to installing gypsum board panels unless blankets are readily installed after gypsum board panels have been installed on one (1) side. Completely fill wall cavity by cutting oversize and stuffing full. Support with clips or adhesive.

D. Ceiling Panels: Minimize the number of abutting end joints and avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent gypsum board panels not less than one (1) framing member.

E. Wall/Partition Panels: Minimize number of abutting end joints or avoid them entirely. Stagger abutting end joints not less than one (1) framing member in alternate courses of gypsum board.

F. Install gypsum board panels with face side out. Do not install imperfect, damaged, or damp gypsum board panels. Butt gypsum board panels together for a light contact at edges and ends with not more than 1/16 inch of open space between gypsum board panels. Do not force into place.

G. Locate both end joints over supports.

H. Position adjoining gypsum board panels so that tapered edges abut tapered edges, and field-cut edges abut field-cut edges and ends. Do not place tapered edges against cut edges or ends.

I. Stagger vertical joints over different studs on opposite sides of partitions.

J. Do not place joints at corners of framed openings.

K. Unless otherwise indicated, cover both faces of steel stud partition framing with gypsum board panels in concealed spaces, including spaces above ceilings, except in chase walls that are braced internally.

1. Fit gypsum board panels around ducts, pipes, and conduits. Allow 1/4 inch to 1/2 inch wide joints to install appropriate sealant.

2. At head of fire-rated partitions abutting metal deck, provide gypsum board as required to comply with fire stopping system.

3. At head of non fire-rated partitions abutting metal deck, provide an additional strip of gypsum board approximately 12 inches wide on one side of partition, with top edge cut to follow the profile of the deck. Attach strip to studs to not interfere with slip head connection. Allow 1/4 inch to 1/2 inch wide joints to install appropriate sealant.

4. Where partitions intersect open concrete coffers, concrete joists, and other structural members projecting below underside of floor/roof slabs and decks, cut gypsum board panels to fit profile formed by coffers, joists, and other structural members; allow 1/4 inch to 1/2 inch wide joints to install appropriate sealant.

L. Isolate perimeter of non-load-bearing gypsum board partitions at structural abutments, except floors, as detailed. Provide 1/4 inch to 1/2 inch wide spaces at these locations and trim edges exposed. Provide appropriate sealant at junctures and abutments.

M. Space fasteners in gypsum board panels according to referenced gypsum board application and finishing standard and manufacturer's written recommendations.

N. Do not fasten into top track at head conditions designed to accommodate deflection or movement or at other similarly conditions.

O. At penetrations over 16 square inches, including electrical panels, recessed boxes, fire extinguisher cabinets and utility panels in one (1) face of fire-rated assemblies, maintain rating of assembly by installing additional layers of gypsum board behind penetrating element. Additional layers behind cement shall match the layers cut out of penetration.

P. Single-Layer Application:

1. Ceilings: Apply gypsum board panels prior to wall/partition panels at right angles to framing, unless otherwise indicated.

2. Partitions/Walls: Apply gypsum board panels vertically or horizontally, unless parallel application is required for fire-resistive rated assemblies.

3. Z-Furring Members: Apply gypsum board panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.

Q. Double-Layer Application: Install gypsum board backing for base layers and gypsum board for face layers.

1. Ceilings: Apply base layer prior to applying base layer on walls/partitions; apply face layers in same sequence. Offset face-layer joints at least 10 inches from parallel base-layer joints. Apply base layers at right angles to framing members, unless otherwise indicated.

2. Partitions/Walls: Apply base layers and face layers vertically, parallel to framing, with joints of base layers located over stud or furring member and face layer joints offset at least one (1) stud or furring member with base layer joints. Stagger joints on opposite sides of partitions.

3. Z-Furring Members: Apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one (1) furring member. Locate edge joints of base layer over furring members.

3.10 Trim Installation

A. Place control joints to be consistent with lines of building spaces and in consistent pattern.

1. Install control joints in ceilings exceeding 2500 square feet in area and in partition, wall and wall furring runs exceeding 30 feet.

2. Do not exceed 50 feet in either direction, between ceiling control joints.

3. Install a control joint where framing or furring changes direction.

4. Do not exceed 30 feet between control joints in walls or wall furring.

5. Install a control joint where a control or expansion joint occurs in base exterior wall.

6. Install horizontal control joints in stairways at each floor line.

7. 1/4 inch joints properly filled with sealant at internal corners of walls and partitions may be considered a control joint.

B. Install corner bead at exterior corners.

C. Install edge trim where edge of gypsum board panels would be otherwise exposed.

D. Install special trim where indicated.

3.11 Acoustical Sealant Installation

A. Install acoustical sealant at gypsum board partition work indicated with sound attenuation blankets.

B. In lieu of acoustical sealant, construction joints at perimeter and within fire rated partition shall be firestopped per Firestopping: Division 07.

C. Apply a 3/8 inch diameter bead of sealant to both sides of runner tracks and end studs to seal interface with adjoining structure.

D. Seal interface between gypsum board and other materials.

E. Apply sealant to perimeter of openings in gypsum board for switches, convenience outlets, light fixtures, diffusers and registers, piping and similar sources of acoustical leakage.

F. Tool exposed sealant flush.

3.12 Finishing

A. General: Treat gypsum board joints, interior angles, flanges of corner beads, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration.

B. Prefill open joints, rounded or beveled edges, and damaged areas using setting-type joint compound.

C. In rooms indicated to receive epoxy paint, high performance coatings, use only setting type compounds. Drying type compounds are not acceptable.

D. Apply joint tape over gypsum board joints except those with accessories having concealed face flanges not requiring taping to prevent cracks from developing in joint treatment at flange edges.

E. Apply the various levels of finish of gypsum board surfaces per GA-214 as follows: Comply with surface finish tolerance indicated.

1. Level 0 “Zero”: No taping, finishing or accessories required. Provide this level for temporary construction.

2. Level 1: Joints and interior angles shall have tape embedded in joint compound. Surface shall be free of excess joint compound. Tool marks and ridges are acceptable.

    a. Provide this level for plenum areas above ceilings, in attics, in areas where assembly will be concealed in Finished Work.
    b. Maximum 1/4 inch gap under a 10 foot straight edge at any point.

3. Level 2: Joints and interior angles shall have tape embedded in joint compound and one (1) separate coat of joint compound applied over joints, angles, fastener heads, and accessories. Surface shall be free of excess joint compound. Tool marks and ridges are acceptable.
    a. Maximum 1/4 inch gap under a 10 foot straight edge at any point.
4. Level 3: Joints and interior angles shall have tape embedded in joint compound and two (2) separate coats of joint compound applied over joints, angles, fastener heads, and accessories. Joint compound shall be smooth and free of tool marks and ridges.
    a. Maximum 3/16 inch gap under a 10 foot straight edge at any point.
5. Level 4: Joints and interior angles shall have tape embedded in joint compound and three (3) separate coats of joint compound applied over joints, angles, fastener heads, and accessories. Furnished joint compound shall be smooth and free of tool marks and ridges.
    a. Provide this level, unless otherwise indicated.
    b. Maximum 1/8 inch gap under a 10 foot straight edge at any point.
6. Level 5: Joints and interior angles shall have tape embedded in joint compound and three (3) separate coats of joint compound applied over joints, angles, fastener heads, and accessories. A thin skim coat of joint compound, or a material manufactured especially for this purpose, shall be applied to entire surface to fill imperfections in joint work, smooth paper texture, and provide a uniform surface for decorating. Surface shall be smooth and free of tool marks and ridges.
    a. Maximum 1/16 inch gap under a 10 foot straight edge at any point.

3.13 Cleaning And Protection

A. Promptly remove residual joint compound from adjacent surfaces.

B. Provide final protection and maintain conditions, in a manner suitable to Installer, that ensures gypsum board assemblies remain without damage or deterioration at Date of Substantial Completion.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes:

1. Glazed Ceramic and Porcelain Tile.

2. Solid polymer thresholds installed as part of tile installations.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Gypsum Board Assemblies: Division 09.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Product Data: For each material and accessory product. Show provisions for conformance with indicated criteria.

C. Submittal layout drawings.

D. Samples:

1. For Verification:

a. Full-size units of each type and composition of tile and for each color and finish required.
b. Full size units of each type of trim and accessory.
c. Solid polymer thresholds in 6 inch lengths.

E. Sustainability Submittals: Provide the following in accordance with Sustainability Requirements: Division 01.

1. Materials Sustainability Documentation Form.

2. Product data, certification letter, and costs for materials with recycled content.

3. Product data and costs for regional materials.

4. Product data for adhesives and sealants indicating VOC content.

5. Product data for paints and coatings indicating VOC content and chemical composition.

F. Closeout Submittals:

1. Maintenance Instructions: Flooring manufacturer's maintenance instructions.

1.4 Definitions

A. Module Size: Actual tile size (minor facial dimension as measured per ASTM C 499) plus joint width indicated.

B. Facial Dimension: Actual tile size (minor facial dimension as measured per ASTM C 499).

C. Wet Areas: As defined by Tile Council of America (TCA).

1.5 Performance Requirements

A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:

1. Level Surfaces: Minimum 0.6.

2. Step Treads: Minimum 0.6.

3. Ramp Surfaces: Minimum 0.8.

1.6 Quality Assurance

A. Manufacturer's Qualifications: Minimum five (5) years producing products similar to those required for this Project.

B. Source Limitations for Tile: Obtain all tile of same type and color or finish from one (1) source or producer.

1. Obtain tile from same production run and of consistent quality in appearance and physical properties for each contiguous area.

C. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one (1) source or producer.

D. Installer's Qualifications:

1. Experience: Minimum five (5) years installing products similar to those required for this Project. Completed three (3) projects of scope, schedule and complexity similar to this Project within last two (2) years as acceptable to Design Professional.

E. Referenced Codes and Standards: Comply with the following in accordance with Division 01.

1. Tile Council of America (TCA)

Ceramic Tile Installation Handbook

1.7 Delivery, Handling And Storage

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement in ANSI A137.1 for labeling sealed tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Store liquid latexes and emulsion adhesives in unopened containers and protected from freezing.

1.8 Project Conditions

A. Environmental Requirements: Do not install tile until construction in spaces is complete and ambient temperature and Relative Humidity conditions are maintained at levels indicated in referenced standards and manufacturer's written instructions.

1.9 Maintenance

A. Extra Materials: Furnish extra materials described below that match product installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed, for each type, composition, color, pattern, and size indicated.

Part 2 Products

2.1 Products, General

A. ANSI Ceramic Tile Standard: ANSI A137.1, "Specifications for Ceramic Tile," for types, compositions, and other characteristics indicated.

1. Provide tile complying with Standard grade requirements, unless otherwise indicated.

2. For facial dimensions of tile, comply with requirements relating to tile sizes specified in Article, "Definitions".

B. Factory Blending: For tile exhibiting color variations within ranges selected during Sample submittals, blend tile in factory and package so tile units taken from one (1) package show same range in colors as those taken from other packages and match approved Samples.

C. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer, unless otherwise indicated.

2.2 Tile Products

A. Ceramic and Porcelain Tile CT-1:

1. Basis of Design: Endure, URB-015, Matte, as manufactured by Pantheon.

2. Others:

   a. Ultra Modern, as manufactured by American Olean.
   b. Pangea, as manufactured by StonePeak.

3. Module Size: 12x24 inches.

B. Ceramic and Porcelain Tile CT-2:

1. Basis of Design: Blend 6x12, Bright White/30510, Gloss, as manufactured by Mosa.

2. Others:

   a. Natural Hues 6x12, as manufactured by Daltile.
   b. Color by Numbers 4x12, as manufactured by Crossville.

C. Ceramic and Porcelain Tile CT-3:

1. Basis of Design: Blend 6x12, Air Blue/32120, Stonematt, as manufactured by Mosa.

2. Others:

   a. Natural Hues 6x12, as manufactured by Daltile.
   b. Color by Numbers 4x12, as manufactured by Crossville.

2.3 Trim Units

A. Glazed Wall Tile Trim Units: Matching characteristics of adjoining flat tile and coordinated with sizes and coursing of adjoining flat tile where applicable. Provide shapes as follows, selected from manufacturer's standard shapes:

1. Base for Thin-Set Mortar Installations: Coved, module size 6 inches by 3 inches in Prep room and 6 inches x 12 inches in toilet rooms.

2. Wainscot Cap for Thin-Set Mortar Installations: Surface bullnose, module size 3 inches by 6 inches in Prep Room and 3 inches x 12 inches in toilet rooms.

3. External Corners for Thin-Set Mortar Installations: Surface bullnose.

4. Internal Corners: Field-butted square corners except with coved base and cap angle pieces designed to fit with stretcher shapes.

2.4 Thresholds

A. Coordinate concrete over pour in bathrooms to accommodate flush tile transition without threshold.

B. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.

1. Bevel edges at 1:2 slope, aligning lower edge of bevel with adjacent floor finish. Limit height of bevel to 1/2 inch or less, and finish bevel to match face of threshold.

C. Solid Polymer Thresholds: Made from homogeneous solid sheets of filled plastic resin complying with material and performance requirements in ANSI Z124.3, for Type 5 or Type 6, without precoated finish.

1. Basis of Design: Corian manufactured by Dupont Polymers. Finish to be selected by Design Professional from manufacturer's standard range.

2. Acceptable Manufacturers:

a. Avonite, Inc.
b. DuPont Polymers.
c. Formica Corporation.
d. Nevamar; International Paper; Decorative Products Division.
e. Swan Corporation (The).
f. Wilsonart International; Division of Premark International, Inc.

2.5 Waterproofing Membranes

A. General: Manufacturer's standard product that complies with ANSI A118.10

B. Polyethylene Sheet: Polyethylene membrane with polypropylene fleece laminated on both sides, 0.008 inch nominal thickness.

1. Product: Schluter KERDI system or equal.

2.6 Crack Suppression Membranes

A. Provide full coverage crack suppression membrane under all floor tile

2.7 Setting Materials

A. Epoxy Mortar: ANSI A118.3.

1. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 degrees F and 212 degrees F, respectively, and certified by manufacturer for intended use.

B. Epoxy Adhesive: ANSI A118.3.

2.8 Grout Materials

A. Epoxy Grout: ANSI A118.3.

1. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 degrees F and 212 degrees F, respectively, and certified by manufacturer for intended use.

B. Grout Color: As scheduled in Finish Schedule, based upon coordination with basis of design tile products. If alternate tile are used, colors will be re-elected by Architect from manufacturer's full range.

2.9 Miscellaneous Materials

A. Water: Potable and free of harmful materials in deleterious amounts.

B. Underlayment: Latex-modified, Portland cement-based formulation provided or approved in writing by manufacturer of tile-setting materials for installations indicated.

C. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved in writing for materials and installations indicated by tile and grout manufacturers.

D. Grout Sealer: Product recommended in writing by grout manufacturer for sealing grout joints that does not change color or appearance of grout.

2.10 Mixing Mortars And Grout

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturer's written instructions.

B. Add materials, water, and additives in accurate proportions.

Part 3 Execution

3.1 Examination

A. Project Site Verification of Conditions:

1. Substrates: Examine for conformance to requirements indicated for that substrate.

2. Existing Substrates: Examine for conditions which will adversely affect execution of Work and which are not included in indicated repair and patching.

3. Floor Drains: Verify that drains are set at proper elevation.

4. Penetrations: Verify that penetrations, sleeves, block-outs and similar items are set properly.

5. Verify that substrates for setting tile are firm, dry, clean, free of oil, waxy films and curing compounds.

6. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed before installing tile.

7. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Design Professional.

B. Conditions: Report to Owner's Representative prior to commencing Work.

C. Corrections: Perform corrections as directed by Owner's Representative.

D. Acceptance: Commencing installation constitutes acceptance of substrate as suitable. Provide Work required because of installation over deficient or defective substrates at no additional cost.

3.2 Preparation

A. Protection: Protect adjacent surfaces from staining, deterioration or damage.

B. Surface Preparation: Prepare surfaces as required to make ready for application of tile and setting materials. Comply with manufacturer's written requirements.

1. Make substrate suitable to provide Finished Work matching approved Samples.

2. Preparing Existing Surfaces:

a. Cleaning: Remove contaminants and bond breaking substances, including, but not limited to, adhesive residue, coatings, dirt and grease.

3. Remove coatings, including curing compounds and other substances that contain soap, wax, oil, or silicone, that are incompatible with tile-setting materials.

4. Prepare concrete substrates to comply with flatness tolerances specified in referenced ANSI A108 Series of tile installation standards.

a. Fill cracks, holes, and depressions with underlayment according to tile-setting material manufacturer's written instructions
b. Remove protrusions, bumps, and ridges by sanding or grinding.

5. Build ramps with underlayment to align top of tile with other finished floors. Slope ramps at not to exceed 1:50. (1/4 inch per foot).

C. Blending: For tile exhibiting color variations within ranges selected during Sample submittals, blend to match approved Samples.

D. Temporary Protective Coating: Where needed to prevent grout from staining or adhering to exposed tile surfaces, precoat with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.3 Installation, General

A. General: Install as required to:

1. Comply with manufacturer's written instructions.

2. Comply with approved submittals.

3. Match approved Samples.

4. Comply with indicated criteria.

5. Comply with requirements of TCA's "Handbook for Ceramic Tile Installation." and ANSI A108 Series "Specifications for Installation of Ceramic Tile" except where more stringent standards are indicated elsewhere.

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions, unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. 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, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Jointing Pattern: Lay tile in grid pattern, unless otherwise indicated. Align joints when adjoining tiles on floor, base, walls, and trim are same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting and tiles less than half size. Provide uniform joint widths, unless otherwise indicated.

1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in Finished Work.

E. Lay out tile wainscots to next full tile beyond dimensions indicated.

F. Expansion Joints: Locate expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Locate joints in tile surfaces directly above joints in concrete substrates.

2. Prepare joints and apply sealants to comply with requirements in Joint Sealants: Division 07.

G. Grout: Grout using latex Portland cement grout, comply with ANSI A 108.10, unless otherwise indicated.

3.4 Floor Tile Installation

A. Mortar Coverage: For installations indicated below, follow procedures in ANSI A108 Series tile installation standards for providing 95 percent mortar coverage.

1. Tile floors composed of tiles 8 inches by 8 inches or larger.

2. Tile floors composed of rib-backed tiles.

B. Joint Widths: Install tile on floors with the following joint widths:

1. Paver Tile: 1/4 inch.

2. .Solid Polymer Thresholds: coordinate concrete over pour in bathrooms to accommodate flush tile transition without threshold.

C. Grout Sealer: Apply grout sealer to latex Portland cement grout joints according to grout-sealer manufacturer's written instructions. Remove excess sealer as soon as grout sealer has penetrated grout joints.

D. Typical Interior Floor Installation: Latex Portland cement medium set mortar; TCA F113 and ANSI A108.5.

3.5 Wall Tile Installation

A. Joint Widths: Install tile on walls with the following joint widths:

1. Glazed Wall Tile: 1/16 inch.

B. Interior Wall Installation Over Gypsum Wallboard: Latex Portland cement thin-set mortar; TCA W243 and ANSI A108.5.

1. Use for all interior walls, unless otherwise indicated.

3.6 Cleaning And Protecting

A. Cleaning: On completion of 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 according to tile and grout manufacturer's written instructions, but no sooner than ten (10) days after installation. Use cleaners recommended in writing by tile and grout manufacturers and after determining that cleaners are safe to use by testing on Samples of tile and other surfaces to be cleaned. Protect adjacent surfaces from cleaning. Flush surfaces with clean water before and after cleaning.

3. Remove temporary protective coating by method recommended in writing by coating manufacturer that is acceptable in writing to tile and grout manufacturer. Trap and remove coating to prevent it from clogging drains.

B. When recommended in writing by tile manufacturer, apply per manufacturer's written instructions a neutral protective cleaner to completed tile walls and floors.

C. Protect installed tile work with heavy covering.

D. Prohibit foot and wheel traffic from tiled floors for at least seven (7) days after grouting is completed.

E. Before final inspection and Date of Substantial Completion, remove protective coverings and rinse neutral cleaner from tile surfaces.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Acoustical ceiling (AC) and suspension systems.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Gypsum Board Assemblies: Division 09.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Product Data: Manufacturer's data and test reports containing sufficient evidence of conformance to classes, ratings, performances and other indicated criteria. Data for anchors into structure and for concealed steel framing containing sufficient evidence of conformance to indicated criteria.

C. Samples:

1. Panels: Two (2), 12 inch square Samples of each type of panel.

2. Suspension System: Two (2), 12 inch long Samples of each type of grid component.

D. Sustainability Submittals: Provide the following in accordance with Sustainability Requirements: Division 01.

1. Materials Sustainability Documentation Form.

1.4 Quality Assurance

A. Installer's Qualifications: Installer shall have minimum five (5) years experience installing products similar to those required for this Project. Installer shall have documented experience of successfully completing three (3) projects of scope, schedule and complexity similar to this Project within last two (2) years

B. Single Source Requirements: Panel products required for Work of this Section shall be supplied by one (1) manufacturer. Suspension grid products required for Work of this Section shall be supplied by one (1) manufacturer of accessory products including, for example, fasteners, sealants and anchors may be from other than primary manufacturer if approved in writing by primary manufacturer.

C. Regulatory Requirements: Components of fire-rated assembly shall comply with a listed assembly of required fire-rating of Underwriters Laboratories, Inc. or other independent Testing Agency approved by Building Code Official having jurisdiction.

D. Referenced Codes and Standards: Comply with Ceiling and Interior Systems Contractors Association (CISCA): CISCA Ceiling Systems Handbook “Recommendations For Direct Hung Ceilings” in accordance with Division 01.

E. Field Mock-up: Install approximately 100 square feet of each type of acoustic ceiling for approval at location directed by Construction Manager. Approved mock-up may be incorporated into Final Work.

1.5 Delivery, Handling And Storage

A. Store materials at Project Site for at least 24 hours before Work begins and under indicated environmental conditions. Store materials on raised platforms, in unopened cartons. Protect from soiling, moisture and other damage.

B. Exercise personal and mechanical cleanliness to prevent soiling of ceiling material. Wear clean white gloves while handling panels.

1.6 Project Conditions

A. Environmental Requirements: Building areas to receive ceilings shall be free of construction dust and debris. Maintain temperature and Relative Humidity within limits recommended in writing by manufacturer, before, during and after installation.

1.7 Maintenance

A. Extra Materials: Deliver to Project Site, at completion of Project, extra acoustical panels and grid of each type used. Furnish acoustical units from same production run of that provided for installation. Quantities of each material shall be full-carton lots as follows:

	Project Area, Per Type of Work	**Extra Materials**
1.	5,000 square feet or less	100 square feet of panel and 2 percent of grid.
2.	5,000-15,000 square feet	150 square feet of panel and 2 percent of grid.

B. When more than one (1) type of acoustical panel or grid are required, furnish each type in a quantity corresponding to area dedicated for the type.

C. Furnish extra stock quantities in addition to normal overrun quantities required for completion of Work.

Part 2 Products

2.1 Manufacturers

A. Products of indicated manufacturers are acceptable, contingent upon conformance to indicated requirements. Equivalent products of other manufacturers will be evaluated as substitutions in accordance with requirements of Division 01.

2.2 Suspension Systems: General

A. Suspension Grid: Provide metal suspension systems of types, structural classifications and finishes indicated that comply with ASTM C 635.

B. Edge Molding And Trim:

1. Material and Finish: Match grid, profiles as indicated.

2. Edge Trim:

a. Lay-in Panels with Exposed Grid: Standard edge angle.
b. Reveal Edge Lay-in Panels with Exposed Grid: “W” profile stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange of exposed suspension member.
c. Narrow Faced or Reveal Face Suspension Systems: Edge angle that matches width of exposed suspension members.
d. Circular Penetrations and Curved Edges: Factory form edge angle to indicated radius smooth and true without kinking or notching.

3. Foam Tape: 1/8 inch by 1 inch foam tape, adhesive coated one (1) side, for sealing edge trim.

C. Steel Framing Accessories:

1. Screws: Corrosion-resistant coated steel drill screws.

a. For Wood and Steel Less Than 0.03 inch: ASTM C 1002.
b. For Steel Over 0.03 inch: ASTM C 954.

2. Wire for Hanger and Ties: ASTM A 641, Class 1 zinc coating, soft-temper, minimum 12 gage for hangers and 16 gage for ties.

3. Rod and Strap Hangers: Galvanized, soft-temper steel, sizes as indicated.

2.3 Acoustical Materials: General

A. Units shall comply with ASTM E 1264 classifications as designated by type, pattern, acoustical ratings and light reflectance.

B. Flame Spread and Smoke Developed: Maximum ratings of 25 and 450 when tested in accordance with ASTM E 84.

C. NRC ratings specified shall be in accordance with ASTM C 423.

2.4 Acoustical Ceiling Systems

A. Acoustical Ceiling Type 1 (ACT-1):

1. Panel Size: 24x24 inches.

2. Basis of Design Panel Product: Ultima by Armstrong, Inc.

3. Grid:

   a. Width: 9/16 inch.
   b. Design: Reveal type.
   c. Material: Zinc plated steel.
   d. Finish: Manufacturers baked-on enamel.
   e. Color: Blizzard White.
   f. Basis of Design Grid Product: Suprafine by Armstrong, Inc.

Part 3 Execution

3.1 Examination

A. Project Site Verification of Conditions:

1. Examine substrates and structural framing to which acoustical ceiling shall be applied for suitability and conformance to specified tolerances.

2. Report deficiencies toOwner's Representative prior to commencing Work.

3. Commencing Work constitutes acceptance of substrates and structural framing. Perform work or re-work required because of deficient substrates at no additional cost.

3.2 Preparation

A. Fire Protection: Coordinate attachment to members protected with fireproofing, including spray-on, intumescent, board, gypsum wallboard assembly, or other types, in order to maintain indicated ratings.

B. Layout:

1. Comply with reflected ceiling plans.

2. If dimensions are not indicated, establish layout of grid to balance border widths at opposite edges of each ceiling.

3. Avoid installation of less-than-half width units.

3.3 Suspension System Installation

A. General: Install in accordance with manufacturer's written instructions and to comply with referenced standards and ASTM C 636.

B. Overhead Anchors: Where it is not possible to wire-tie directly to structure or preset inserts, install overhead anchors in accordance with manufacturer's written instructions. Do not anchor to metal roof decks.

C. Edge Moldings: At perimeter, penetrations, junctions with other ceiling surfaces, and the intersection of ceiling and any vertical surfaces, install edge molding of type indicated.

1. Set edge angle over continuous foam tape.

2. Use maximum lengths.

3. Miter corners.

4. Anchor at maximum 24 inches on center and within 3 inches of each end with screws. Nails are not acceptable. At metal stud partitions, anchor into studs where possible.

D. Hangers:

1. Suspend hangers directly from structure or from anchors.

   a. Wire hanger loops shall be tightly wrapped and sharply bent to prevent vertical movement or rotation. Wrap wire around itself minimum three (3) full turns within 3 inches.
   b. Do not attach hangers to other systems within ceiling space or their system supports, including ductwork, piping and conduit.

2. Hangers shall be one-piece without splices.

3. Install hangers free from contact with other objects within ceiling space not part of supporting structural system or ceiling system. Do not kink or bend hangers.

4. Hanger wires shall not be more than 1 in 6 out of plumb, unless countersplayed hangers at approximately same slope and in same plane are provided.

E. Supplemental Framing:

1. Where structural members are spaced more than 4 feet on center or otherwise do not align with required hanger suspension points and other overhead anchors are not available, provide supplemental framing to bridge between the structural members.

2. Where ducts or other elements prevent the regular spacing of hangers, provide a trapeze to span under interrupting element.

3. Supplemental Framing and Trapezes: Suspend, anchor or weld to structure at both ends to prevent rotation, sizes as follows:

   a. Spans up to 4 feet: One (1) cold-rolled channel, vertical with wire hangers each end.
   b. Spans over 4 feet up to 6 feet: Doubled cold-rolled channels, wired together, vertical, with 1/8 inch by 1 inch bolted strap hangers each end.
   c. Spans over 6 feet: Slotted steel channel, sized for span and load condition, with 3/8 inch threaded rod hangers each end.

F. Fixtures, Diffusers and other Elements Attached to Ceiling: Provide hangers within 6 inches of support points of grid-mounted light fixtures.

3.4 Panel Installation

A. Install Work in accordance with manufacturer's written instructions.

B. Cull out and discard irregular, broken, off-color, and poorly textured units.

C. Intermingle ceiling material from several cartons to disperse slight variations over a large area.

D. Run grain of ceiling units in one (1) direction within each room and space as indicated.

E. Scribe and cut for accurate fit at borders and around penetrating Work.

3.5 Tolerances

A. No portion of installed ceiling shall deviate from a true horizontal plane by more than 1/4 inch in 10 feet.

B. Joints between and within grid members and edge trim shall be 1/16 inch maximum.

C. Grid members shall not deviate from an idealized plan location by more than 1/4 inch in 10 feet.

3.6 Adjustments And Cleaning

A. Adjust sags or twists which develop in ceiling systems.

B. Minor marks on panels may be removed if cleaning method does not damage surface. Use of spackling or paint to hide defect is not acceptable.

C. Touch up minor damage to grid finish with manufacturer’s written recommended paint. Touch-ups shall be invisible when viewed from normal standing eye level under normal lighting conditions.

D. Replace with new material, any Work which is damaged, soiled, abraded, chipped, broken or discolored.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Flooring and accessories as follows:

1. Resilient Base (RB).

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Product Data: For each component or material required including accessories, anchors, and other miscellaneous products including written installation instructions.

C. Samples: Two (2) Samples per each material type. Tile or sheet material shall each be 6 inch.

D. Certifications: By each manufacturer that products meet specified requirement.

E. Sustainability Submittals: Provide the following in accordance with Sustainability Requirements: Division 01.

1. Materials Sustainability Documentation Form.
2. Product data, certification letter, and costs for materials with recycled content.
3. Product data and costs for regional materials.
4. Product data for adhesives and sealants indicating VOC content.
5. Product data for paints and coatings indicating VOC content and chemical composition.
6. Product data for products containing composite wood or agrifiber products or wood glues indicating that they do not contain urea-formaldehyde resin.

F. Closeout Submittals: Maintenance instructions for each product installed.

1.4 Quality Assurance

A. Grade: Materials shall be Regular Grade, an industry standard which represents best quality production available. Second quality or rejects are not acceptable.

B. Installer's Qualifications: Installer shall have minimum five (5) years experience installing products similar to those required. Installer shall have documented experience of successfully completing three (3) projects of scope, schedule and complexity similar to this Project within last two (2) years.

C. Single Source Requirements: Supply each primary product required for Work of this Section from one (1) manufacturer. Accessory products including, for example, fasteners, sealants, anchors shall be approved in writing by primary manufacturer.

1.5 Delivery, Handling And Storage

A. Deliver to Project Site in original manufacturer unopened packaging, bearing name of product and manufacturer, shipping and handling instructions.

B. Store materials in dry space at between 55 degrees F and 90 degrees F.

C. Store tiles flat. Move tiles and accessories to final location 48 hours before installation.

1.6 Project Conditions

A. Maintain temperature at 70 degrees F in spaces to receive materials specified herein 48 hours prior to installation. Maintain space at 55 degrees F after installation.

1.7 Maintenance

A. Extra Materials: Deliver to Owner's Representative, full-cartons of tile flooring and base for future use. Provide 2 percent of total quantity of each type and color used, but not less than two (2) full-cartons of each type and color, and 16 feet of each color base.

Part 2 Products

2.1 Resilient Base

A. Products of Johnsonite have been specified as the Basis of Design. Equivalent products of other manufacturers will be evaluated as substitutions in accordance with requirements of Division 01.

B. Base: Provide rubber base indicated.

1. RB-1: Basis of Design: Straight Base (or equal by Roppe or Forbo).

    a. Height: 4 inches.
    b. Profile: Straight base.
    c. Color: 20 "charcoal WG".

2.2 Accessories

A. Adhesives: Water-resistant types manufactured to be suitable for floors on grade, floors above grade, and for adhering base, as recommended in writing by tile and base manufacturers.

Part 3 Execution

3.1 Examination

A. Project Site Verification of Conditions:

1. Examine substrates for suitability and conformance to specified tolerances.

2. Report any deficiencies to Owner's Representative prior to commencing Work.

3. Commencing Work constitutes acceptance of substrate. Perform future work or re-work required because of deficient substrates at no additional cost.

B. Testing: Test substrate for moisture content per manufacturer's written instructions.

3.2 Preparation

A. Clean substrate of curing compounds, paint, oil, grease or other matter detrimental to adhesion of flooring. Sand and prime if necessary.

3.3 Installation

A. Extend tile and base indicated on schedules for main areas, into adjoining closets, alcoves and recesses, indicated but not identified by room number.

B. Adhere base as recommended in writing by manufacturer.

C. Install base straight and true and with neatly formed corners. Scribe base accurately to vertical surfaces.

D. Cleaning and Waxing:

1. Remove surplus adhesive from tile and base, by method recommended in writing by tile manufacturer which will not soften or otherwise cause damage.

3.4 Protection

A. Protect base until Final Cleaning and Date of Substantial Completion.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Linoleum sheet flooring.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Resilient Tile Flooring: Division 09.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Product Data: For each type of product.

C. Sustainable Design Submittals:

1. Adhesives shall have a VOC content of 50 g/L or less.
2. Product Data: For adhesives, indicating VOC content.
3. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
4. Flooring products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

D. Shop Drawings: For each type of linoleum flooring. Include flooring layouts, locations of seams, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.

1. Show details of special patterns.

E. Samples: For each exposed product and for each color and pattern specified in manufacturer's standard size, but not less than 6-by-9-inch sections.

F. Qualification Data: For Installer.

G. Closeout Submittals:

1. Maintenance Data: For each type of linoleum flooring to include in maintenance manuals.

1.4 Quality Assurance

A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for flooring installation.

1. Engage an installer who employs workers for this Project who are trained or certified by flooring manufacturer for installation techniques required.

1.5 Delivery, Storage, And Handling

A. Store flooring and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 65 deg F or more than 90 deg F.

1. Floor Tile: Store on flat surfaces.

2. Sheet Flooring: Store rolls upright.

1.6 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 flooring during the following time periods:

1. 72 hours before installation.

2. During installation.

3. 72 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 flooring installation.

D. Close spaces to traffic for 72 hours after flooring installation.

E. Install flooring after other finishing operations, including painting, have been completed.

Part 2 Products

2.1 Performance Requirements

A. Flooring products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

1. "Laboratory Test Reports" Subparagraph below applies to LEED 2009 for Schools, LEED v4, IgCC, ASHRAE 189.1, and Green Globes.

2. Laboratory Test Reports: For flooring products, indicating compliance with requirements for low-emitting materials.

2.2 Linoleum Sheet Flooring

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Basis of design: MCS, 3139 Lava, as manufactured by Forbo Industries, Inc. or approved equal.

B. Linoleum Sheet Flooring: ASTM F 2034, Type I, linoleum sheet with backing.

1. Roll Size: In manufacturer's standard length but not less than 79 inches wide.

C. Thickness: 0.080 inch.

D. Heat-Welding Bead: For seamless installation, solid-strand product of linoleum flooring manufacturer.

2.3 Installation Materials

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by linoleum flooring manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by flooring and adhesive manufacturers to suit products and substrate conditions indicated.

1. Adhesives shall have a VOC content of 50g/L or less.

2. Product Data: For adhesives, indicating VOC content.

3. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.

4. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Floor Polish: Provide protective, liquid floor-polish products recommended by linoleum flooring manufacturer.

Part 3 Execution

3.1 Examination

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of flooring.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 Preparation

A. Prepare substrates according to linoleum flooring manufacturer's written instructions to ensure adhesion of flooring.

B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

C. Do not install flooring until it is the same temperature as space where it is to be installed.

1. At least 72 hours in advance of installation, move flooring and installation materials into spaces where they will be installed.

D. Immediately before installation, sweep and vacuum clean substrates to be covered by flooring.

3.3 Installation, General

A. Comply with manufacturer's written instructions for installing flooring.

B. Scribe and cut flooring to butt neatly and tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings.

C. Extend flooring into toe spaces, door reveals, closets, and similar openings.

D. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on flooring as marked on substrates. Use chalk or other nonpermanent marking device.

E. Adhere flooring to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

F. Heat-Welded Seams: For seamless installation, comply with ASTM F 1516. Rout joints and heat weld with welding bead to permanently fuse sections into a seamless flooring. Prepare, weld, and finish seams to produce surfaces flush with adjoining flooring surfaces.

3.4 Linoleum Sheet Flooring Installation

A. Unroll linoleum sheet flooring and allow it to stabilize before cutting and fitting.

B. Lay out linoleum sheet flooring as follows:

1. Maintain uniformity of flooring direction.
2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches away from parallel joints in flooring substrates.
3. Match edges of flooring for color shading at seams.
4. Avoid cross seams.
5. Eliminate deformations that result from hanging method used during drying process (stove bar marks).

3.5 Cleaning And Protection

A. Comply with manufacturer's written instructions for cleaning and protecting linoleum flooring.

B. Perform the following operations immediately after completing linoleum flooring installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect linoleum flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Floor Polish: Remove soil, visible adhesive, and surface blemishes from linoleum flooring before applying liquid floor polish.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Sub-floor preparation, carpet tile installation and carpet accessories.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Finish Schedule: See Drawings.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Shop Drawings: Layout diagrams of each area per design intent drawings showing layout grid.

C. Product Data: Carpet Schedule: Prepare yardage take-off for each carpet color and/or patterns and submit in schedule form.

D. Samples: Three (3) full size carpet tile Samples of each type and color specified. Label Samples to identify color, quality of construction, manufacturer, project name and general area of installation.

E. Sustainability Submittals: Provide the following in accordance with Sustainability Requirements: Division 01.

1. Materials Sustainability Documentation Form.
2. Product data, certification letter, and costs for materials with recycled content.
3. Product data and costs for regional materials.
4. Product data for adhesives and sealants indicating VOC content.
5. Product data indicating compliance with testing and product requirements of Carpet and Rug Institute's "Green Label" Program.
    a. Carpet.
    b. Carpet Cushion.

F. Closeout Submittals:

1. Maintenance Instructions: Five (5) copies of carpet manufacturer's written instructions and recommendations for cleaning and maintenance.

2. Special Warranty: As indicated.

1.4 Performance Requirements

A. Manufacturer's Instructions: Install Work in accordance with carpet tile manufacturer's written instructions. Should such recommendations conflict with these Specifications, so state in proposal. First stage of installation work for each carpet type shall be subject to approval, and Work approved shall be standard for remainder of installation.

1.5 Quality Assurance

A. Installation shall be by installers approved in writing by manufacturers.

1.6 Project Conditions

A. Environmental Requirements: Maintain carpeting and spaces to be carpeted at a minimum of 68 degrees F for at least 48 hours prior to installation with Relative Humidity not over 65 percent. Maintain conditions 24 hours a day during installation and for 72 hours after completion.

B. Field Measurements: Field check dimensions and conditions, and be responsible for proper installation of carpet. Dimensions indicated are approximate.

C. Other Construction: Do not start carpet installation until painting and finishing work are completed, and ceilings and overhead work are tested and approved.

1.7 Special Warranty

A. Warrant carpet in writing for manufacturer’s standard Warranty Period, as specified below. Warranty shall commence upon Date of Substantial Completion of carpet installation as determined by Design Professional.

B. Wear: Manufacturer’s standard Warranty.

C. Static: Lifetime of carpet.

D. Edge Ravel: Manufacturer’s standard Warranty.

E. Delamination: Manufacturer’s standard Warranty.

F. Dimensional Stability: Manufacturer’s standard Warranty.

1.8 Maintenance

A. Extra Materials: Deliver to Project Site, extra materials of each type of carpet used. Extra materials shall be from same production runs as that used in Work.

B. For each material provide as extra stock five (5) percent minimum of quantity of that material used in Work.

C. Extra material shall be in addition to normal overrun quantities required for completion of Work.

Part 2 Products

2.1 Approved Manufacturers

A. Products of Bolyu are specified to establish the desired quality and performance of Work. Equivalent products manufactured by Interface or Shaw as listed are acceptable.

B. Carpet shall be new, first quality and from same dye lot colors selected. Carpeting shall have a critical radiant flux Class 1 as tested in accordance with ASTM E 648 and NFPA 253.

C. Construction: Flat needled, non-woven.

D. Yarn Type: Universal fibers solution-dyed nylon.

E. Refer to Finish Schedule on Drawings.

2.2 Carpet Tile Schedule

A. CPT-1: Basis of Design as scheduled: Monogram/MNG, Capital/55, as manufactured by Bolyu.

1. Tile Size: 24 inch by 24 inch.

2. Backing: Nexterra.

3. Others:

a. 2nd Avenue as manufactured by Interface.
b. Expand Tile as manufactured by Shaw.

B. CPT-2: Basis of Design as scheduled: Svelte/SVL, Shining Moment/25, as manufactured by Bolyu.

1. Tile Size: 24 inch by 24 inch.

2. Backing: Nexterra.

3. Others:

a. 1st Avenue as manufactured by Interface.
b. Color Plank as manufactured by Shaw.

C. CPT-3: Basis of Design as scheduled: Svelte/SVL, Red Hot/85, as manufactured by Bolyu.

1. Tile Size: 24 inch by 24 inch.

2. Backing: Nexterra.

3. Others:

a. 1st Avenue as manufactured by Interface.
b. Color Plank as manufactured by Shaw.

2.3 Accessory Materials

A. Leveling Compound: Noncrumbling latex base patching compound. Volatile Organic Compounds (VOCs) compliant.

B. Floor Sealer: Floor sealers, as recommended in writing by carpet manufacturer, shall be compatible with adhesive used.

C. Contact Cement: "Grab-Plus", nonflammable type by Durabond Products or "Touchdown" No. 700 by W. F. Taylor Company. Volatile Organic Compounds (VOCs) compliant.

D. Releasable Adhesive: 3M Company, Blue Glue Multi-Purpose Carpet Adhesive or approved equivalent. Include primer if required.

E. Double Face Tape: Europort, Commercial Flooring Tape, Product Number 77-960 or approved equivalent.

F. Reducer Strips: Mercer or approved equivalent. Color as selected from manufacturer's standards by Design Professional.

G. Carpet Protection: St. Regis "Seekure" and nonstaining tape or approved equal.

Part 3 Execution

3.1 Inspection

A. Prior to installation, inspect subfloors, and advise Owner's Representative in writing of any condition, which will prevent proper installation. Installation of material will be interpreted as acceptance of subfloors as proper to receive Work. Test for presence of moisture in accordance with ASTM F 1869.

B. Prior to installation, inspect carpet for manufacturing defects and visible color variation. Do not install defective carpet.

3.2 Preparation

A. Vacuum clean subfloors prior to installation of any material. Remove all substances detrimental to installation.

1. Make floors level and free of irregularities. Fill depressions, cracks and joints with trowel-applied leveling compound. Correct changes in floor height by troweling on leveling compound to create a ramp-like effect. Slope ramps at not to exceed 1:50. (1/4 inch per foot).

3.3 General Workmanship Requirements

A. Install carpet under open bottom items such as convectors and against door thresholds.

B. Install carpet tightly against all permanent vertical surfaces so that all portions of floor areas to receive carpet are covered.

C. Where removable items such as door stops, telephone or electrical outlets are present, remove them prior to installing carpet and replace them in their original location after carpet has been installed.

D. Where carpet meets other finished floor materials that are higher or lower than top surface of carpet, provide a vinyl-reducing strip of appropriate size and profile to effect a smooth transition between the two (2) surfaces. Use full-length pieces only. Butt reducer strips tight to vertical surfaces. Where splicing cannot be avoided, butt ends tight and flush.

E. Where carpet meets other finished floors at same top elevation as carpet, finish carpet with no exposed edging.

F. Entire installation shall be tight and flat to sub-floor, well fastened at edges, and present a uniform appearance, free from stain, dirt, tears, frayed or pulled tufts. There shall be a monolithic match of color, pattern and texture within any one (1) area.

3.4 Installation

A. Comply with CRI 104 and carpet manufacturer's written installation instructions.

B. Install carpet tiles as indicated on Finish Legend.

C. Establish grid using standard tile laying methods and chalk lines.

D. Arrange installation so that no less than one-half tile occurs, except where design requires otherwise.

E. Joints shall be tightly butted and carefully aligned.

F. Contact Cement: Apply contact cement to all surfaces receiving carpet in the following locations.

1. Perimeter tiles 6 inches or less in width at walls and other contiguous projections.

G. Installation 100 percent Glue-Down: (Releasable Adhesive): Using floor sealer, seal surfaces receiving adhesive. Provide 100 percent adhesive coverage.

3.5 Protection

A. Apply carpet protection over traffic lanes. Securely tape covering in place and maintain covering in good condition until Date of Substantial Completion. Upon acceptance of Work remove protective coverings from Project Site.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Surface preparation and field application of paints on interior surfaces throughout Project, except as specified herein. Also includes the following:

1. Coating of exposed-to-view Mechanical and Electrical work as specified herein.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. High-Performance Coatings: Division 09.

C. Electrical: Division 26.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Product Data: For each coat of each coating system specified.

1. Painting Schedule: Schedule listing surface preparation, between coat preparation and selected products for each coat for each substrate and system required.

2. Manufacturer's technical information, including label analysis and instructions for handling, storing and applying each material proposed for use.

3. List of each material and cross-reference specific coating, finish system, application, and location. Identify each material by manufacturer's catalog number and general classification.

4. For products not specifically listed in Part 3:

a. Manufacturer's pre-printed description of product line indicating ranking of submitted materials within product line or manufacturer's certification that materials submitted are best quality materials available from manufacturer.

C. Samples:

1. Samples for Verification Purposes: Of each color and material to be applied, with texture to simulate actual conditions, on representative Samples of actual substrate.

a. Stepped Samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.

b. List of material and application for each coat of each Sample. Label each Sample as to location and application.

c. Samples on the following substrates for Design Professional's review of color and texture only:

1) Ferrous Metal: Two 4 inch square Samples of flat metal and two 8 inch **long** Samples of solid metal for each color and finish.

2) Wood: Two 4 inch square Samples of each species present on job of each color and finish.

3) Gypsum Wallboard: Two 12 inch square Samples of each color and finish.

D. Qualifications: Manufacturer and Installer.

E. Sustainability Submittals: Provide the following in accordance with Sustainability Requirements: Division 01.

1. Materials Sustainability Documentation Form.

2. Product data and costs for regional materials.

3. Product data for paints and coatings indicating VOC content and chemical composition.

1.4 Definitions

A. Architectural Spaces: Corridors, rooms, closets, stairways and other spaces not specifically defined as utility spaces.

B. Coat: Individual applications of a film of paint at manufacturer's written recommended Minimum Wet Film (MWF) allowed to dry before a new film is applied.

C. Coatings: High Performance Coatings System: Division 09.

D. Concealed: Concealed from view in Finished Work.

E. Epoxy Paint: High Performance Coating System: Division 09.

F. Exposed: Exposed to view in Finished Work.

G. Exterior: Exposed to the exterior atmosphere. Finished areas covered by roofs, but exposed to outside atmosphere, shall be considered an exterior area.

H. Finish Coat: Final coat of system.

I. Interior: Not exposed to exterior atmosphere.

J. MDF, MWF: Minimum Dry Film (MDF) thickness or Minimum Wet Film (MWF) thickness as recommended in writing by manufacturer.

K. MPI: Master Painters Institute.

L. Paint or Painting: A decorative, protective, or otherwise functional film applied to a substrate which may be another paint. It includes a complete system of, for example, surface preparation, primers, barrier coats, undercoats, finish coats, sanding and cleaning as specified herein for surface indicated. Paint is not for severe conditions such as described in High-Performance Coatings: Division 09.

M. Semi-Exposed or Semi-Concealed: Surfaces not visible from any normal seated or standing eye levels but visible from higher or lower eye levels or visible at certain times. (For example, inside of access doors; cupboard interiors; drawer interiors; shelf undersides lower than 30 inches above floor; attic and loft spaces with accessways for regular maintenance and counter undersides on non-public side).

N. Shop Primed: Primer coat applied at shop or fabricator's plant.

O. SSPC: Steel Structures Painting Council.

P. Utility Spaces: Mechanical equipment rooms, rooms scheduled as "unpainted", and spaces intended only for access by building maintenance personnel.

1.5 Colors

A. Provide colors indicated. For surfaces not indicated, color shall be selected by Design Professional.

B. A designated color shall be required in one or more types and sheens of paint, depending upon paint system specified for each specific surface.

C. Matching colors shall be exact. Do not consider that standard color line of a manufacturer to nearest shade shall be acceptable, even in small scope work.

1.6 Sheen

A. Provide sheens indicated. For surfaces not indicated, sheen shall be selected by Design Professional.

B. Paint gloss shall be defined as the sheen rating of applied paint, in accordance with ASTM D 523:

1. Flat finish: 0 to 5 units at 60 degrees, maximum 15 units at 85 degrees.

2. Eggshell finish: 5 to 20 units at 60 degrees.

3. Satin finish: 15 to 35 units at 60 degrees.

4. Semi-Gloss finish: 30 to 65 units at 60 degrees.

1.7 Quality Assurance

A. Manufacturer’s Qualifications: Company specializing in manufacture of products specified in this Section with minimum five years experience.

B. Applicator’s Qualifications: Company specializing in performing Work of this Section with minimum five years experience.

C. Product Quality:

1. Materials shall be of one brand when possible. In any case, primers, fillers and sealers shall be same brand as finish coats. Where necessary to thin a product, use manufacturer's written recommended thinner.

2. Materials shall be manufacturer’s best quality product available for each type of material. Best quality product shall be selected from manufacturer’s complete product offering, irregardless of marketing descriptions, for example, Contractor’s Grade, Professional Grade and Specification Grade. Economy quality is satisfactory for painting temporary structures.

1.8 Delivery, Handling And Storage

A. Deliver paint materials in sealed original labeled containers, bearing manufacturer’s name, type of paint, brand name, color designation and instructions for mixing and/or reducing.

B. Provide adequate storage facilities. Store paint materials at minimum ambient temperature of 45 degrees F in well ventilated area.

1.9 Project Conditions

A. Environmental Requirements: During application of paint, except as paint manufacturer's label instructions recommend otherwise, wet trade work shall be completed and dried out. Surfaces shall be dried using natural or forced ventilation, 60 degrees F or higher, maximum 85 percent Relative Humidity.

B. Do not apply paint or finishes in areas where dust is being generated.

C. If permanent lighting system is not functional, provide temporary lighting equivalent to permanent lighting system to illuminate surfaces being worked on.

1.10 Coordination

A. Provide finish coats which are compatible with prime paints used.

B. Where necessary, provide block, barrier or intermediate coats over incompatible primers, paints or coatings.

C. Notify Design Professional in writing of anticipated problems when using specified paints or coatings with substrates primed by Work specified in other Sections.

D. Schedule Work to minimize future Work in finish painted spaces and to allow for installation of Work that is not to be field painted, for example, sealants, hardware and pre-finished accessories.

1.11 Maintenance

A. Extra Materials: Deliver to Owner's Representative, at storage location on Project Site as directed, extra materials of each paint product furnished.

1. Provide minimum of five gallons, intermediate and other non-finish coat products.
2. Provide minimum of five gallons or five percent of each color and type of finish coat, whichever is larger.
3. Extra materials shall be in tightly sealed, manufacturer's original containers complete with original label. Indicate color and application (for example, office walls, doors or toilets) on each container.

Part 2 Products

2.1 Manufacturer

A. Approved Manufacturers: Products of the following manufacturers are listed in Schedule at end of this Section to establish desired quality and performance of Work:

1. Benjamin Moore and Company (BM).
2. PPG Industries, Pittsburgh Paints (PPG).
3. Sherwin-Williams (SW).

B. Equivalent products by the following listed manufacturers are acceptable subject to compliance with specified criteria. Equivalent products of other manufacturers shall comply with specified criteria and be listed on the MPI 'Green' Approved Products List.

Part 3 Execution

3.1 Examination Of Surfaces

A. Examine surfaces to be painted prior to commencement of Work. Do not paint surfaces which are not suitable. Surface to receive paint shall be clean, tight-coated and free of defects that will telegraph through paint system. Unsuitable surfaces include, but not limited to, the following:

1. Damaged surfaces (for example, nicks, dents, gouges, holes in gypsum wallboard, plaster, steel doors and frames, and similar conditions).
2. Oily, greasy, dusty or soiled surfaces.
3. Non-dressed welds which will be exposed to view.

4. Lack of touch-up where specified in other Sections.

5. Deteriorated shop-primed surfaces.

6. Rusted surfaces, unless approved in writing as acceptable by coating manufacturer.

7. Work with loose or missing items, unless specified to be painted separately.

B. Review other Sections in which primers are provided to ensure compatibility of total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers. Notify Design Professional regarding anticipated problems using the indicated materials over substrates primed by Work specified in other Sections.

C. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:

1. Concrete, Concrete Unit Masonry, and Clay Masonry: 12 percent.

2. Metal: Non-condensing.

3. Wood: 15 percent, measured in accordance with ASTM D 2016.

4. Plaster and Gypsum Wallboard: 12 percent.

D. Notify Design Professional in writing of improper materials, incompatible substrates for specified system, workmanship or other defects which shall affect satisfactory execution and permanency of Work. Absence of such notification will be construed as acceptance of surfaces. Later claims of defects in surfaces shall not relieve Contractor from responsibility for performing Work.

3.2 Protection

A. Protect other surfaces from paint and damage. Provide drop cloths, shields and protective equipment to prevent spray or droppings from fouling surfaces not being painted.

B. Handle scaffolding, ladders and products carefully to prevent damage to finished surfaces.

C. Post WET PAINT signs and close off newly coated areas where possible. Remove signs when Work has dried.

D. Remove electrical plates, surface hardware, fittings and fastenings, prior to painting operations. Store items and reinstall upon completion of coating work in each area.

3.3 Surfaces Not To Be Field Painted

A. Areas scheduled "unpainted", except for specific elements in unpainted areas which are specifically indicated for paint.

B. Exposed concrete, unless otherwise indicated.

C. Face brick or other similar masonry, unless otherwise indicated.

D. Stainless steel, bronze, aluminum, copper or other prefinished metal, unless otherwise indicated.

E. Plastic surfaces.

F. Sealants of types which should not be painted over.

G. Rating labels on doors and frames (Mask off).

H. Finish Hardware, except hardware that is factory primed.

I. Acoustical ceiling work including metal grid work, except adjacent primed metal work.

J. Gypsum wallboard and plaster scheduled to receive wall covering.

K. Elevator cab doors and frames, unless otherwise indicated.

L. Sprinkler heads.

M. Piping, conduits and ducts exposed in utility spaces.

N. Valves and controls.

O. Operating parts of machinery and equipment.

P. Name and identification plates on equipment (Mask off).

Q. Work furnished with complete factory finish, unless otherwise indicated.

R. Surfaces with integral finish such as glass, tile and flooring, unless otherwise indicated.

S. Exposed cross laminated timber panels or glu-lam beams.

3.4 Architectural Surfaces To Be Field Painted

A. Except for special coatings or finishes indicated elsewhere and "Surfaces Not to be Field Painted" listed above, field paint the following:

1. Wall or ceiling surfaces in a space indicated on Finish Schedule to be painted.

3.5 Mixing

A. Paint products shall be factory-mixed and ready for application upon delivery.

B. Do not thin products except as specified, and except where label instructions require thinning. Follow manufacturer’s written recommendations and instructions accurately.

3.6 Surface Preparation

A. Prepare and clean substrates according to paint manufacturer’s written instructions.

B. Provide primers and barrier coats recommended in writing by manufacturer, but not listed in Schedule.

C. Remove hardware, faceplates, and similar items before painting, and carefully reinstall them when painting work is completed. Mask along edges of items which cannot be removed.

D. Refine minor defects in substrates and factory primed surfaces by light sanding, wire-brushing, soft-brushing, solvent cleaning, dry wiping, and similar methods appropriate to substrates and subsequent finish. Do not use steel wool.

E. Uncoated Steel and Iron Surfaces: Remove grease, mill scale, weld splatter, dirt and rust from steel and iron surfaces in accordance with SSPC-SP 1. Where heavy coatings of scale are evident, remove by wire brushing or other hand tools in accordance with SSPC-SP 2 or any other approved SSPC-SP method. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Prime paint after repairs.

F. Shop Primed Steel Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Spot prime bare steel surfaces.

G. Galvanized Surfaces: Solvent clean to remove oils and dirt in accordance with SSPC-SP 1. Remove white rust by hand or power brushing. Remove chromate passivated treatments. Apply primer immediately after preparing Work.

H. Wood: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats.

I. Provide masking when necessary to achieve a neat finish painting edge next to dissimilar surfaces. Remove masking carefully when paint has dried.

3.7 Application Of Paints

A. Verify compatibility of each type of finish coat with shop primers and between field coats.

B. Apply each coat of painting system as scheduled.

C. Apply coating only to clean, dry, smooth surfaces.

D. Apply paints according to manufacturer's label instructions, using types of brushes, rollers, or equipment as applicable to type of paint applied. Comply with coverage rates and film thicknesses of such written instructions.

E. Apply paint in proper consistency and quantity so it flows out to a level surface free of brush and roller marks, bubbles, dust, splatter, drips, runs, sags, or holidays. Spread paint evenly with uniform color, texture and sheen. Do not smear, splatter or run coatings over adjoining colors or materials. Cut-in lines shall be straight. Blend in brush painted cut-in areas on walls at, for example, ceilings, window and door jambs to provide uniform, evenly coated appearance on all surfaces.

F. Allow applied coat to dry before next coat is applied.

G. Tint each coat slightly off the preceding coat as a color indication to assure coverage of each coat.

H. Prime woodwork on six sides before installation.

I. Prime concealed surfaces of interior millwork.

J. Seal hardware mortises, tops, bottoms, and cut-offs of wood doors with heavy coat of varnish or similar sealer immediately upon delivery to Project Site.

3.8 Field Quality Control

A. Have available at Project Site, a magnetic dry-film thickness gauge, a wet film thickness gauge, thermometer to measure surface (not ambient) temperatures, a hand lens with magnification to 25X, and device to test alkali content in surfaces. Use these devices for spot-checking quality and uniformity of paint coats and surface conditions, routinely and make available when requested by Design Professional.

3.9 Cleaning, Touch-Up, and Repair

A. As Work proceeds and upon completion, promptly remove paint where oversprayed, spilled, splashed or splattered.

B. During progress of Work, keep premises free from unnecessary accumulation of tools, equipment, temporary protection, surplus materials and debris.

C. Touch-up minor blemishes and skips in paint in preparation for initial inspection. Perform other corrections and repainting required by inspection.

D. Remove masking and other temporary protection.

E. Repair or replace Work damaged as a result of inadequate or unsuitable protection.

3.10 Interior Institutional Low-Odor/VOC Latex Schedule

A. Primer for Steel Substrates:

1. BM: M04 Acrylic Metal Primer.
2. Duron: DuraClad 62 Universal Acrylic Metal Primer.
3. PPG: Pitt-Tech Plus DTM 90-912.
4. SW: ProCryl Universal Primer, B66-310.

B. Primer for Wood Panel Substrates: Including wood doors and painted plywood (but excluding running trim to receive clear sealer):

1. BM: Pristine Eco Spec Interior Latex Primer Sealer, 231.
2. Duron: Terminator 2 Water-Based Stain Killer.

3. PPG: Pure Performance Interior Latex Primer, 9-900.

4. SW: ProGreen 200 Prime B28W600.

C. Primer for Gypsum Board and Plaster Substrates:

1. BM: Pristine Eco Spec Interior Latex Primer Sealer, 231.

2. Duron: Terminator 2 Water-Based Stain Killer.

3. PPG: Pure Performance Interior Latex Primer, 9-900.

4. SW: ProGreen Primer, B28W600.

D. Top Coats: Two coats of institutional low-odor/VOC interior latex:

	Flat	Eggshell	Semigloss
1. BM:	Eco Spec Interior Latex Flat 219	Eco Spec Interior Latex Eggshell Enamel 223	Eco Spec Interior Latex Semi-Gloss Enamel 224
2. Duron:	Genesis Acrylic flat, 60	Genesis Eggshell, 79	Genesis Semi-gloss, 83
3. PPG:	Pure Performance Interior Flat Latex 9-100	Pure Performance Interior Eggshell Latex 9-300	Pure Performance Interior Semi-Gloss Latex 9-500
4. SW:	Harmony Interior Latex Flat B5	Harmony Interior Latex Eg-Shel B9	Harmony Interior Latex Semi-Gloss B10

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Surface preparation and field application of high-performance coatings, including, but not limited to, the following:

1. Exterior surfaces.

2. Coating of exposed-to-view Mechanical and Electrical Work as specified herein.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Fluoropolymer Coatings: Division 05.

C. Painting: Division 09.

D. Mechanical and Electrical: Divisions 22, 23 and 26, refer to for Sections requiring Work of this Section.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Product Data: For each coating system specified.

1. Coating Schedule: Schedule listing surface preparation, between coat preparation and selected products for each coat for each substrate and system required.

2. Manufacturer's technical information, including label analysis and instructions for handling, storing and applying each material proposed for use.

3. List of each material and cross-reference specific coating, finish system, application, and location. Identify each material by manufacturer's catalog number and general classification.

C. Samples:

1. For Initial Color Selection: In form of manufacturer's color charts. After color selection, Design Professional will furnish color chips for surfaces to be coated.

2. Samples for Verification Purposes: Of each color and material to be applied with texture to simulate actual conditions on representative Samples of actual substrate.

a. Stepped Samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture is achieved.
b. List of material and application for each coat of each Sample. Label each Sample as to location and application.
c. Samples on the following substrates for Design Professional's review of color and texture only.

1) Ferrous Metal: Two 4 inch square Samples of flat metal and two 8 inch long Samples of solid metal for each color and finish.

2) Non-Ferrous Metal: Two 4 inch square Samples of flat metal and two 8 inch long Samples of solid metal for each color and finish.

3) Wood: Two (2) 4 inch square Samples of each species present on job of each color and finish.

D. Qualifications: Manufacturer and Installer.

E. Certifications: By manufacturer that products supplied comply with local regulations controlling use of Volatile Organic Compounds (VOCs).

F. Sustainability Submittals: Provide the following in accordance with Sustainability Requirements: Division 01.

1. Materials Sustainability Documentation Form.

2. Product data, certification letter, and costs for materials with recycled content.

3. Product data and costs for regional materials.

4. Product data for paints and coatings indicating VOC content and chemical composition.

1.4 Definitions

A. Architectural Spaces: Corridors, rooms, closets, stairways and other spaces not defined as utility spaces.

B. Coat: Individual application of a film of high performance coating at manufacturers Minimum Wet Film (MWF) thickness and allowed to dry before a new film is applied.

C. Coating: A highly protective, decorative or otherwise functional high performance film applied to a substrate. Coatings shall mean a complete system of, for example, surface preparation, primers, barrier coats, undercoats, finish coats, sanding and cleaning as specified herein for surfaces indicated.

D. Concealed: Concealed from view in Finished Work.

E. Epoxy Paint: High performance coating system as specified herein.

F. Exposed: Exposed to view in Finished Work.

G. Exterior: Exposed to the exterior atmosphere. Finished areas covered by roofs, but exposed to outside atmosphere, shall be considered an exterior area.

H. Finish Coat: Final coat of system.

I. Interior: Not exposed to exterior atmosphere.

J. MDF-MWF: Minimum Dry Film (MDF) thickness or Minimum Wet Film (MWF) thickness as recommended in writing by manufacturer.

K. Paint or Painting: Coating system in accordance with Painting: Division 09.

L. Semi-Exposed or Semi-Concealed: Surfaces not visible from any normal seated or standing eye levels but visible from higher or lower eye levels or visible at certain times. (For example, inside of access doors; cupboard interiors; drawer interiors; shelf undersides lower than 30 inches above floor; attic and loft spaces with accessways for regular maintenance and counter undersides on non-public side).

M. Shop Primed: Primer coat applied at shop or fabricator's plant.

N. SSPC: Steel Structures Painting Council.

O. Utility Spaces: Mechanical equipment rooms, rooms scheduled as "unpainted" or "uncoated", and spaces accessible only to building maintenance personnel.

1.5 Colors

A. Provide colors indicated. For surfaces not indicated, color shall be selected by Design Professional.

B. Color Scheme:

1. For majority of wall surfaces, provide one light color.

2. Not more than 3 deep accent colors will be specified for approximately 20 percent of wall area.

3. Doors and frames shall be coated same color.

4. Each exposed mechanical or electrical system shall be coated a different deep accent color and as indicated.

C. A designated color may be required in one or more types and sheens of coating, depending upon coating system specified for each specific surface.

D. Matching colors shall be exact. Do not consider that standard color line of a manufacturer to nearest shade is acceptable, even in small scope work.

1.6 Sheen

A. Provide sheens indicated. For surfaces not indicated, sheen shall be selected by Design Professional.

B. Coating gloss shall be defined as the sheen rating of applied coating, in accordance with the following values:

1. Flat finish: 0 to 5 units at 60 degrees, maximum 15 units at 85 degrees.

2. Eggshell finish: 5 to 20 units at 60 degrees.

3. Satin finish: 15 to 35 units at 60 degrees.

4. Semi-Gloss finish: 30 to 65 units at 60 degrees.

1.7 Sample Coating Work Mock-Up

A. Provide Sample Coating Work in field on mock-up as indicated for each major coating system. Coating work shall be in conformance with approved Samples. Finish one complete surface of approximately 100 square feet of each color scheme required, clearly indicating selected colors, finish texture, materials and workmanship. Adjust tint, sheen and colors as directed. Do not proceed with field coating until Sample Coating Work is approved.

B. When approved, Sample Area shall serve as a minimum standard for Work throughout Project.

C. Upon completion of Work, restore Sample coated surfaces to new condition.

1.8 Quality Assurance

A. Manufacturer’s Qualifications: Company specializing in manufacture of products specified in this Section with minimum five years experience.

B. Applicator’s Qualifications: Company specializing in performing Work of this Section with minimum five years experience.

C. Product Quality:

1. Materials shall be of one brand when possible. In any case, primers, fillers and sealers shall be same brand as finish coats. Where necessary to thin a product, use manufacturer's written recommended thinner.

2. Materials shall be manufacturer’s best quality product available for each type of material. Best quality product shall be selected from manufacturer’s complete product offering, irregardless of marketing descriptions, for example, Contractor’s Grade, Professional Grade and Specification Grade. Economy quality is satisfactory for coating temporary structures.

3. Materials shall comply with Contract Documents, codes, and local restrictions. Where a conflict occurs between Contract Documents and codes and local restrictions, more stringent requirement shall govern.

D. Coating Materials:

1. Fire-retardance: Coatings shall be Fire-Retardant Class “A” when applied to non-combustible surfaces per ASTM E 84.

2. USDA: Products shall be authorized by USDA for non-food contact or incidental food contact surfaces.

3. FDA: Products shall be manufactured from ingredients, which conform to FDA 21 CFR 175.300.

1.9 Delivery, Handling And Storage

A. Deliver coating materials in sealed original labeled containers, bearing manufacturer's name, type of coating, brand name, color designation and instructions for mixing or reducing.

B. Provide adequate storage facilities. Store coating materials at minimum ambient temperature of 45 degrees F in well ventilated area.

1.10 Project Conditions

A. Environmental Requirements: During application of coating, except as coating manufacturer's label instructions recommend otherwise, wet trade work shall be completed and dried out. Surfaces shall be dried using natural or forced ventilation, 60 degrees F or higher, maximum 85 percent Relative Humidity.

B. Do not apply coatings in areas where dust is being generated.

C. If permanent lighting system is not functional, provide temporary lighting equivalent to permanent lighting system to illuminate surfaces being worked on.

1.11 Coordination

A. Provide finish coats that are compatible with primers used.

B. Where required, provide block, barrier or intermediate coats over incompatible primers, paints or coatings.

C. Notify Design Professional in writing regarding anticipated problems when using specified coatings with substrates primed by other than this Installer.

D. Schedule Work to minimize future Work in finish coated spaces and to allow for installation of Work that is not to be field coated, including, sealants, hardware, pre-finished accessories, and similar items.

1.12 Maintenance

A. Extra Materials: Deliver to Owner’s Representative, at storage location on Project Site as directed, extra materials of each coating product furnished.

1. Provide minimum two percent of each primer, intermediate and other non-finish coat products.

2. Provide minimum five percent of each color and type of finish coat.

3. Extra materials shall be in tightly sealed, manufacturer's original containers complete with original label. Indicate color and application (for example, office walls, doors or bathrooms) on each container.

Part 2 Products

2.1 General

A. Provide regional materials in accordance with Sustainability Action Plan specified in Sustainability Requirements: Division 01.

B. Use paints and coatings that comply with the VOC limits specified in Sustainability Requirements: Division 01. Where indicated, the chemical restrictions do not apply to this section.

2.2 Manufacturer

A. Basis of Design:

1. The Sherwin-Williams Company.

2. Kemper System Ltd.

3. PPG Industries.

B. Equivalent products from other manufacturers may be submitted subject to approval of Design Professional and will be evaluated as substitutions in accordance with requirements of Division 01:

1. Product substitution shall include a comparison schedule listing the specified product and the proposed product, including but not limited to the following:

a. Cost.
b. Schedule.
c. Differences between the specified product and the substitution.
d. Chemical properties and components of the system.
e. Application substrate.

Part 3 Execution

3.1 Examination Of Surfaces

A. Examine surfaces to be coated prior to commencement of Work. Do not coat surfaces that are not suitable. Surface to receive coating shall be clean, tight-coated and free of defects that will telegraph through coating system. Unsuitable surfaces include, but not limited to, the following:

1. Damaged surfaces (for example, nicks, dents, gouges, holes in gypsum wallboard, plaster, steel doors and frames, and similar conditions).

2. Oily, greasy, dusty, or soiled surfaces.

3. Non-dressed welds that will be exposed to view.

4. Lack of touch-up where specified in other Sections.

5. Deteriorated shop-primed surfaces.

6. Rusted surfaces, unless approved in writing as acceptable by coating manufacturer.

7. Work with loose or missing items, unless specified to be coated separately.

B. Review other Sections in which primers are provided to ensure compatibility of total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers. Notify Design Professional regarding anticipated problems using the indicated materials over substrates primed by Work specified in other Sections.

C. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:

1. Concrete Floors: 8 percent.

2. Metal: Non-condensing.

3. Wood: 15 percent, measured in accordance with ASTM D 2016.

4. Plaster and Gypsum Wallboard: 12 percent.

D. Notify Construction Manager in writing of improper materials, incompatible substrates for specified system, workmanship or other defects which shall affect satisfactory execution and permanency of Work. Absence of such notification will be construed as acceptance of surfaces. Later claims of defects in surfaces shall not relieve Contractor from responsibility for performing Work.

3.2 Protection

A. Protect other surfaces from coating and damage. Provide drop cloths, shields and protective equipment to prevent spray or droppings from fouling surfaces not intended for coating.

B. Handle scaffolding, ladders and products carefully to prevent damage to finished surfaces.

C. Post WET PAINT signs and close off newly coated areas where possible. Remove signs when Work has dried.

D. Remove electrical plates, surface hardware, fittings and fastenings, prior to coating operations. Store items and reinstall upon completion of coating work in each area.

3.3 Surfaces Not To Be Field Coated

A. Areas, elements and surfaces scheduled for paint in Painting: Division 09.

B. Areas scheduled “unpainted or uncoated”, except for specific elements in uncoated areas which area indicated to be coated.

C. Exposed concrete, unless otherwise indicated.

D. Stainless steel, bronze, aluminum, copper or other pre-finished metal, unless otherwise indicated.

E. Plastic surfaces.

F. Sealants of types which should not be painted over.

G. Rating labels on doors and frames. Mask off.

H. Finish hardware, except hardware that is factory primed.

I. Acoustical ceiling work including metal grid work, except adjacent primed metal work.

J. Surfaces scheduled to receive fiberglass reinforced epoxy systems.

K. Elevator cab doors and frames, unless otherwise indicated.

L. Sprinkler heads.

M. Piping, conduits and ducts exposed in enclosed shafts.

N. Valves and controls.

O. Hot pipes and stacks.

P. Operating parts of machinery and equipment.

Q. Name and identification plates on equipment. Mask off.

R. Work furnished with complete factory finish, unless otherwise indicated.

S. Surfaces with integral finish such as glass, tile and flooring, unless otherwise indicated.

3.4 Surfaces To Be Field Coated

A. Except for special coatings or finishes indicated elsewhere and "Surfaces Not to be Field Coated" listed above, field coat the following:

1. Wall or ceiling surfaces in a space indicated on Finish Schedule and details to be coated.

2. All exposed interior and exterior CLT and glulam wood surfaces.

3. Factory primed hardware items indicated in Door Hardware: Division 08.

3.5 Mixing

A. Single component products shall be factory-mixed and ready for application upon delivery.

B. Multi-component products shall be factory pre-packaged for mixing on Project Site. Pre-packaging shall be sized to allow for mixing of proper proportions in full container units without separate measuring on Project Site.

C. Do not thin products except as indicated, and where label instructions require thinning. Follow manufacturer's written recommendations and instructions.

3.6 Surface Preparation

A. Prepare and clean substrates according to coating manufacturer's written instructions, SSPC recommendation, and as indicated, whichever is more stringent. Verify proper conditions of surfaces.

B. Provide primers and barrier coats recommended in writing by manufacturer, but not listed in Schedule.

C. Remove hardware, faceplates, and similar items before coating, and carefully reinstall them when coating work is completed. Mask along edges of items that cannot be removed.

D. Refine minor defects in substrates and factory primed surfaces by light sanding, wire-brushing, soft-brushing, solvent cleaning, dry wiping, and similar methods appropriate to substrates and subsequent finish. Do not use steel wool.

E. Lightly sand and dust off coatings between coats or treat as recommended in writing by system manufacturer.

F. Concrete Floors: Remove contamination, acid etches, and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.

G. Uncoated Steel and Iron Surfaces: Remove grease, mill scale, weld splatter, dirt and rust from steel and iron surfaces in accordance with SSPC-SP 1. Where heavy coatings of scale are evident, remove by wire brushing or other hand tools in accordance with SSPC-SP 2 or any other approved SSPC-SP method. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Prime coat after repairs.

H. Shop Primed Steel Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Spot prime bare steel surfaces.

I. Galvanized Surfaces: Solvent clean to remove oils and dirt in accordance with SSPC-SP 1. Remove white rust by hand or power brushing. Remove chromate passivated treatments. Apply primer immediately after preparing Work.

J. Aluminum Surfaces: Remove surface contamination by steam or high pressure water. Remove oxidation with acid etch and solvent washing. Apply primer immediately following cleaning.

K. Copper Surfaces: Remove contamination by steam, high-pressure water, or solvent washing. Apply primer immediately following cleaning.

L. Wood: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats.

M. Provide masking when necessary to achieve a neat finish coating edge next to dissimilar surfaces. Remove masking carefully when coating has dried.

3.7 Application Of Coatings

A. Verify compatibility of each type of finish coat with shop primers and between field coats.

B. Apply each coat of system as scheduled.

C. Apply coating only to clean, dry, smooth surfaces.

D. Apply coatings according to manufacturer's label instructions, using types of brushes, rollers, or equipment as applicable to type of coating applied. Comply with coverage rates and film thicknesses of such written instructions.

E. Apply coating in proper consistency and quantity so it flows out to a level surface free of brush and roller marks, bubbles, dust, splatter, drips, runs, sags or holidays. Spread coating evenly with uniform color, texture and sheen. Do not smear, splatter or run coatings over adjoining colors or materials. Cut-in lines shall be straight. Blend in brush coated cut-in areas on walls at, for example, ceilings, window and door jambs to provide uniform, evenly coated appearance on all surfaces.

F. Allow applied coat to dry before next coat is applied.

G. Tint each coat slightly off the preceding coat as a color indication to assure coverage of each coat.

H. Prime concealed surfaces of interior millwork.

I. Seal hardware mortises, tops, bottoms, and cut-offs of wood doors with heavy coat of varnish or similar sealer immediately upon delivery to Project Site.

3.8 Field Quality Control

A. Have available at Project Site, a magnetic dry-film thickness gauge, a wet film thickness gauge, thermometer to measure surface (not ambient) temperatures, a hand lens with magnification to 25X, and device to test alkali content in surfaces. Use these devices for spot-checking quality and uniformity of coats and surface conditions, routinely and make available when requested by Design Professional.

B. Owner reserves right to invoke the following testing procedure at any time during period when coating is being applied:

1. Owner may engage services of an independent Testing Agency to sample coating material being used. Samples of material delivered to Project Site will be taken, identified, sealed and certified in presence of Contractor.

2. Testing Agency shall perform appropriate tests for the following characteristics as required by Owner:

    a. Quantitative materials analysis.
    b. Abrasion resistance.
    c. Apparent reflectivity.
    d. Flexibility.
    e. Washability.
    f. Absorption.
    g. Accelerated yellowness.
    h. Dry opacity.
    i. Accelerated yellowness.
    j. Recoating.
    k. Skinning.
    l. Color retention.
    m. Alkali and mildew resistance.

3. If test results show material being used does not comply with specified requirements, Contractor shall be directed to stop coating, remove noncomplying materials, pay for testing and retesting, recoat surfaces coated with rejected coating, and remove rejected coating from previously coated surfaces when rejected coating and specified coating are incompatible or in any way compromise quality of specified coating system.

3.9 Cleaning, Touch-Up, Repair

A. As Work proceeds and upon completion, promptly remove coating where oversprayed, spilled, splashed or splattered.

B. During progress of Work, keep premises free from unnecessary accumulation of tools, equipment, temporary protection, surplus materials and debris.

C. Touch-up minor blemishes and skips in coating in preparation for initial inspection. Perform other corrections and recoating required by inspection.

D. Remove masking and other temporary protection.

E. Repair or replace Work damaged as a result of inadequate or unsuitable protection.

3.10 High Performance Coatings Schedules

A. Provide the following coating systems for surfaces indicated.

B. Provide specific coating system for each substrate as indicated on Finish Schedule.

3.11 Exterior Coating Schedule

A. Wood products including cross laminated timber panels and glulam beams.

1. SW Superdeck Exterior Waterborne Semi-transparent Stain:

a. Top Coat: Two coats. Color as selected by architect based upon samples on each substrate.

B. Concrete Traffic Surfaces (Second Level Balcony Terrace):

1. Kemperol 2K-PUR with aggregate.

a. Primer, Basecoat, and top coat and aggregate.
b. Aggregate Color as selected by Architect from manufacturer's full range.
c. Thickness as recommended by manufacturer for substrate and foo traffic service conditions.

C. Steel Substrates (urethane, gloss, maximum 250 g/L VOC):

1. PPG: 8-13 mil acrylic aliphatic urethane gloss system.

a. Primer: Pitt-Guard All Weather Direct-To-Rust Epoxy Coatings, 97-946 Series.
b. Top Coat: Two coats Pitthane Ultra Gloss Urethane Enamels, 95-812 Series.

2. SW: 6-12 mil acrylic/polyester waterbased urethane gloss system.

a. Primer: Waterbased Tile-Clad Epoxy Finish, B73-100.
b. Top Coat: Two coats Hydrogloss Single Component Waterbased Urethane, B65 Series.

D. Galvanized-Metal Substrates (urethane, gloss, maximum 250 g/L VOC):

1. PPG: 8-13 mil acrylic aliphatic urethane gloss system.

a. Primer: Pitt-Guard All Weather Direct-To-Rust Epoxy Coatings, 97-946 Series.
b. Top Coat: Two coats Pitthane Ultra Gloss Urethane Enamels, 95-812 Series.

2. SW: 6-12 mil acrylic/polyester waterbased urethane gloss system.

a. Primer: Waterbased Tile-Clad Epoxy Finish, B73-100.
b. Top Coat: Two coats Hydrogloss Single Component Waterbased Urethane, B65 Series.

3.12 Interior General Service (Dry) High Performance Coatings Schedule

A. Wood products including cross laminated timber panels and glulam beams.

1. SW Superdeck Exterior Waterborne Semi-transparent Stain:

a. Top Coat: Two coats. Color as selected by architect based upon samples on each substrate.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Exterior signs and their installation complete as specified herein and as indicated on Drawings and shall include the following.

1. Cast and Fabricated Letters.

2. Accessories, Supports and Anchors.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Shop Drawings: Show fabrication and installation details, post setting and wiring diagrams as required.

C. Samples: Two (2) sets of finish Samples for approval.

D. Closeout Submittals: Special Warranty: As indicated.

1.4 Special Warranty

A. Furnish five (5) year Warranty on metal finishes, against peeling, cracking, fading, crazing or blistering.

Part 2 Products

2.1 Approved Manufacturers

A. Products of Andco Industries Corporation are specified to establish desired quality and performance of the Work. Equivalent products of other manufacturers will be evaluated as substitutions in accordance with requirements of Division 01.

2.2 Cast Letters

A. Cast Letters:

1. Material: Aluminum 0.90 inch thick.

2. Letter Height: As shown on Drawings.

3. Letter Style: As shown on Drawings.

4. Mounting Method: Projected from surface on pin mounts.

5. Final Finish (Color): Anodized Aluminum.

2.3 Finish

A. Etch and degrease all exposed aluminum. Provide manufacturer’s standard, baked-on enamel finish. Color shall be as selected by Design Professional.

2.4 Workmanship

A. Execute aluminum letter forms with square edges or as indicated on Drawings. Chipped, nicked, cut or ragged edges will not be accepted.

B. Edges of signs or letters shall be smoothly finished.

C. All finishes shall be free from lines, ridges, variations in color, orange peel, bubbles, pin holes, mottling, crazing, coarse particles and grit.

Part 3 Execution

3.1 Installation

A. Install Work in accordance with approved submittals.

3.2 Cleaning

A. After installation, clean exposed surfaces in accordance with sign manufacturer's written instructions.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Provide signs, as indicated in drawings.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Finishes: Division 09.

C. Exterior Signs: Division 10.

D. Sections of Work to which interior signage is attached or fastened to its surface.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Shop Drawings: Show fabrication and installation details.

C. Samples: Provide Sample inter-letter and inter-word spacing on Sample sign inserts and panels for Design Professional's approval before fabrication is initiated.

D. Sustainability Submittals: Provide the following in accordance with Sustainability Requirements: Division 01.

1. Materials Sustainability Documentation Form.
2. Product data, certification letter, and costs for materials with recycled content.
3. Product data and costs for regional materials.
4. Product data for adhesives and sealants indicating VOC content.

E. Closeout Submittals: Special Warranty: As indicated.

1.4 Special Warranty

A. Furnish five (5) year warranty on metal finishes, against peeling, cracking, fading, crazing or blistering.

Part 2 Products

2.1 Approved Manufacturers

A. Products of ASI Sign Systems Inc., System Emboss are specified to establish desired quality and performance of Work. Equivalent products of other manufacturers will be evaluated as substitutions in accordance with requirements of Division 01.

2.2 Signs

A. Provide sign types indicated on Drawings.

B. Provide sign for each interior door.

C. All signage shall be ADA compliant.

2.3 Workmanship

A. Execute reverse screening of letters true and level, letter forms with rounded corners, chipped, nicked, cut or ragged edges are not acceptable. Screening to be executed in such a manner that edges and corners of finished letter forms are true and clean. Laminations shall be free of trapped air or other imperfections and edges shall be trimmed flush, so that front face appears monolithic.

B. Fabricate joints, miters, and other features with Work accurately machined, filed and fitted rigidly framed together at joints and contact points. Carefully match work to produce a perfect continuity of lines and designs, with finish materials in contact having hairline joints. Edges of sign plaques shall be smoothly finished.

C. Finishes shall be free from lines, ridges, variations in color, orange peel, bubbles, pin holes, mottling, crazing, coarse particles and grit.

Part 3 Execution

3.1 Installation

A. Erect Work plumb, level and true, with proper alignment and relationship to Work of other Sections, free of sway and deflection, structurally sound and rigidly secured.

3.2 Cleaning

A. After installation, clean exposed surfaces in accordance with sign manufacturer's written instructions.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes:

1. Compact Laminate (Solid Phenolic) toilet compartments configured as toilet enclosures and urinal screens.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Section 102813 "Toilet Accessories" for toilet tissue dispensers, grab bars, and similar accessories mounted on toilet compartments.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for toilet compartments.

C. Shop Drawings: For toilet compartments.

1. Include plans, elevations, sections, details, and attachment details.

2. Show locations of centerlines of toilet fixtures.

3. Show locations of floor drains.

D. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:

1. Each type of material, color, and finish required for toilet compartments, prepared on 6-inch- square Samples of same thickness and material indicated for Work.

2. Each type of hardware and accessory.

E. Product Schedule: For toilet compartments, prepared by or under the supervision of supplier, detailing location and selected colors for toilet compartment material.

F. Sustainability Submittals: Provide the following in accordance with Sustainability Requirements: Division 01.

1. Materials Sustainability Documentation Form.

2. Product data, certification letter, and costs for materials with recycled content.

G. Product Certificates: For each type of toilet compartment.

H. Maintenance Data: For toilet compartments to include in maintenance manuals.

I. Maintenance Material Submittals:

1. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

a. Door Hinges: Two hinge(s) with associated fasteners.
b. Latch and Keeper: Two latch(es) and keeper(s) with associated fasteners.
c. Door Bumper: Two door bumper(s) with associated fasteners.
d. Door Pull: Two door pull(s) with associated fasteners.
e. Fasteners: Ten fasteners of each size and type.

1.4 Warranty

A. Manufacturer's standard 25 year limited warranty for panels, doors, and stiles against breakage, corrosion, delamination and defects in factory workmanship.

1.5 Project Conditions

A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

Part 2 Products

2.1 Performance Requirements

A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 30 or less.

2. Smoke-Developed Index: 55 or less.

B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for toilet compartments designated as accessible.

2.2 Compact Laminate (Solid Phenolic) Toilet Compartments

A. Basis of Design: Bobrick DuraLine Series with Plastic Laminate “Microdot” finish by Formica. Gap-free interlocking or other privacy solution required. Equivalent products by Bradley or Global and will be considered as substitutions.

B. Toilet-Enclosure Style: Floor-mounted and overhead braced.

C. Urinal-Screen Style: Floor anchored.

D. Door, Panel**,** Screen, and Pilaster Construction: One-piece, compact laminate laminated to solid phenolic core material without splices or joints in facings or cores. Provide with no-sightline system.

1. Core Material: solid phenolic.

2. Doors and Panels: Finished to not less than 1 inch thick.

3. Edges: Black.

4. Stiles: Floor-anchored stiles with expansion shields and threaded rods.

E. Pilaster Shoes and Sleeves (Caps): one-piece 22 gauge stainless-steel and 4 inches high, finished to match hardware.

F. Urinal-Screen Post: Manufacturer's standard post design of material matching the thickness and construction of pilasters or 1-3/4-inch- square, aluminum tube with satin finish 1-1/4-inch- square, stainless-steel tube 0.050 inch thick with satin finish.

G. Brackets (Fittings):

1. Stirrup Type: continuous full height, stainless steel.

2.3 Hardware And Accessories (Refer To Drawings For Locations Of Accessories)

A. Hardware and Accessories: Manufacturer's full height brackets and operating hardware and accessories.

1. Material: Stainless steel.

2. Hinges: Manufacturer's standard paired, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees, allowing emergency access by lifting door.

3. Latch and Keeper: Manufacturer's standard recessed latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.

4. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.

5. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.

6. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.

B. Anchorages and Fasteners: Manufacturer's f exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless-steel, hot-dip galvanized-steel, or other rust-resistant, protective-coated steel anchors compatible with related materials.

2.4 Materials

A. Particleboard: Solidly fused plastic laminate with matte finished melamine surfaces; integrally bonded color face sheets and black phenolic-resin core**.**

B. Adhesives: Manufacturer's standard product**.**

C. Aluminum Castings: ASTM B 26/B 26M.

D. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.

E. Stainless-Steel Castings: ASTM A 743/A 743M.

2.5 Fabrication

A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.

B. Floor-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.

C. Urinal-Screen Posts: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at tops and bottoms of posts. Provide shoes and sleeves (caps) at posts to conceal anchorage.

D. Door Size and Swings: Unless otherwise indicated, provide 24-inch- wide in-swinging doors for standard toilet compartments and 36-inch- wide out-swinging doors with a minimum 32-inch- wide clear opening for compartments designated as accessible.

Part 3 Execution

3.1 Examination

A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.

1. Confirm location and adequacy of blocking and supports required for installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 Installation

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

1. Maximum Clearances:

a. Pilasters and Panels: 1/2 inch.
b. Panels and Walls: 1 inch.

2. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than three brackets attached at midpoint and near top and bottom of panel.

a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
b. Align brackets at pilasters with brackets at walls.

B. Floor-Anchored Units: Set pilasters with anchors penetrating not less than 2 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Level, plumb, and tighten pilasters. Hang doors and adjust so tops of doors are level with tops of pilasters when doors are in closed position.

C. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.3 Adjusting

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Toilet accessories.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Tile: Division 09.

C. Compact Laminate (Solid Phenolic) Toilet Compartments: Division 10.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Product Data: For each accessory for approval.

C. Quality Control Procedures: Schedules of Toilet Accessories showing quantity and location for each room or area.

D. Sustainability Submittals: Provide the following in accordance with Sustainability Requirements: Division 01.

1. Materials Sustainability Documentation Form.

2. Product data, certification letter, and costs for materials with recycled content.

3. Product data and costs for regional materials.

1.4 Quality Assurance

A. Installer's Qualifications: Not less than five (5) years documented, successful experience with Work comparable to Work of this Project.

1.5 Delivery, Handling And Storage

A. Accessories to be delivered by the Owner in carefully packed containers, each complete with required fasteners and miscellaneous devices. Handle with care. Label each container indicating type, floor and space designation, brand name of manufacturer. Mirrors shall be factory labeled and labels shall not be removed until installation has been approved.

1.6 Handicap Accessories

A. Items shall comply with ANSI 117.1 ADA rules and regulations.

Part 2 Products

2.1 Approved Manufacturers

A. Products of Bobrick Washroom Equipment, Inc. are used to establish desired quality and performance of Work. Equivalent products of A & J Washroom Accessories Inc. and American Specialties, Inc. (ASI) may be provided. See Drawings for types and locations.

B. Dyson Air Blades are basis off design and listed in Alternates sections. Basis of design bid product shall be Xlerator Hand Dryer. Equivalent products may be submitted per directions in Division 01 for evaluation.

2.2 Required Products

A. Refer to Toilet Accessory Schedule on Drawings for list of Products and Requirements.

Part 3 Execution

3.1 Coordination

A. Cooperate in scheduling and coordination of Work with other Sections.

B. Templates: Furnish templates to respective trades for locations and clearances required in rough framing in connection with installation of recessed accessory fixtures. Templates for location of mounting holes (standard and metric dimensions) for toilet tissue dispensers and folding utility shelves and other accessories shall be furnished to toilet partition manufacturer.

3.2 Installation

A. Install accessories on provided wood grounds and frames for both recessed and surface mounting. Installation shall be in accordance with written instructions of product manufacturer and as approved by Owner's Representative. Anchorage in masonry shall be with expansion shields or toggles, as conditions require, and with lead plugs in tile and mortar. Wood plugs are not acceptable. Location of accessories to be used by handicapped shall be in accordance with applicable rules and regulations for handicapped.

B. Units with rough or jagged edges or corners are not acceptable.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Fire extinguishers, cabinets, fasteners and all required accessories complete as indicated.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Firestopping: Division 07, refer to for firestopping at fire rated cabinets.

C. Gypsum Board Assemblies: Division 09, refer to for cabinet framing and cutout.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Product Data: Show construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire-protection specialties.

1. Fire Extinguishers: Include rating and classification.

2. Cabinets: Include door hardware, cabinet type, trim style, panel style, and details of installation. Include written certification that submitted fire extinguisher cabinets will conform to required fire ratings an accommodate specified fire extinguishers.

3. Show location of knockouts for hose valves.

C. Samples: For each exposed cabinet finish.

D. Certifications: Extinguishers full and operational.

E. Sustainability Submittals: Provide the following in accordance with Sustainability Requirements: Division 01.

1. Materials Sustainability Documentation Form.

2. Product data, certification letter, and costs for materials with recycled content.

3. Product data and costs for regional materials.

1.4 Quality Assurance

A. Regulatory Agencies and Codes: Comply with Codes as referenced below.

B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Standard for Portable Fire Extinguishers."

C. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent Inspection and Testing Agency acceptable to authorities having jurisdiction.

1.5 Coordination

A. Coordinate size of cabinets to ensure that type and capacity of hoses, hose valves, and hose racks indicated are accommodated.

Part 2 Products

2.1 Fire Extinguisher Cabinets

A. Approved Manufacturers: Products of indicated manufacturers are acceptable. Equivalent products of other manufacturers will be evaluated as substitutions in accordance with requirements of Division 01.

1. Larsen's Manufacturing Company.
2. J. L. Industries, Inc.
3. Potter-Roemer, Inc.

B. Provide fire extinguisher cabinets for the following types of portable fire extinguishers:

1. Class ABC multi-purpose dry chemical type.

C. Box:

1. Mounting: Partially-recessed where furred walls are provided and surface mount otherwise.
2. Material: 20 gauge cold-rolled steel, with #4 stainless steel finish.

D. Doors and Trim:

1. Material: 20 gauge cold rolled steel, with #4 stainless steel finish with square trim.
2. Door Style: Vertical Duo.
3. Glass: Manufacturers standard 1/4 inch acrylic.
4. Lettering; Die cut applied letters.
    a. Style: Vertical.
    b. Color: Black.
    c. Handle: Manufacturers standard.

E. Hose Valve Cabinets: Match extinguisher cabinets.

2.2 Fire Extinguishers

A. Approved Manufacturers: Manufacturers and products as follows are acceptable. Equivalent products of other manufacturers will be evaluated as substitutions in accordance with requirements of Division 01.

1. Walter Kidde Company.
2. J. L. Industries, Inc.
3. Larsen's Manufacturing Company.
4. Potter-Roemer, Inc.

B. Provide extinguishers that do not contain ozone-depleting substances such as CFCs, HCFCs, or Halons.

C. Dry Chemical Multi-Purpose Type:

1. Provide Class 2 A: UL listed and FMG Global approved multi-purpose dry chemical stored pressure fire extinguishers.

3. Extinguishers shall be equipped with cylinder with pressure gauge, carrying handle, locking ring pin, squeeze-grip discharge lever, siphon tube, hose, discharge horn and mounting bracket. Finish shall be red enamel

4. Capacity: 10 pounds.

3. Provide stainless steel cylinder with pressure gauge, carrying handle, locking ring pin, squeeze-grip discharge lever, siphon tube, discharge nozzle and mounting bracket.

E. Provide manufacturer's standard wall brackets for wall mounted fire extinguishers.

Part 3 Execution

3.1 Examination

A. Examine roughing-in for hose valves, hose racks, and cabinets to verify locations of piping connections before cabinet installation.

B. Examine walls and partitions for suitable framing depth and blocking where recessed and semirecessed cabinets are to be installed.

C. Examine fire extinguishers for proper charging and tagging. Remove and replace damaged, defective, or undercharged units.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 Installation

A. General: Comply with manufacturer's written instructions for installing fire-protection specialties.

B. Install fire extinguishers and cabinets where indicated and in accordance with manufacturer's written instructions. Handle of extinguisher shall be a maximum of 54 inches above finished floor.

C. Install in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.

1. Prepare recesses for cabinets as required by type and size of cabinet and trim style.

2. Fasten mounting brackets to structure and cabinets, square and plumb.

3. Fasten cabinets to structure, square and plumb.

D. Maintain extinguishers in fully charged condition, and certify in writing they are fully charged and operational when Work is accepted.

3.3 Installation Of Fire Rated Extinguisher Cabinets And Hose Or Valve Cabinets

A. General: Install fire rated cabinets in accordance with manufacturer’s written installation instructions.

B. Install fire rated cabinets with not more than 1/16 inch tolerance between pipe outside diameter and knockout outside diameter. Center pipe within knockout.

C. Seal through-penetrations with firestopping sealant specified in Firestopping: Division 07.

3.4 Adjusting, Cleaning And Protection

A. Adjust cabinet doors that do not swing or operate freely.

B. Refinish or replace cabinets and doors damaged during installation.

C. Provide final protection and maintain conditions that ensure that cabinets and doors are without damage or deterioration at Date of Substantial Completion.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Residential appliances complete as indicated.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Finish Carpentry: Division 06.

C. Architectural Woodwork: Division 06.

D. Mechanical and Electrical: Divisions 23 and 26, refer to for roughing-in of water, drain, electrical and ventilating services.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Product Data: To Design Professional for approval. Describing in detail appliances proposed for use.

1.4 Quality Assurance

A. Electrical appliances shall bear UL labels.

B. Energy Star Appliances: Provide appliances that bear the ENERGY STAR label and meet the ENERGY STAR specifications for energy efficiency, where applicable.

C. Coordinate installation of appliances with cabinetwork.

1.5 Delivery, Handling And Storage

A. Deliver appliances to Project Site in manufacturer's shipping cartons. Handle with care. Store appliances in cartons until ready for installation.

1.6 Warranty

A. Provide manufacturer’s standard Warranty but not less than one (1) year Project Warranty.

1.7 Service Contract

A. Furnish one (1) year Service Contract on equipment from Date of Acceptance, with Owner’s option to extend.

Part 2 Products

2.1 Approved Manufacturers

A. Manufacturers and products as indicated are acceptable. Equivalent products of other manufacturers will be evaluated as substitutions in accordance with requirements of Division 01. Refrigerator and Ice maker finishes shall match.

2.2 Kitchen Equipment

A. Energy Star under Counter Ice Maker:

1. UADA151MS00A manufactured by U-line in stainless steel with reversible handle.

B. Microwave Ovens: By Owner.

C. Coffee Maker: By Owner.

D. Energy Star Rated Refrigerator:

1. WRT318F2DM manufactured by Whirlpool 18.2 cubic feet in stainless steel with left hand door.

Part 3 Execution

3.1 Installation

A. Verify accuracy of dimensions indicated for openings in casework to receive appliances.

B. Verify location of roughing-in of utility services.

C. Set appliances in place, connect to utilities and check for proper operation.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Horizontal louver blinds and accessories complete as indicated.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Samples: Showing full color range for selection and approval.

Part 2 Products

2.1 Approved Manufacturers

A. Products of manufacturers as follows are specified to establish desired quality and performance of Work. Equivalent products of other manufacturers will be evaluated as substitutions in accordance with requirements of Division 01.

1. Hunter Douglas:

a. CL62 1” slats in brushed aluminum 065 finish.

2.2 Finish

A. Manufacturer's standard baked enamel on exposed aluminum parts. Colors shall be as selected by Design Professional from manufacturer's standards. Cords and tapes to be color coordinated with selected color.

2.3 Tilt Control

A. Wand type of transparent plastic. Full tilt.

B. Standard Cord Lock.

2.4 Slat Supports

A. Braided polyester yarn, 0.045 inch to 0.066 inch diameter.

2.5 Brackets

A. Manufacturer's standard. Provide intermediate brackets for blinds over 55 inches wide.

2.6 Lifting Mechanism

A. Non-corrosive, self-lubricating.

2.7 Cord Lock

A. Non-corrosive.

Part 3 Execution

3.1 Installation

A. Install Work in accordance with manufacturer's written instructions.

B. Provide adequate clearance to permit unencumbered operation.

C. Make required adjustments.

3.2 Cleaning

A. Clean soiled surfaces using products and methods in accordance with blind manufacturer's written recommendations.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: stainless Steel grate with frames.

1. Recess positioned.

B. Products Furnished But Not Installed Under This Section:

1. Cast-In-Place Concrete: Division 03, refer to for recess installation of mat frame in floor.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Concrete Accessories: Division 03.

C. Cast-In-Place Concrete: Division 03, refer to for floor depression formed without frame.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Shop Drawings: Show layout and types of grates and frames not less than half-scale sections of typical installations, anchors, and accessories, and field measurements of slab recess to receive frames grates.

C. Samples: Full color range Samples for selection by Design Professional.

D. Closeout Submittals:

1. Maintenance Data: Include cleaning instructions and stain removal procedures.

2. Warranty: As indicated.

E. Sustainability Submittals: Provide the following in accordance with Sustainability Requirements: Division 01.

1. Materials Sustainability Documentation Form.

2. Product data, certification letter, and costs for materials with recycled content.

3. Product data and costs for regional materials.

1.4 Warranty

A. Manufacturer's standard one (1) year Warranty from Date of Substantial Completion.

Part 2 Products

2.1 Approved Manufacturers

A. Products of Construction Specialties, Inc. are indicated to establish desired quality and performance of Work. Equivalent products of other manufacturers will be evaluated as substitutions in accordance with requirements of Division 01.

2.2 Materials

A. Stainless steel: extruded 6105-T5 aluminum.

1. Rolling Load: 1000 lbs/wheel.

2. Uniform Load: 1000 lbs/sq. ft.

2.3 Model And Description

A. Floor Mat:

1. Basis of Design: G4 Peditred by Construction Specialties, Inc.: extruded aluminum per ASTM B 221, Level Base frame with 1" deep recess.

   a. Construction: extruded 6105-T5 aluminum alloy with 3/4" deep tread rails joined by an EPDM hinge and cushion to compromise the overall grid length (traffic direction). The hinge shall be complete with perforations between each tread rail for drainage, unless otherwise specified
   b. Fasteners: Non-corrosive screws and anchors for securing frames together and to floors.
   c. Rail finish shall be aluminum.

2. Recessed Frame: 1" deep recessed frame in 6063-T6 aluminum alloy with a 1/4"wide exposed surface. Black EPDM filler trims shall be furnished as required, when standard 1 1/2" tread spacing cannot be maintained.

   a. Rail finish shall be aluminum.

3. Underlayment Leveling Grout: As approved in writing by mat manufacturer.

4. Tread Insert: MonoTuft HD™ Carpet shall meet CRI standard for good indoor air quality. Fibers shall include a minimum of 100, 12 mil monofilament fibers per square inch. Available in one of 21 standard colors as offered by manufacturer. Each carpet fiber and monofilament shall be fusion-bonded to a rigid two-ply backing to prevent fraying and supplied in continuous splice free lengths. Anti-static carpet fibers shall contain antimicrobial additive and be treated with Scotchgard® to reduce soiling. Carpet weight shall be 33-oz./yd².

   a. Insert color shall be Wrought Iron.

2.4 Fabrication

A. Construct recessed mat frames square, with tight, rigid mitered corner joints. Coat surfaces with protective coating where in contact with cementitious materials.

B. Fabricate in shop to greatest extend possible. Provide single mat for each location. Where joints are necessary, space symmetrically and away from normal traffic lanes. Verify sizes by field measurement before shop fabrication.

Part 3 Execution

3.1 Examination

A. Verify that floor openings are ready to receive Work.

B. Verify field measurements are as indicated on Shop Drawings.

C. Beginning of installation means acceptance of existing conditions.

3.2 Preparation

A. Furnish mat frames to concrete trades for installation. Include accessories and written installation instructions.

B. Install underlayment leveling grout as required to provide proper depth for mat installation.

C. Verify size of floor recess before cutting and fabricating mats.

D. Vacuum clean floor recess.

3.3 Installation

A. Install mats in floor recess flush with finish floor after final cleaning of finish flooring.

3.4 Tolerances

A. Maximum Gap Allowed between Recessed Frame and Mat: 1/8 inch maximum at each side.

END

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 work of this section.

B. The following related items of work are included under other Sections:

1. Trenching, Backfilling, and Compaction
2. Roadways, Drives, Sidewalks, Curb and Gutter Patching
3. Concrete

1.2 Summary

A. The work required under this section consists of furnishing all labor, materials, equipment, services and related items necessary to supply and install Site Furnishings, and all related work, complete, as indicated on the drawings or specified herein.

B. Major items of work include, but are not limited to, supplying and installing:

1. Litter receptacles
2. Benches
3. Bicycle racks

1.3 Quality Assurance

A. Manufacturer Qualifications: Manufacturer with 10-years experience in production of specified products.

B. Installer Qualifications: Installer shall be a firm having a minimum of five (5) years successful experience in the installation of Site Furnishings, Structures, and Surfaces similar to the size, scope and complexity of this project as shown and specified and who can demonstrate said experience through documented references.

1.4 Submittals:

A. Manufacturer's Data & Shop Drawings

B. Submit fabrication data, shop drawings and/or catalogue cuts for each manufactured site furnishing specified

C. Submit color and material samples.

D. Submit recommended maintenance manual.

E. Shop drawings shall include, but not be limited to, depicting all materials and fastening methods in sizes and relationships as shown. All elevations shall be prepared at not less than 1/2" = 1'-0" and all details at not less than 3" = 1'-0".

F. Submit shop drawings for all custom site furnishings and structures specified or illustrated on the drawings, for approval prior to fabrication.

1.5 Coordination:

A. Coordinate and cooperate with other Contractors to enable the work to proceed as rapidly and efficiently as possible.

B. Before any work is started, a conference shall be held between the Contractor and the Owner concerning the work under this Contract.

1.6 Substitution And Rejection:

A. The Owner reserves the right to reject material or work which does not conform to the Contract Documents. Rejected work shall be removed or corrected at the earliest possible time.

1.7 Protection:

A. The Contractor shall be responsible for work until finally inspected and accepted. After delivery and before and after installation, protect work against theft, injury or damage.

B. The Contractor shall protect work, equipment and material of all other trades from damage that might be caused by this work or workmen and shall pay for all such damage, should it occur.

Part 2 Products

2.1 General

A. All Site Furnishings shall be new and in perfect condition. After award of the Contract, and prior to beginning the work, the Contractor shall submit for approval, two copies of the complete list of materials which he proposes to install. Quantities of materials and equipment need not be included. Deviations from the specifications shall not be allowed.

2.2 Materials

A. Basis of Design selections for benches, litter receptacles and bicycle racks are indicated on the drawings.

Part 3 Execution

3.1 Inspection

A. Examine the subgrade, finished surfaces and installation conditions. Do not commence work until all unsatisfactory conditions are corrected.

3.2 Laying Out The Work

A. The trade performing the work of this section assumes full and sole responsibility for the accuracy and correctness of all layouts, lines, levels, grades and other aspects of the work under this section. Layout all work in accordance with the requirements, therefore, as indicated in the drawings.

3.3 Installation

A. Locate all site furnishings where indicated on the drawings and attach as detailed on the drawings and as elaborated upon in the specifications and in conformance with manufacturer's recommendation.

B. Any item locations not specifically detailed in the Contract Documents shall be located at the direction of the Landscape Architect.

C. Clean and touch-up paint all abraded, welded and scratched surfaces with matching paint provided by each site furnishing and structure manufacturer.

3.4 Cleaning:

A. Perform cleaning during installation of the work and upon completion of the work.

B. Remove from the project site and excess material and equipment at the completion of the work of this section.

C. Repair damage resulting from Site Furnishing and Structure installation work.

END

Part 1 General

1.1 Summary (Non-inclusive)

A. Section Includes: Hydraulic passenger elevators.

1.2 Related Work Specified Elsewhere (Non-inclusive)

A. Applicable Sections: Division 01.

B. Construction Facilities: Section 015200, for temporary use of elevators for construction purposes.

C. Cast-in-Place Concrete: Section 033000, for setting sleeves, inserts, and anchoring devices in concrete.

D. Metal Fabrications: Section 055000, for the following:

1. Attachment plates and angle brackets for supporting guide-rail brackets.
2. Hoist beams.
3. Structural-steel shapes for subsills.
4. Pit ladders.
5. Cants made from steel sheet in hoistways.

E. Sump Pumps: Section 221429, for sump pumps, sumps, and sump covers in elevator pits.

F. Data Communications Horizontal Cabling: Section 271519, for telephone service for elevators.

G. Digital, Addressable Fire-Alarm System: Section 283111, for smoke detectors in elevator lobbies to initiate emergency recall operation.

H. Car wall finishes, including trim.

I. Car floor finishes.

J. Car ceiling finishes.

K. Car door finishes.

L. Hoistway door and frame finishes.

M. Car light fixtures.

N. Handrails.

O. Cutouts and other provisions for installing elevator signal equipment in cars.

1.3 Submittals

A. Submit per the requirements of Division 01.

B. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information. Include product data for car enclosures; hoistway entrances; and operation, control, and signal systems.

C. Shop Drawings:

1. Include plans, elevations, sections, and large-scale details indicating service at each landing; machine layout; coordination with building structure; relationships with other construction; and locations of equipment.

2. Indicate maximum dynamic and static loads imposed on building structure at points of support as well as maximum and average power demands.

D. Samples for Initial Selection: For finishes involving color selection.

E. Samples for Verification: For exposed car, hoistway door and frame, and signal equipment finishes, 3-inch- square Samples of sheet materials and 4-inch lengths of running trim members.

F. Qualification Data: For Installer.

G. Manufacturer Certificates: Signed by elevator manufacturer, certifying that hoistway, pit, and machine layout and dimensions, as shown on Drawings, and electrical serviceas shown and specified, are adequate for elevator system being provided.

H. Sample Warranty: For special warranty.

I. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.

1. Usually delete option in subparagraph below for projects where Owner's staff does not maintain elevators; retaining increases cost of elevators.

2. Submit manufacturer's/installer's standard operation and maintenance manual, in accordance with ASME A17.1/CSA B44 including diagnostic and repair information available to manufacturer's and Installer's maintenance personnel.

J. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.

K. Continuing Maintenance Proposal: Submit a continuing maintenance proposal from Installer to Owner, in the form of a standard one-year maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

L. Sustainability Submittals: Provide the following in accordance with Sustainability Requirements: Division 01.

1. Materials Sustainability Documentation Form.

2. Product data, certification letter, and costs for materials with recycled content.

3. Product data and costs for regional materials.

1.4 Definitions

A. Definitions in ASME A17.1/CSA B44 apply to work of this Section.

1.5 Quality Assurance

A. Installer Qualifications: Elevator manufacturer or an authorized representative who is trained and approved by manufacturer.

1.6 Delivery, Storage, And Handling

A. Deliver, store, and handle materials, components and equipment in manufacturer's protective packaging. Store materials, components, and equipment off of ground, under cover, and in a dry location.

1.7 Coordination

A. Coordinate installation of sleeves, block outs, elevator equipment with integral anchors, and other items that are embedded in concrete or masonry for elevator equipment. Furnish templates, sleeves, elevator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.

B. Coordinate locations and dimensions of other work specified in other Sections that relates to hydraulic elevators, including pit ladders; sumps and floor drains in pits; entrance subsills; electrical service; and electrical outlets, lights, and switches in hoistways, pits, and machine rooms.

1.8 Warranty

A. Manufacturer's Special Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.

2. Warranty Period: 1 year(s) from date of Substantial Completion.

Part 2 Products

2.1 Manufacturers

A. Otis.

B. ThyssenKrupp.

C. Kone.

D. Schindler.

2.2 Performance Requirements

A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.

B. Accessibility Requirements: Comply with Section 407 in the United States Access Board's ADA-ABA Accessibility Guidelines and with ICC A117.1.

2.3 Elevators

A. Elevator System, General: Manufacturer's standard elevator systems. Unless otherwise indicated, manufacturers' standard components shall be used, as included in standard elevator systems and as required for complete system.

B. Elevator Description:

1. Elevator Number(s): 1.

2. Type: Holeless, beside-the-car, telescoping, single or dual cylinder.

3. Rated Load: 3500 lb.

4. Rated Speed: 100 fpm.

5. Operation System: Single automatic.

6. Auxiliary Operations:

    a. Battery-powered lowering.
    b. Automatic operation of lights and ventilation fans.

7. Car Enclosures to accommodate stretcher requirements:

    a. Inside Width: 80 inches from side wall to side wall to accommodate stretcher.
    b. Inside Depth: 64-1/2 from back wall to front wall (return panels) to accommodate stretcher.
    c. Inside Height: Not less than 93 inches to underside of ceiling.
    d. Front Walls (Return Panels): Satin stainless steel, No. 4 finish with integral car door frames.
    e. Side and Rear Wall Panels: Satin stainless steel, No. 4 finish.
    f. Reveals: Satin stainless steel, No. 4 finish.
    g. Door Faces (Interior): Satin stainless steel, No. 4 finish.
    h. Door Sills: Aluminum.
    i. Ceiling: Satin stainless steel, No. 4 finish.
    j. Handrails: 1/2 by 2 inches (13 by 50 mm) rectangular satin stainless steel, No. 4 finish, at rear of car.
    k. Floor: carpet as specified.
    l. Floor prepared to receive carpet (specified in Section 096813 "Tile Carpeting").

8. Hoistway Entrances:

    a. Width: 42 inches.
    b. Height: 84 inches.
    c. Type: Two-speed center opening.
    d. Frames: Satin stainless steel, No. 4 finish.
    e. Doors: Satin stainless steel, No. 4 finish.
    f. Sills: Aluminum.

9. Hall Fixtures: Satin stainless steel, No. 4 finish.

10. Additional Requirements:

    a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from satin stainless steel, No. 4 finish.
    b. Provide hooks for protective pads in and one complete set(s) of full-height protective pads.

2.4 Systems And Components

A. Pump Units: Positive-displacement type with a maximum of 10 percent variation between no load and full load and with minimum pulsations.

1. Pump shall be submersible type with submersible squirrel-cage induction motor, and shall be suspended inside oil tank from vibration isolation mounts.

2. Motor shall have solid-state starting.

3. Motor shall have variable-voltage, variable-frequency control.

B. Hydraulic Silencers: System shall have hydraulic silencer containing pulsation-absorbing material in blowout-proof housing at pump unit.

C. Piping: Size, type, and weight of piping as recommended by elevator manufacturer, with flexible connectors to minimize sound and vibration transmissions from power unit.

1. Cylinder units shall be connected with dielectric couplings.

2. Casing for Underground Piping: Schedule 40 PVC pipe complying with ASTM D 1785, joined with PVC fittings complying with ASTM D 2466 and solvent cement complying with ASTM D 2564.

D. Hydraulic Fluid: Elevator manufacturer's standard fluid with additives as needed to prevent oxidation of fluid, corrosion of cylinder and other components, and other adverse effects.

E. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work. Device installation is specified in another Section.

F. Car Frame and Platform: Welded steel units.

G. Guides: Roller guides, Polymer-coated, nonlubricated sliding guides or sliding guides with guide-rail lubricators. Provide guides at top and bottom of car frame.

2.5 Operation Systems

A. General: Provide manufacturer's standard microprocessor operation system as required to provide type of operation indicated.

B. Auxiliary Operations:

1. Single-Car Battery-Powered Lowering: When power fails, car is lowered to the lowest floor, opens its doors, and shuts down. System includes rechargeable battery and automatic recharging system.

2. Nuisance Call Cancel: When car calls exceed a preset number while car load is less than a predetermined weight, all car calls are canceled. Preset number of calls and predetermined weight can be adjusted.

3. Automatic Operation of Lights and Fan: When elevator is stopped and unoccupied with doors closed, lighting, ventilation fan, and cab displays are de-energized after 5 minutes and are re-energized before car doors open.

4. Car-to-Lobby Feature: Feature, activated by keyswitch at main lobby, that causes car to return immediately to lobby and open doors for inspection. On deactivation by keyswitch, calls registered before keyswitch activation are completed and normal operation is resumed.

2.6 Door-Reopening Devices

A. Infrared Array: Provide door-reopening device with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more light beams shall cause doors to stop and reopen.

B. Nudging Feature: After car doors are prevented from closing for predetermined adjustable time, through activating door-reopening device, a loud buzzer shall sound and doors shall begin to close at reduced kinetic energy.

2.7 Car Enclosures

A. General: Provide steel-framed car enclosures with nonremovable wall panels, with removable car roof, access doors, power door operators, and ventilation.

1. Provide standard railings complying with ASME A17.1/CSA B44 on car tops where required by ASME A17.1/CSA B44.

B. Materials and Finishes: Manufacturer's standards, but not less than the following:

1. Subfloor: Exterior, underlayment-grade plywood, not less than 5/8-inch nominal thickness.

2. Floor Finish: carpet tile as specified in finish schedule.

3. Stainless-Steel Wall Panels: Flush, formed-metal construction; fabricated from stainless-steel sheet.

4. Stainless-Steel Doors: Flush, hollow-metal construction; fabricated from stainless-steel sheet.

5. Sight Guards: Provide sight guards on car doors.

6. Sills: Extruded or machined metal, with grooved surface, 1/4 inch thick.

7. Metal Ceiling: Flush stainless-steel panels, with four low-voltage downlights in each panel.

8. Light Fixture Efficiency: Not less than 35 lumens/W.

9. Ventilation Fan Efficiency: Not less than 3.0 cfm/W

2.8 Hoistway Entrances

A. Hoistway Entrance Assemblies: Manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Frame size and profile shall accommodate hoistway wall construction.

1. Where gypsum board wall construction is indicated, frames shall be self-supporting with reinforced head sections.

B. Fire-Rated Hoistway Entrance Assemblies: Door-and-frame assemblies shall comply with NFPA 80 and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction based on testing at as close-to-neutral pressure as possible according to NFPA 252

1. Fire-Protection Rating: 1 hour

C. Materials and Fabrication: Manufacturer's standards, but not less than the following:

1. Stainless-Steel Frames: Formed from stainless-steel sheet.

2. Stainless-Steel Doors: Flush, hollow-metal construction; fabricated from stainless-steel sheet.

3. Sight Guards: Provide sight guards on doors matching door edges.

4. Sills: Extruded or machined metal, with grooved surface, 1/4 inch thick.

5. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M.

2.9 Signal Equipment

A. General: Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Provide vandal-resistant buttons and lighted elements illuminated with LEDs.

B. Swing-Return Car-Control Stations: Provide car-control stations mounted on rear of hinged return panel adjacent to car door and with buttons, switches, controls, and indicator lights projecting through return panel but substantially flush with face of return panel.

1. Mark buttons and switches for function. Use both tactile symbols and Braille.

2. Provide "No Smoking" sign matching car-control station, either integral with car-control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.

C. Emergency Communication System: Two-way voice communication system, with visible signal, which dials preprogrammed number of monitoring station and does not require handset use. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.

D. Car Position Indicator: None.

E. Hall Push-Button Stations: Provide one hall push-button station at each landing.

1. Provide units with flat faceplate for mounting with body of unit recessed in elevator door frame.

2. Provide telephone jack in each unit for firefighters' two-way telephone communication service.

F. Hall Lanterns: None.

G. Hall Annunciator: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.

1. Audible signals may be placed on cars.

H. Emergency Pictorial Signs: Fabricate from materials matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire, elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station unless otherwise indicated.

2.10 Finish Materials

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.

B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, commercial steel, Type B, pickled.

C. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.

D. Stainless-Steel Bars: ASTM A 276, Type 304.

E. Stainless-Steel Tubing: ASTM A 554, Grade MT 304.

F. Aluminum Extrusions: ASTM B 221, Alloy 6063.

Part 3 Execution

3.1 Examination

A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Verify critical dimensions and examine supporting structure and other conditions under which elevator work is to be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 Installation

A. Install cylinder plumb and accurately centered for elevator car position and travel. Anchor securely in place, supported at pit floor and braced at intervals as needed to maintain alignment. Anchor cylinder guides at spacing needed to maintain alignment and avoid overstressing guides.

B. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS workmanship and welding operator qualification standards.

C. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts to minimize vibration transmission to structure and structure-borne noise due to elevator system.

D. Install piping above the floor, where possible. Install underground piping in casing.

E. Lubricate operating parts of systems as recommended by manufacturers.

F. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay installation of sills and frames until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.

G. Leveling Tolerance: 1/4 inch, up or down, regardless of load and travel direction.

H. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.

3.3 Field Quality Control

A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.

B. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times that tests are to be performed on elevators.

3.4 Protection

A. Temporary Use: Comply with the following requirements for elevator used for construction purposes:

1. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.

2. Provide strippable protective film on entrance and car doors and frames.

3. Provide padded wood bumpers on entrance door frames covering jambs and frame faces.

4. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.

5. Do not load elevators beyond their rated weight capacity.

6. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleanup, and adjustment as necessary for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

7. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

3.5 Demonstration

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate**,** adjust, and maintain elevator(s).

B. Check operation of elevator with Owner's personnel present before date of Substantial Completion and again not more than one month before end of warranty period. Determine that operation systems and devices are functioning properly.

3.6 Maintenance

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

1. Perform maintenance during normal working hours.

2. Perform emergency callback service during normal working hours with response time of two hours or less.

END

SECTION 210517 - SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING

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. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SLEEVES

A. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

B. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

C. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.2 STACK-SLEEVE FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Jay R. Smith Mfg. Co.
2. Zurn Industries, LLC.

B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. GPT; an EnPro Industries company.
4. Metraflex Company (The).
5. Proco Products, Inc.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.4 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
   1. Cut sleeves to length for mounting flush with both surfaces.
      a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
   2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.
   1. Cut sleeves to length for mounting flush with both surfaces.
   2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
   3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."

E. 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 for firestopping specified in Section 078400 "Firestopping."

3.2 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.
   1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
   2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076000 "Flashing and Sheet Metal."
   3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
   4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
   5. Using grout, seal the space around outside of stack-sleeve fittings.

B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078400 "Firestopping."

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

END OF SECTION 210517

SECTION 210518 - ESCUTCHEONS FOR FIRE-SUPPRESSION PIPING

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. Escutcheons.
2. Floor plates.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

D. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.

E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed and exposed-rivet hinge, and spring-clip fasteners.

2.2 FLOOR PLATES

A. One-Piece Floor Plates: Cast-iron flange.

B. Split-Casting Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. Escutcheons for New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
b. Chrome-Plated Piping: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
c. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
g. Bare Piping in Equipment Rooms: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping: One-piece, floor-plate type.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 210518

SECTION 210523 - GENERAL-DUTY VALVES FOR WATER-BASED FIRE-SUPPRESSION PIPING

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. Two-piece ball valves with indicators.
2. Iron butterfly valves with indicators.
3. Check valves.
4. Iron OS&Y gate valves.
5. Trim and drain valves.

1.3 DEFINITIONS

A. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

B. NRS: Nonrising stem.

C. OS&Y: Outside screw and yoke.

D. SBR: Styrene-butadiene rubber.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, and weld ends.
3. Set valves open to minimize exposure of functional surfaces.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.

D. Protect flanges and specialties from moisture and dirt.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. UL Listed: Valves shall be listed in UL's "Online Certifications Directory" and shall bear UL mark.

B. FM Global Approved: Valves shall be listed in its "Approval Guide.

C. Source Limitations for Valves: Obtain valves for each valve type from single manufacturer.

D. ASME Compliance:

1. ASME B16.1 for flanges on iron valves.
2. ASME B1.20.1 for threads for threaded-end valves.
3. ASME B31.9 for building services piping valves.

E. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

F. NFPA Compliance: Comply with NFPA 24 for valves.

G. Valve Pressure Ratings: Not less than the minimum pressure rating indicated or higher as required by system pressures.

H. Valve Sizes: Same as upstream piping unless otherwise indicated.

I. Valve Actuator Types:

1. Worm-gear actuator with handwheel for quarter-turn valves, except for trim and drain valves.
2. Handwheel: For other than quarter-turn trim and drain valves.
3. Handlever: For quarter-turn trim and drain valves NPS 2 and smaller.

2.2 TWO-PIECE BALL VALVES WITH INDICATORS

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. NIBCO INC.
2. Victaulic Company.

B. Description:

1. UL 1091, except with ball instead of disc and FM Global standard for indicating valves (butterfly or ball type), Class Number 1112.
2. Minimum Pressure Rating: 175 psig.
3. Body Design: Two piece.
4. Body Material: Forged brass or bronze.
5. Port Size: Full or standard.
6. Seats: PTFE.
7. Stem: Bronze or stainless steel.
8. Ball: Chrome-plated brass.
9. Actuator: Worm gear or traveling nut.
10. End Connections for Valves NPS 1 through NPS 2: Threaded ends.
11. End Connections for Valves NPS 2-1/2: Grooved ends.

2.3 IRON BUTTERFLY VALVES WITH INDICATORS

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. Anvil International.
2. Kennedy Valve Company; a division of McWane, Inc.
3. NIBCO INC.
4. Tyco Fire & Building Products LP.
5. Victaulic Company.

B. Description:

1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball type), Class Number 112.
2. Minimum Pressure Rating: 175 psig.
3. Body Material: Cast or ductile iron with nylon, EPDM, epoxy, or polyamide coating.
4. Seat Material: EPDM.
5. Stem: Stainless steel.
6. Disc: Ductile iron, nickel plated and EPDM or SBR coated.
7. Actuator: Worm gear or traveling nut.
8. Supervisory Switch: Internal or external.
9. Body Design: Grooved-end connections.

2.4 CHECK VALVES

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. Anvil International.
2. Kennedy Valve Company; a division of McWane, Inc.
3. NIBCO INC.
4. Tyco Fire & Building Products LP.
5. Victaulic Company.
6. Viking Corporation.

B. Description:

1. Standard: UL 312 and FM Global standard for swing check valves, Class Number 1210.
2. Minimum Pressure Rating: 175 psig.
3. Type: Single swing check.
4. Body Material: Cast iron, ductile iron, or bronze.
5. Clapper: Bronze, ductile iron, or stainless steel.
6. Clapper Seat: Brass, bronze, or stainless steel.
7. Hinge Shaft: Bronze or stainless steel.
8. Hinge Spring: Stainless steel.
9. End Connections: Flanged, grooved, or threaded.

2.5 IRON OS&Y GATE VALVES

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. Clow Valve Company; a subsidiary of McWane, Inc.
2. Kennedy Valve Company; a division of McWane, Inc.
3. Mueller Co.
4. NIBCO INC.
5. Victaulic Company.

B. Description:

1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: 175 psig.
3. Body and Bonnet Material: Cast or ductile iron.
4. Wedge: Cast or ductile iron, or bronze with elastomeric coating.
5. Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.
6. Stem: Brass or bronze.
7. Packing: Non-asbestos PTFE.
8. End Connections: Flanged or Grooved.

2.6 TRIM AND DRAIN VALVES

A. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Fire-End & Croker Corporation.
b. NIBCO INC.
c. Potter Roemer LLC.
d. Tyco Fire & Building Products LP.
e. Victaulic Company.
f. Watts; a Watts Water Technologies company.

2. Description:

a. Pressure Rating: 175 psig.
b. Body Design: Two piece.
c. Body Material: Forged brass or bronze.
d. Port size: Full or standard.
e. Seats: PTFE.
f. Stem: Bronze or stainless steel.
g. Ball: Chrome-plated brass.
h. Actuator: Handlever.
i. End Connections for Valves NPS 1 through NPS 2-1/2: Threaded ends.
j. End Connections for Valves NPS 1-1/4 and NPS 2-1/2: Grooved ends.

B. Angle Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Fire Protection Products, Inc.
b. NIBCO INC.

2. Description:

a. Pressure Rating: 175 psig.
b. Body Material: Brass or bronze.
c. Ends: Threaded.
d. Stem: Bronze.
e. Disc: Bronze.
f. Packing: Asbestos free.
g. Handwheel: Malleable iron, bronze, or aluminum.

C. Globe Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. NIBCO INC.

2. Description:

a. Pressure Rating: 175 psig.
b. Body Material: Bronze with integral seat and screw-in bonnet.
c. Ends: Threaded.
d. Stem: Bronze.
e. Disc Holder and Nut: Bronze.
f. Disc Seat: Nitrile.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron, bronze, or aluminum.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 GENERAL REQUIREMENTS FOR VALVE INSTALLATION

A. Comply with requirements in the following Sections for specific valve installation requirements and applications:
1. Section 211313 "Wet-Pipe Sprinkler Systems" for application of valves in wet-pipe, fire-suppression sprinkler systems.
2. Section 211316 "Dry-Pipe Sprinkler Systems" for application of valves in dry-pipe, fire-suppression sprinkler systems.

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 valves in horizontal piping with stem at or above the pipe center.

D. Install valves in position to allow full stem movement.

E. Install valve tags. Comply NFPA standard applying to the piping system in which valves are installed. Install permanent identification signs indicating the portion of system controlled by each valve.

END OF SECTION 210523

SECTION 211100 - FACILITY FIRE-SUPPRESSION WATER-SERVICE PIPING

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 fire-suppression water-service piping and related components 5 feet outside the building and service entrance piping through floor into the building and the following:

1. Pipes, fittings, and specialties.

B. Related Requirements:

1. Section 331000 "Water Utilities" for site water piping extending 5 feet from the building and beyond.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with requirements of utility company supplying the water. Include tapping of water mains and backflow prevention.
2. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

C. Comply with FM Global's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.

D. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-suppression water-service piping.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

B. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

C. Protect flanges, fittings, and specialties from moisture and dirt.

PART 2 - PRODUCTS

2.1 DUCTILE-IRON PIPE AND FITTINGS

A. Ductile iron pipe, direct buried:

1. Provide ductile iron pipe conforming to the requirements of AWWA C151. The minimum thickness Class of pipe shall be Class 50, with standard thickness cement mortar lining interior, and interior asphaltic seal coat and exterior asphaltic coating, in accordance with AWWA and ANSI Standards.
2. Below Grade: Supply pipe in lengths not in excess of a nominal 20 feet with rubber ring type push-on joints, mechanical joint or approved restrained joint. Provide flange joint pipe where shown on the drawings. Provide mechanical and restrained joint pipe with sufficient quantities of accessories as required for each joint.
3. Polyethylene encasement over pipe, fittings, and valves is a requirement, the material, installation and workmanship shall conform to applicable sections of AWWA C105. Make provisions to keep the polyethylene from direct exposure to sunlight prior to installation. Backfill following installation without delay to avoid exposure to sunlight.

B. Ductile Iron Pipe Above Grade or in Below Ground Concrete Pits:

1. Flanged ductile iron pipe, AWWA C115, with factory applied screwed long hub flanges except as otherwise specified hereinafter. Face and drill flanges after being screwed on the pipe, with flanges true to 90 degrees with the pipe axis and flush with end of pipe, ANSI B16.1, 125 psi or 250 psi standard, for the purpose intended.
2. Wall Sleeve Castings: Size and types shown on the drawings and be hot dipped galvanized. Seal strips, where required shall be Link Seal as manufactured by Thunderline Corp., Wayne, Michigan or equal.
3. Pipe Thickness Class: Minimum of Class 53 as defined in AWWA C150 for all sizes of flanged pipe.
4. Rubber Ring Gaskets: Full face type, AWWA C111, 1/16 inch rubber ring gaskets and of approved composition suitable for the required service.

5. Pipe and fittings exposed to view in the finished work are to be painted in accordance with Section 099100, Painting. Pipe shall not receive the standard tar or asphalt coat on the outside surfaces but shall be shop primed on the outside with one coat of Kop-Coat No. 621 Rust Inhibitive Primer or equal. Paint color shall match the wall color.
6. Bolts and Nuts on Flanged Fittings: Grade B, ASTM A307. Low alloy, high strength steel in accordance with AWWA C111. Assemble stainless steel bolts and nuts using anti-seize compound to prevent galling.

C. All Pipe Fittings: Ductile iron with a minimum pressure rating of 350 psi. Fittings shall meet the requirements of ANSI and AWWA specifications as applicable. Rubber gasket joints shall conform to AWWA C111 for mechanical and push-on type joints. Ball joints shall conform to AWWA C151 with a separately cast ductile iron bell conforming to ASTM A148. Flanged fittings shall conform to AWWA C115 and be furnished flat faced and drilled to 125 psi or 250 psi template in accordance with ANSI B16.1 with full faced gaskets.

D. Provide cement mortar lining and bituminous seal coat on the inside of the pipe and fittings in accordance with AWWA C104. Provide standard asphaltic coating on the exterior.

E. Provide a factory hydrostatic test of not less than 500 psi for all pipe in accordance with AWWA C151.

F. Provide detectable adhesive backed identification tape on top and sides of all buried ductile iron pipe, extended from joint to joint along the length of the pipe and have black lettering identifying the pipe service at no more than 12 inch intervals. According to service, the tape background color shall be as follows: potable water-blue.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with excavating, trenching, and backfilling requirements in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. Water-Main Connection: Arrange with water utility company for tap of size and in location indicated in water main.

B. Comply with NFPA 24 for fire-service-main piping materials and installation.

C. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.

D. Extend fire-suppression water-service piping and connect to water-supply source and building fire-suppression water-service piping systems at locations and pipe sizes indicated.

1. Terminate fire-suppression water-service piping within the building at the floor slab until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building's fire-suppression water-service piping systems when those systems are installed.

E. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

F. Comply with requirements in Section 211313 "Wet-Pipe Sprinkler Systems," and Section 211316 "Dry-Pipe Sprinkler Systems" for fire-suppression-water piping inside the building.

G. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

H. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

3.3 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure rating same as or higher than systems pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in tubing NPS 2 and smaller.

C. Install flanges, flange adaptors, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of tubes and remove burrs.

E. Remove scale, slag, dirt, and debris from outside and inside of pipes, tubes, and fittings before assembly.

F. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.

G. Ductile-Iron Piping, Grooved Joints: Cut-groove pipe. Assemble joints with grooved-end, ductile-iron-piping couplings, gaskets, lubricant, and bolts.

H. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with bolts according to ASME B31.9.

I. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure.

J. Do not use flanges or unions for underground piping.

3.4 ANCHORAGE INSTALLATION

A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:

1. Concrete thrust blocks.
2. Locking mechanical joints.
3. Set-screw mechanical retainer glands.
4. Bolted flanged joints.
5. Heat-fused joints.
6. Pipe clamps and tie rods.

B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches in fire-suppression water-service piping according to NFPA 24 and the following:

1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
2. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.
3. Bonded-Joint Fiberglass, Water-Service Piping: According to AWWA M45.

C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.5 CONNECTIONS

A. Connect fire-suppression water-service piping to utility water main.

B. Connect fire-suppression water-service piping to interior fire-suppression piping.

3.6 FIELD QUALITY CONTROL

A. Use test procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described below.

B. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

C. Hydrostatic Tests: Test at not less than one-and-one-half times the working pressure for two hours.

1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for one hour; decrease to zero psig. Slowly increase again to test pressure and hold for one more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

D. Prepare test and inspection reports.

3.7 CLEANING

A. Clean fire-suppression water-service piping as follows:

1. Purge new piping systems and parts of existing systems that have been altered, extended, or repaired before use.
2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:

a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow it to stand for 24 hours.
b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow it to stand for three hours.
c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.

B. Prepare reports of purging and disinfecting activities.

END OF SECTION 211100

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

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. Pipes, fittings, and specialties.
2. Cover system for sprinkler piping.
3. Specialty valves.
4. Sprinklers.
5. Alarm devices.
6. Manual control stations.
7. Control panels.
8. Pressure gages.

B. Related Requirements:

1. Section 230523 "General-Duty Valves for Water-Based Fire-Suppression Piping" for ball, butterfly, check, gate, post-indicator, and trim and drain valves.

1.3 DEFINITIONS

A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175-psig maximum.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For wet-pipe sprinkler systems.

1. Include plans, elevations, sections, and attachment details.
2. Include diagrams for power, signal, and control wiring.

C. Delegated-Design Submittal: For wet-pipe sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer and professional engineer.

B. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

C. Welding certificates.

D. Fire-hydrant flow test report.

E. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

F. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wet-pipe sprinkler systems and specialties to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. Welding Qualifications: Qualify procedures and operators according to 2010 ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13.

B. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

C. Delegated Design: Engage a qualified professional engineer to design wet-pipe sprinkler systems.

1. Sprinkler system design shall be approved by authorities having jurisdiction.

a. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
b. Sprinkler Occupancy Hazard Classifications:

1) Storage Areas: Ordinary Hazard, Group 2.
2) Electrical Equipment Rooms: Ordinary Hazard, Group 1.
3) Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
4) Office and Public Areas: Light Hazard.

2. Minimum Density for Automatic-Sprinkler Piping Design:

a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.

3. Maximum Protection Area per Sprinkler: According to UL listing.
4. Maximum Protection Area per Sprinkler:

a. Office Spaces: 225 sq. ft.
b. Storage Areas: 130 sq. ft.
c. Mechanical Equipment Rooms: 130 sq. ft.
d. Electrical Equipment Rooms: 130 sq. ft.
e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.

2.2 STEEL PIPE AND FITTINGS

A. Standard-Weight, Black-Steel Pipe: ASTM A 53/A 53M. Pipe ends may be factory or field formed to match joining method.

B. Schedule 10, Black-Steel Pipe: ASTM A 135/A 135M or ASTM A 795/A 795M, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10, plain end.

C. Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.

D. Uncoated-Steel Couplings: ASTM A 865/A 865M, threaded.

E. Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

F. Malleable- or Ductile-Iron Unions: UL 860.

G. Cast-Iron Flanges: ASME 16.1, Class 125.

H. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

1. Pipe-Flange Gasket Materials: EPDM rubber gasket.

a. Class 125 and Class 250, Cast-Iron, Flat-Face Flanges: Full-face gaskets.
b. Class 150 and Class 300, Ductile-Iron or -Steel, Raised-Face Flanges: Ring-type gaskets.

2. Metal, Pipe-Flange Bolts and Nuts: Carbon steel unless otherwise indicated.

I. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.

1. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

J. Grooved-Joint, Steel-Pipe Appurtenances:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Anvil International.
b. Tyco Fire & Building Products LP.
c. Victaulic Company.

2. Pressure Rating: 175-psig minimum.

3. Uncoated Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting, with dimensions matching steel pipe.
4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.3 SPECIALTY VALVES

A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

B. Pressure Rating:

1. Standard-Pressure Piping Specialty Valves: 175-psig minimum.

C. Body Material: Cast or ductile iron.

D. Size: Same as connected piping.

E. End Connections: Flanged or grooved.

F. Alarm Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Reliable Automatic Sprinkler Co., Inc. (The).
b. Tyco Fire & Building Products LP.
c. Victaulic Company.
d. Viking Corporation.

2. Standard: UL 193.

3. Design: For horizontal or vertical installation.
4. 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.

G. Automatic (Ball Drip) Drain Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Reliable Automatic Sprinkler Co., Inc. (The).
b. Tyco Fire & Building Products LP.

2. Standard: UL 1726.

3. Pressure Rating: 175-psig minimum.
4. Type: Automatic draining, ball check.
5. Size: NPS 3/4.
6. End Connections: Threaded.

2.4 SPRINKLER PIPING SPECIALTIES

A. Branch Outlet Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Anvil International.
b. Tyco Fire & Building Products LP.
c. Victaulic Company.

2. Standard: UL 213.

3. Pressure Rating: 175-psig minimum.
4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-tee and -cross fittings.
6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flow Detection and Test Assemblies:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. AGF Manufacturing Inc.
b. Reliable Automatic Sprinkler Co., Inc. (The).
c. Tyco Fire & Building Products LP.
d. Victaulic Company.

2. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

3. Pressure Rating: 175-psig minimum.
4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded or grooved.

C. Sprinkler Inspector's Test Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. AGF Manufacturing Inc.
b. Tyco Fire & Building Products LP.
c. Victaulic Company.
d. Viking Corporation.

2. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

3. Pressure Rating: 175-psig minimum.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

D. Flexible Sprinkler Hose Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. FlexHead Industries, Inc.
b. Victaulic Company.

2. Standard: UL 1474.

3. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
4. Pressure Rating: 175-psig minimum.
5. Size: Same as connected piping, for sprinkler.

2.5 SPRINKLERS

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. Reliable Automatic Sprinkler Co., Inc. (The).
2. Tyco Fire & Building Products LP.
3. Victaulic Company.
4. Viking Corporation.

B. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

C. Pressure Rating for Automatic Sprinklers: 175-psig minimum.

1. Nominal Orifice: 1/2 inch, with discharge coefficient K between 5.3 and 5.8.

D. Sprinkler Finishes: Chrome plated bronze and painted.

E. 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: Plastic, white finish, one piece, flat.

2.6 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Electrically Operated Alarm Bell:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Notifier.
   b. Potter Electric Signal Company, LLC.

2. Standard: UL 464.

3. Type: Vibrating, metal alarm bell.
4. Size: 6-inch minimum- diameter.
5. Finish: Red-enamel factory finish, suitable for outdoor use.
6. 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. Water-Flow Indicators:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Potter Electric Signal Company, LLC.
   b. System Sensor.
   c. Viking Corporation.

2. Standard: UL 346.

3. Water-Flow Detector: Electrically supervised.
4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
5. Type: Paddle operated.
6. Pressure Rating: 250 psig.
7. Design Installation: Horizontal or vertical.

D. Pressure Switches:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Potter Electric Signal Company, LLC.
   b. System Sensor.
   c. Tyco Fire & Building Products LP.
   d. Viking Corporation.

2. Standard: UL 346.

3. Type: Electrically supervised water-flow switch with retard feature.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design Operation: Rising pressure signals water flow.

E. Valve Supervisory Switches:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Potter Electric Signal Company, LLC.
b. System Sensor.

2. Standard: UL 346.

3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled valve is in other than fully open position.
6. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.7 PRESSURE GAGES

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. AGF Manufacturing Inc.

B. Standard: UL 393.

C. Dial Size: 3-1/2- to 4-1/2-inch diameter.

D. Pressure Gage Range: 0- to 250-psig minimum.

E. Label: Include "WATER" label on dial face.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 SERVICE-ENTRANCE PIPING

A. Connect sprinkler piping to water-service piping for service entrance to building. Comply with requirements for exterior piping in Section 211100 "Facility Fire-Suppression Water-Service Piping" for exterior piping.

B. Install shutoff valve, pressure gage, drain, and other accessories indicated at connection to water-service piping.

C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.3 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.

C. Use listed 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.

E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

G. Install sprinkler piping with drains for complete system drainage.

H. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

I. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.

J. Install alarm devices in piping systems.

K. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.

L. 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 are not subject to freezing.

M. Fill sprinkler system piping with water.

N. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

O. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression Piping."

3.4 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. 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.

H. Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

I. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

J. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

K. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

L. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.5 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain 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. Specialty Valves:

1. Install valves in vertical position for proper direction of flow, in main supply to system.
2. Install alarm valves with bypass check valve and retarding chamber drain-line connection.
3. Install deluge valves in vertical position, in proper direction of flow, and in main supply to deluge system. Install trim sets for drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.

3.6 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.

B. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.

3.7 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.8 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Coordinate with fire-alarm tests. Operate as required.
6. Coordinate with fire-pump tests. Operate as required.
7. Verify that equipment hose threads are same as local fire department equipment.

B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.9 CLEANING

A. Clean dirt and debris from sprinklers.

B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.10 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

3.11 PIPING SCHEDULE

A. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends, cast-iron threaded fittings, and threaded grooved ends, grooved-end fittings, grooved-end-pipe couplings, and grooved joints.

B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

C. Standard-pressure, wet-pipe sprinkler system, NPS 2 and smaller, shall be one of the following:

1. Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. Schedule 40, black-steel pipe with plain ends; steel welding fittings; and welded joints.
3. Schedule 40, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

D. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 4, shall be one of the following:

1. Schedule 10, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. Schedule 10, black-steel pipe with plain ends; steel welding fittings; and welded joints.
3. Schedule 10, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.12 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Concealed sprinklers.

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
2. Upright Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 211313

SECTION 211316 - DRY-PIPE SPRINKLER SYSTEMS

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. Pipes, fittings, and specialties.
2. Specialty valves.
3. Sprinkler specialty pipe fittings.
4. Sprinklers.
5. Alarm devices.
6. Manual control stations.
7. Control panels.
8. Pressure gages.

B. Related Requirements:

1. Section 230523 "General-Duty Valves for Water-Based Fire-Suppression Piping" for ball, butterfly, check, gate, and trim and drain valves.

1.3 DEFINITIONS

A. Standard-Pressure Sprinkler Piping: Dry-pipe sprinkler system piping designed to operate at working pressure of 175-psig maximum.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For dry-pipe sprinkler systems.

1. Include plans, elevations, sections, and attachment details.
2. Include diagrams for power, signal, and control wiring.

C. Delegated-Design Submittal: For dry-pipe sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer and professional engineer.

B. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

C. Fire-hydrant flow test report.

D. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

E. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For dry-pipe sprinkler systems and specialties to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTIONS

A. Dry-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Opening of sprinklers releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into piping and discharges from opened sprinklers.

2.2 PERFORMANCE REQUIREMENTS

A. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13.

B. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

C. Delegated Design: Engage a qualified professional engineer to design wet-pipe sprinkler systems.

D. 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:

a. Exterior Canopy Area: Ordinary Hazard, Group 1.

3. Minimum Density for Automatic-Sprinkler Piping Design:

a. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1950-sq. ft. area.

4. Maximum Protection Area per Sprinkler: According to UL listing.
5. Maximum Protection Area per Sprinkler:

a. All Areas: 130 sq. ft.

6. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:

a. Ordinary-Hazard Occupancies: 250 gpm.

E. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

2.3 STEEL PIPE AND FITTINGS

A. Standard-Weight, Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.

B. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.

C. Galvanized-Steel Couplings: ASTM A 865/A 865M, threaded.

D. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

E. Malleable- or Ductile-Iron Unions: UL 860.

F. Cast-Iron Flanges: ASME B16.1, Class 125.

2.4 SPECIALTY VALVES

A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

B. Pressure Rating:

1. Standard-Pressure Piping Specialty Valves: 175-psig minimum.

C. Body Material: Cast or ductile iron.

D. Size: Same as connected piping.

E. End Connections: Flanged or grooved.

F. Dry-Pipe Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Reliable Automatic Sprinkler Co., Inc. (The).
b. Tyco Fire & Building Products LP.
c. Victaulic Company.
d. Viking Corporation.

2. Standard: UL 260.
3. Design: Differential-pressure type.
4. Include UL 1486, quick-opening devices, trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.

5. Air-Pressure Maintenance Device:

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) Reliable Automatic Sprinkler Co., Inc. (The).
        2) Tyco Fire & Building Products LP.
        3) Victaulic Company.
        4) Viking Corporation.

6. Standard: UL 260.
7. Type: Automatic device to maintain minimum air pressure in piping.
8. Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure, strainer, pressure ratings with 14- to 60-psig adjustable range, and 175-psig outlet pressure.
9. Air Compressor:

    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) General Air Products, Inc.
        2) Viking Corporation.

    b. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
    c. Motor Horsepower: Fractional.
    d. Power: 120-V ac, 60 Hz, single phase.

10. Air-Pressure Maintenance Device:

    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) Reliable Automatic Sprinkler Co., Inc. (The).
        2) Tyco Fire & Building Products LP.
        3) Victaulic Company.
        4) Viking Corporation.

    b. Standard: UL 260.
    c. Type: Automatic device to maintain minimum air pressure in piping.
    d. Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure, strainer, pressure ratings with 14- to 60-psig adjustable range, and 175-psig outlet pressure.

G. Automatic (Ball Drip) Drain Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Reliable Automatic Sprinkler Co., Inc. (The).
   b. Tyco Fire & Building Products LP.

2. Standard: UL 1726.
3. Pressure Rating: 175-psig minimum.
4. Type: Automatic draining, ball check.
5. Size: NPS 3/4.
6. End Connections: Threaded.

2.5 SPRINKLER PIPING SPECIALTIES

A. General Requirements for Dry-Pipe System Fittings: UL listed for dry-pipe service.

B. Branch Outlet Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Anvil International.
   b. Tyco Fire & Building Products LP.
   c. Victaulic Company.

2. Standard: UL 213.
3. Pressure Rating: 175-psig minimum.
4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-tee and -cross fittings.
6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.

C. Flow Detection and Test Assemblies:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. AGF Manufacturing Inc.
   b. Reliable Automatic Sprinkler Co., Inc. (The).
   c. Tyco Fire & Building Products LP.
   d. Victaulic Company.

2. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
3. Pressure Rating: 175-psig minimum.
4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

D. Sprinkler Inspector's Test Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. AGF Manufacturing Inc.
   b. Tyco Fire & Building Products LP.
   c. Victaulic Company.
   d. Viking Corporation.

2. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
3. Pressure Rating: 175-psig minimum.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

2.6 SPRINKLERS

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. Reliable Automatic Sprinkler Co., Inc. (The).
2. Tyco Fire & Building Products LP.
3. Victaulic Company.
4. Viking Corporation.

B. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

C. Pressure Rating for Automatic Sprinklers: 175-psig minimum.

D. Sprinkler Finishes: Painted.

E. Special Coatings: Corrosion-resistant paint.

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.

2.7 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Pressure Switches:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Potter Electric Signal Company, LLC.
   b. System Sensor.
   c. Tyco Fire & Building Products LP.
   d. Viking Corporation.

2. Standard: UL 346.
3. Type: Electrically supervised water-flow switch with retard feature.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design Operation: Rising pressure signals water flow.

C. Valve Supervisory Switches:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Potter Electric Signal Company, LLC.
   b. System Sensor.

2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled valve is in other than fully open position.
6. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application

2.8 CONTROL PANELS

A. Description: Single-area, two-area, or single-area cross-zoned type control panel as indicated, including NEMA ICS 6, Type 1 enclosure, detector, alarm, and solenoid-valve circuitry for operation of deluge valves.

1. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide" when used with thermal detectors and Class A detector circuit wiring.
2. Electrical characteristics are 120-V ac, 60 Hz, with 24-V dc rechargeable batteries.
3. 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. Manual Control Stations: Electric operation, metal enclosure, labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.

C. Panels Components:

1. Power supply.
2. Battery charger.
3. Standby batteries.
4. Field-wiring terminal strip.
5. Electrically supervised solenoid valves and polarized fire-alarm bell.
6. Lamp test facility.
7. Single-pole, double-throw auxiliary alarm contacts.
8. Rectifier.

2.9 PRESSURE GAGES

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. AGF Manufacturing Inc.

B. Standard: UL 393.

C. Dial Size: 3-1/2- to 4-1/2-inch diameter.

D. Pressure Gage Range: 0- to 250-psig minimum.

E. Label: Include "WATER" or "AIR/WATER" label on dial face.

F. Air System Piping Gage: Include "AIR" or "AIR/WATER" label on dial face.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 WATER-SUPPLY CONNECTIONS

3.3 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.

C. Use listed 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.

E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

G. Install sprinkler piping with drains for complete system drainage.

H. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

I. Install automatic (ball drip) drain valves to drain piping between fire department connections and check valves. Drain to floor drain or to outside building.

J. Connect compressed-air supply to dry-pipe sprinkler piping.

K. Install alarm devices in piping systems.

L. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements in NFPA 13.

M. 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 are not subject to freezing.

N. Drain dry-pipe sprinkler piping.

O. Pressurize and check dry-pipe sprinkler system piping and air compressors.

P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

Q. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression Piping."

3.4 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. 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.

H. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

I. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.5 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain 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. Specialty Valves:

1. Install valves in vertical position for proper direction of flow, in main supply to system.
2. Install dry-pipe valves with trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.

    a. Install air compressor and compressed-air-supply piping.

3.6 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.7 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Start and run air compressors.
6. Coordinate with fire-alarm tests. Operate as required.

B. Prepare test and inspection reports.

3.8 CLEANING

A. Clean dirt and debris from sprinklers.

B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.9 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

3.10 PIPING SCHEDULE

A. Standard-pressure, dry-pipe sprinkler system shall be the following:

1. Schedule 40, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
2. Schedule 40, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.11 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Spaces Subject to Freezing: Dry sidewall sprinklers Upright, dry pendent sprinklers; and dry sidewall sprinklers as indicated.

END OF SECTION 211316

SECTION 220513 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

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 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.

1.3 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 NEMA MG 1 unless otherwise indicated.

B. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 104 deg F 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. Multispeed Motors: Separate winding for each speed.

F. Rotor: Random-wound, squirrel cage.

G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

H. Temperature Rise: Match insulation rating.

I. Insulation: Class F.

J. 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.

K. 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.

C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

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 220513

SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

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. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal fittings.
4. Grout.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SLEEVES

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

D. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

F. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

G. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

2.2 STACK-SLEEVE FITTINGS

A. Manufacturers: Subject to compliance with requirements.

B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL FITTINGS

A. Manufacturers: Subject to compliance with requirements.

B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

2.4 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."

E. 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 for firestopping specified in Section 078400 "Firestopping."

3.2 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076000 "Flashing and Sheet Metal."
3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Using grout, seal the space around outside of stack-sleeve fittings.

B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078400 “Firestopping"

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:

a. Piping Smaller Than NPS 6 Cast-iron wall sleeves.
b. Piping NPS 6 and Larger: Cast-iron wall sleeves.

2. Exterior Concrete Walls below Grade:

a. Piping Smaller Than NPS 6: Galvanized-steel wall sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

b. Piping NPS 6 and Larger: Galvanized-steel wall sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs-on-Grade:

a. Piping Smaller Than NPS 6: Galvanized-steel wall sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

b. Piping NPS 6and Larger: Cast-iron wall sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

4. Concrete Slabs above Grade:

a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves.

5. Interior Partitions:

   a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
   b. Piping NPS 6 and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION 220517

SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING

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. Escutcheons.
2. Floor plates.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

D. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.

E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.

2.2 FLOOR PLATES

A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

B. Split-Casting Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.

1. Escutcheons for New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
b. Chrome-Plated Piping: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
c. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
g. Bare Piping in Equipment Rooms: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping: One-piece, floor-plate type.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 220518

SECTION 220519 - METERS AND GAGES FOR PLUMBING PIPING

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. Bimetallic-actuated thermometers.
2. Dial-type pressure gages.
3. Gage attachments.
4. Test plugs.
5. Test-plug kits.

B. Related Sections:

1. Section 221113 "Facility Water Distribution Piping" for domestic water meters and combined domestic and fire-protection water-service meters outside the building.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of meter and gage, from manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 BIMETALLIC-ACTUATED THERMOMETERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ashcroft Inc.
2. Ernst Flow Industries.
3. Marsh Bellofram.
4. Miljoco Corporation.
5. Nanmac Corporation.
6. Noshok.
7. Palmer Wahl Instrumentation Group.
8. REOTEMP Instrument Corporation.
9. Tel-Tru Manufacturing Company.
10. Trerice, H. O. Co.
11. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
12. Weiss Instruments, Inc.
13. WIKA Instrument Corporation - USA.
14. Winters Instruments - U.S.

B. Standard: ASME B40.200.

C. Dial: Non-reflective aluminum with permanently etched scale markings and scales in deg F.

D. Connector Type(s): Union joint, adjustable angle, with unified-inch screw threads.

E. Connector Size: 1/2 inch, with ASME B1.1 screw threads.

F. Stem: 0.25 or 0.375 inch in diameter; stainless steel.

G. Window: Plastic.

H. Ring: Stainless steel.

I. Element: Bimetal coil.

J. Pointer: Dark-colored metal.

K. Accuracy: Plus or minus 1 percent of scale range.

2.2 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Ashcroft Inc.
b. Ernst Flow Industries.
c. Flo Fab Inc.
d. Marsh Bellofram.
e. Miljoco Corporation.
f. Noshok.
g. Palmer Wahl Instrumentation Group.
h. REOTEMP Instrument Corporation.
i. Tel-Tru Manufacturing Company.
j. Trerice, H. O. Co.
k. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
l. Weiss Instruments, Inc.
m. WIKA Instrument Corporation - USA.
n. Winters Instruments - U.S.

2. Standard: ASME B40.100.
3. Case: Solid-front, pressure relief type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass
10. Ring: Stainless steel.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.3 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.

B. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

2.4 TEST PLUGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flow Design, Inc.
2. Miljoco Corporation.
3. National Meter, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Company, Inc.
6. Trerice, H. O. Co.
7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
8. Weiss Instruments, Inc.

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

2.5 TEST-PLUG KITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flow Design, Inc.
2. Miljoco Corporation.
3. National Meter, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Company, Inc.
6. Trerice, H. O. Co.
7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
8. Weiss Instruments, Inc.

B. Furnish one test-plug kit(s) containing one thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.

C. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F.

D. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch- diameter dial and probe. Dial range shall be at least 0 to 200 psig.

E. Carrying Case: Metal or plastic, with formed instrument padding.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

B. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.

C. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

D. Install remote-mounted pressure gages on panel.

E. Install valve and snubber in piping for each pressure gage for fluids.

F. Install test plugs in piping tees.

G. Install thermometers in the following locations:

1. Inlet and outlet of each water heater.
2. Inlets and outlets of each domestic water heat exchanger.
3. Inlet and outlet of each domestic hot-water storage tank.
4. Inlet and outlet of each remote domestic water chiller.

H. Install pressure gages in the following locations:

1. Building water service entrance into building.
2. Inlet and outlet of each pressure-reducing valve.
3. Suction and discharge of each domestic water pump.

3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

A. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Domestic Cold-Water Piping: 0 to 100 deg F.

B. Scale Range for Domestic Hot-Water Piping: 0 to 180 deg F.

3.5 PRESSURE-GAGE SCHEDULE

A. Pressure gages at discharge of each water service into building shall be one of the following:

1. Solid-front, pressure-relief, direct-mounted, metal case.
2. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.

B. Pressure gages at inlet and outlet of each water pressure-reducing valve shall be one of the following:

1. Solid-front, pressure-relief, direct-mounted, metal case.
2. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.

C. Pressure gages at suction and discharge of each domestic water pump shall be one of the following:

1. Solid-front, pressure-relief, direct-mounted, metal case.
2. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.

3.6 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Water Service Piping: 0 to 160 psi.

B. Scale Range for Domestic Water Piping: 0 to 160 psi.

END OF SECTION 220519

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

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. Brass ball valves.
2. Bronze swing check valves.

B. Related Sections:

1. Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Nonrising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

G. SWP: Steam working pressure.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

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. Valve Actuator Types:

1. Handwheel: For valves other than quarter-turn types.
2. Handlever: For quarter-turn valves NPS 6 and smaller.

3. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug-valve head.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. 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.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Grooved: With grooves according to AWWA C606.
3. Solder Joint: With sockets according to ASME B16.18.
4. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRASS BALL VALVES

A. One-Piece, Reduced-Port, Brass Ball Valves with Brass Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Kitz Corporation.
b. Mitsubishi Diamond Back.
c. NIBCO INC.
d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
e. Henry Techonologies.
f. Sporlan.
g. Superior.
h. Ranco.

2. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 400 psig.
c. Body Design: One piece.
d. Body Material: Forged brass.
e. Ends: Threaded.
f. Seats: PTFE or TFE.
g. Stem: Brass.
h. Ball: Chrome-plated brass.
i. Port: Reduced.

2.3 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. American Valve, Inc.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Division.
e. Hammond Valve.
f. Kitz Corporation.
g. Milwaukee Valve Company.
h. NIBCO INC.
i. Powell Valves.
j. Red-White Valve Corporation.
k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
l. Zy-Tech Global Industries, Inc.

2. Description:

a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 200 psig.
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: Bronze.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 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 check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball valves.
2. Throttling Service: ball valves.
3. Pump-Discharge Check Valves:

    a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2-1/2 and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: One piece, reduced port, brass with bronze trim.
3. Bronze Swing Check Valves: Class 125, bronze disc.

END OF SECTION 220523

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

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. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Pipe positioning systems.
8. Equipment supports.

B. Related Sections:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 ACTION SUBMITTALS

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

B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Pipe stands.
3. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of trapeze hangers.
2. Design Calculations: Calculate requirements for designing trapeze hangers.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.7 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.

2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.4 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.5 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.6 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-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 INSTALLATION

A. Metal 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 the building structure.

B. Metal 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 for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.

D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

E. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled fiberglass struts.

F. Fastener System Installation:

1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

G. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.

H. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

I. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

J. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

K. 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.

L. Install lateral bracing with pipe hangers and supports to prevent swaying.

M. 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.

N. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

O. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

P. Insulated Piping:

1. Attach clamps and spacers to piping.

    a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

    a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    b. NPS 4: 12 inches long and 0.06 inch thick.
    c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.

5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are 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 carbon-steel pipe hangers and supports or metal trapeze pipe hangers and attachments for general service applications.

F. Use fiberglass pipe hangers and fiberglass strut systems and corrosion-resistant attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal-hanger shield inserts for insulated piping and tubing.

J. 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 up to 1050 deg F, pipes NPS 4 to NPS 24, 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 36, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. 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 or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.

18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
19. 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.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.

10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

N. 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.

O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.

c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

R. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

S. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

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. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Stencils.
5. Valve tags.
6. Warning tags.

1.3 ACTION SUBMITTALS

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

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch or 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: Black.
3. Background Color: White
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-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: Black.

C. Background Color: Red.

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 partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, 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 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link or beaded chain; or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.5 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

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 Section 099100 "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.

C. Pipe Label Color Schedule:

1. Domestic Water Piping:

a. Background Color: Green.
b. Letter Color: White.

2. Sanitary Waste and Storm Drainage Piping:

a. Background Color: Green.
b. Letter Color: White.

3.4 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

a. Cold Water: 1-1/2 inches, round.
b. Hot Water: 1-1/2 inches, round.

2. Valve-Tag Color:

a. Cold Water: Natural.
b. Hot Water: Natural.

3. Letter Color:

a. Cold Water: Black.
b. Hot Water: Black.

3.5 WARNING-TAG INSTALLATION

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

END OF SECTION 220553

SECTION 220716 - PLUMBING EQUIPMENT INSULATION

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 insulating the following plumbing equipment:

1. Domestic water, hot-water pumps.
2. Domestic water storage tanks.
3. Domestic water filter housings.

B. Related Sections:

1. Section 220719 "Plumbing Piping Insulation."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied, if any).

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content and chemical components.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail removable insulation at equipment connections and access panels.
4. Detail application of field-applied jackets.
5. Detail application at linkages of control devices.
6. Detail field application for each equipment type.

D. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:

1. Sheet Form Insulation Materials: 12 inches square.
2. Sheet Jacket Materials: 12 inches square.

3. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.6 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with equipment Installer for equipment insulation application.

C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Equipment Insulation Schedule" article for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide the following:

    a. Pittsburgh Corning Corporation; Foamglas.

2. Block Insulation: ASTM C 552, Type I.
3. Special-Shaped Insulation: ASTM C 552, Type III.
4. Board Insulation: ASTM C 552, Type IV.
5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
6. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Products: Subject to compliance with requirements, provide one of the following::

    a. Aeroflex USA, Inc.; Aerocel.
    b. Armacell LLC; AP Armaflex.
    c. K-Flex USA; Insul-Sheet and K-FLEX LS.

H. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corp.; SoftTouch Duct Wrap.
b. Johns Manville; Microlite.
c. Knauf Insulation; Friendly Feel Duct Wrap.
d. Manson Insulation Inc.; Alley Wrap.
e. Owens Corning; SOFTR All-Service Duct Wrap.

I. High-Temperature, Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type V, without factory-applied jacket.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Industrial Insulation Group (IIG); MinWool-1200 Flexible Batt.
b. Johns Manville; HTB 26 Spin-Glas.
c. Roxul Inc.; Roxul RW.

J. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For equipment applications, provide insulation without factory-applied jacket Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corp.; CertaPro Commercial Board.
b. Fibrex Insulations Inc.; FBX.
c. Johns Manville; 800 Series Spin-Glas.
d. Knauf Insulation; Insulation Board.
e. Manson Insulation Inc.; AK Board.
f. Owens Corning; Fiberglas 700 Series.

K. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Fibrex Insulations Inc.; Coreplus 1200.
b. Johns Manville; Micro-Lok.
c. Knauf Insulation; 1000-Degree Pipe Insulation.
d. Manson Insulation Inc.; Alley-K.
e. Owens Corning; Fiberglas Pipe Insulation.

L. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Armacell LLC; Tubolit.
b. Nomaco Insulation; IMCOLOCK, IMCOSHEET, NOMALOCK, and NOMAPLY.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Products: Subject to compliance with requirements, provide the following:

a. Ramco Insulation, Inc.; Super-Stik.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

1. Products: Subject to compliance with requirements, provide the following:

a. Ramco Insulation, Inc.; Thermokote V.

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

1. Products: Subject to compliance with requirements, provide the following:

a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-97.
b. Eagle Bridges - Marathon Industries; 290.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-27.
d. Mon-Eco Industries, Inc.; 22-30.
e. Vimasco Corporation; 760.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-84.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Aeroflex USA, Inc.; Aeroseal.
b. Armacell LLC; Armaflex 520 Adhesive.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
d. K-Flex USA; R-373 Contact Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
b. Eagle Bridges - Marathon Industries; 225.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
b. Eagle Bridges - Marathon Industries; 225.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

G. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Dow Corning Corporation; 739, Dow Silicone.
b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.

c. P.I.C. Plastics, Inc.; Welding Adhesive.
d. Speedline Corporation; Polyco VP Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
b. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.
b. Eagle Bridges - Marathon Industries; 501.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.
d. Mon-Eco Industries, Inc.; 55-10.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
3. Service Temperature Range: 0 to 180 deg F.
4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
5. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.

b. Eagle Bridges - Marathon Industries; 570.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F.
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
b. Eagle Bridges - Marathon Industries; 550.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
d. Mon-Eco Industries, Inc.; 55-50.
e. Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.
1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
c. Vimasco Corporation; 713 and 714.

2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over insulation.
3. Service Temperature Range: 0 to plus 180 deg F.
4. Color: White.

2.6 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass Products: Subject to compliance with requirements, provide the following:

   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
   b. Eagle Bridges - Marathon Industries; 405.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
   d. Mon-Eco Industries, Inc.; 44-05.
   e. Pittsburgh Corning Corporation; Pittseal 444.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F.
5. Color: White or gray.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
   b. Eagle Bridges - Marathon Industries; 405.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
   d. Mon-Eco Industries, Inc.; 44-05.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.

6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. PVDC Jacket for Indoor Applications: 4-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perm when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.

    a. Products: Subject to compliance with requirements, provide the following:

        1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

5. PVDC Jacket for Outdoor Applications: 6-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perm when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.

    a. Products: Subject to compliance with requirements, provide the following:

        1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

6. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.

    a. Products: Subject to compliance with requirements, provide the following:

        1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

2.8 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. in. for covering equipment.

1. Products: Subject to compliance with requirements, provide the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Chil-Glas No. 5.

B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for equipment.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab.
b. Vimasco Corporation; Elastafab 894.

2.9 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd.

1. Products: Subject to compliance with requirements, provide the following:

a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

2.10 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Johns Manville; Zeston.
b. P.I.C. Plastics, Inc.; FG Series.
c. Proto Corporation; LoSmoke.
d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: Color as selected by Architect.
4. Factory-fabricated tank heads and tank side panels.

C. Metal Jacket:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
c. RPR Products, Inc.; Insul-Mate.

2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

    a. Sheet and roll stock ready for shop or field sizing.
    b. Finish and thickness are indicated in field-applied jacket schedules.
    c. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper.
    d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.

3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.

    a. Sheet and roll stock ready for shop or field sizing.
    b. Material, finish, and thickness are indicated in field-applied jacket schedules.
    c. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper.
    d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.

2.11 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. ABI, Ideal Tape Division; 428 AWF ASJ.
    b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
    c. Compac Corporation; 104 and 105.
    d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. ABI, Ideal Tape Division; 491 AWF FSK.
    b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
    c. Compac Corporation; 110 and 111.
    d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches.
3. Thickness: 6.5 mils.

4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. ABI, Ideal Tape Division; 370 White PVC tape.
    b. Compac Corporation; 130.
    c. Venture Tape; 1506 CW NS.

2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. ABI, Ideal Tape Division; 488 AWF.
    b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
    c. Compac Corporation; 120.
    d. Venture Tape; 3520 CW.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

E. PVDC Tape: White vapor-retarder PVDC tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide the following:

    a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape and Saran 560 Vapor Retarder Tape.

2. Width: 3 inches.
3. Film Thickness: 4 mils.
4. Adhesive Thickness: 1.5 mils.
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/inch in width.

2.12 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:

a. ITW Insulation Systems; Gerrard Strapping and Seals.
b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with winged seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with winged seal.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated.

a. Products: Subject to compliance with requirements, provide one of the following:

1) AGM Industries, Inc.; CWP-1.
2) GEMCO; CD.
3) Midwest Fasteners, Inc.; CD.
4) Nelson Stud Welding; TPA, TPC, and TPS.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

a. Products: Subject to compliance with requirements, provide one of the following:

1) AGM Industries, Inc.; CHP-1.
2) GEMCO; Cupped Head Weld Pin.
3) Midwest Fasteners, Inc.; Cupped Head.
4) Nelson Stud Welding; CHP.

3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.

a. Products: Subject to compliance with requirements, provide one of the following:

1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
2) GEMCO; Perforated Base.
3) Midwest Fasteners, Inc.; Spindle.

b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.

c. Spindle: Copper- or zinc-coated, low-carbon steel fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.

   a. Products: Subject to compliance with requirements, provide one of the following:

      1) GEMCO; Nylon Hangers.
      2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.

   b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
   c. Spindle: Nylon, 0.106-inch-diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
   d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.

   a. Products: Subject to compliance with requirements, provide one of the following:

      1) AGM Industries, Inc.; Tactoo Self-Adhering Insul-Hangers.
      2) GEMCO; Peel & Press.
      3) Midwest Fasteners, Inc.; Self Stick.

   b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
   c. Spindle: Copper- or zinc-coated, low-carbon steel fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
   d. Adhesive-backed base with a peel-off protective cover.

6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

   a. Products: Subject to compliance with requirements, provide one of the following:

      1) AGM Industries, Inc.; RC 150.
      2) GEMCO; R-150.
      3) Midwest Fasteners, Inc.; WA-150.
      4) Nelson Stud Welding; Speed Clips.

   b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) GEMCO.
        2) Midwest Fasteners, Inc.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, galvanized steel.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. C & F Wire.

2.13 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

C. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

O. For above ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.4 INSTALLATION OF EQUIPMENT, TANK, AND VESSEL INSULATION

A. Mineral-Fiber, Pipe, and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of tank and vessel surfaces.

2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
3. Protect exposed corners with secured corner angles.
4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:

    a. Do not weld anchor pins to ASME-labeled pressure vessels.
    b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
    c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
    d. Do not overcompress insulation during installation.
    e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
    f. Impale insulation over anchor pins and attach speed washers.
    g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
7. Stagger joints between insulation layers at least 3 inches.
8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.

1. Apply 50 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
2. Seal longitudinal seams and end joints.

C. Insulation Installation on Pumps:

1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch-diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
2. Fabricate boxes from stainless steel, at least 0.040 inch thick.
3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

3.5 INSTALLATION OF CALCIUM SILICATE INSULATION

A. Insulation Installation on Domestic Water Boiler Breechings:

1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation material.
2. Install two-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
3. On exposed applications without metal jacket, finish insulation surface with a skim coat of mineral-fiber, hydraulic-setting cement. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth. Thin finish coat to achieve smooth, uniform finish.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

E. Where PVDC jackets are indicated, install as follows:

1. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. 33-1/2-inch-circumference limit allows for 2-inch-overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
2. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.8 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. 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.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.10 EQUIPMENT INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.

B. Insulate indoor and outdoor equipment that is not factory insulated.

C. Heat-exchanger (water-to-water for domestic water heating service) insulation shall be one of the following:

1. Calcium Silicate: 3 inches thick.
2. Cellular Glass: 3 inches thick.
3. Mineral-Fiber Blanket: 2 inches thick and 2-lb/cu. ft. nominal density.
4. Mineral-Fiber Board: 2 inches thick and 2-lb/cu. ft. nominal density.
5. Mineral-Fiber Pipe and Tank: 2 inches thick.
6. Mineral-Fiber Preformed Pipe Insulation, Type I: 2 inches thick.

D. Domestic hot-water pump insulation shall be one of the following:

1. Cellular Glass: 2 inches thick.
2. Mineral-Fiber Blanket: 1 inch thick and 2-lb/cu. ft. nominal density.
3. Mineral-Fiber Board: 1 inch thick and 2-lb/cu. ft. nominal density.

E. Domestic hot-water storage tank insulation shall be one of the following, of thickness to provide an R-value of 12.5:

1. Cellular glass.
2. Mineral-Fiber Blanket: 2-lb/cu. ft. nominal density.
3. Mineral-Fiber Board: 2-lb/cu. ft. nominal density.
4. Mineral-fiber pipe and tank.

F. Domestic water storage tank insulation shall be one of the following:

1. Cellular Glass: 2 inches thick.
2. Flexible Elastomeric: 1 inch thick.
3. Mineral-Fiber Blanket: 1 inch thick and 2-lb/cu. ft. nominal density.
4. Mineral-Fiber Board: 1 inch thick and 2-lb/cu. ft nominal density.
5. Mineral-Fiber Pipe and Tank: 1 inch thick.
6. Polyolefin: 1 inch thick.

3.11 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Equipment, Concealed:

1. None.
2. PVC: 20 mils thick.
3. Aluminum, Corrugated: 0.016 inch thick.
4. Painted Aluminum, Corrugated: 0.016 inch thick.
5. Stainless Steel, Type 304 or Type 316, Corrugated: 0.010 inch thick.

D. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:

1. None.
2. PVC: 20 mils thick.
3. Aluminum, Corrugated: 0.016 inch thick.
4. Painted Aluminum, Corrugated: 0.016 inch thick.
5. Stainless Steel, Type 304 or Type 316, Corrugated: 0.010 inch thick.

E. Equipment, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches:

1. None.
2. Painted Aluminum, Corrugated: 0.016 inch thick.
3. Stainless Steel, Type 304 or Type 316, Corrugated: 0.010 inch thick.

3.12 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Equipment, Concealed:

1. None.
2. PVC: 20 mils thick.
3. Aluminum, Corrugated: 0.016 inch thick.
4. Painted Aluminum, Corrugated: 0.016 inch thick.
5. Stainless Steel, Type 304 or Type 316, Corrugated: 0.010 inch thick.

D. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:

1. None.
2. Painted Aluminum, Corrugated: 0.016 inch thick.
3. Stainless Steel, Type 304 or Type 316, Corrugated: 0.010 inch thick.

END OF SECTION 220716

SECTION 220719 - PLUMBING PIPING INSULATION

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 insulating the following plumbing piping services:

1. Domestic cold-water piping.
2. Domestic hot-water piping.
3. Domestic recirculating hot-water piping.
4. Domestic chilled-water piping for drinking fountains.
5. Roof drains and rainwater leaders.
6. Supplies and drains for handicap-accessible lavatories and sinks.

B. Related Sections:

1. Section 220716 "Plumbing Equipment Insulation."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content and chemical components.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

C. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.6 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," and "Outdoor, Aboveground Piping Insulation Schedule," articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide the following:

a. Pittsburgh Corning Corporation; Foamglas.

2. Block Insulation: ASTM C 552, Type I.
3. Special-Shaped Insulation: ASTM C 552, Type III.

G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Aeroflex USA, Inc.; Aerocel.
b. Armacell LLC; AP Armaflex.
c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.

H. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. CertainTeed Corp.; SoftTouch Duct Wrap.
b. Johns Manville; Microlite.
c. Knauf Insulation; Friendly Feel Duct Wrap.

d. Manson Insulation Inc.; Alley Wrap.
e. Owens Corning; SOFTR All-Service Duct Wrap.

I. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Fibrex Insulations Inc.; Coreplus 1200.
b. Johns Manville; Micro-Lok.
c. Knauf Insulation; 1000-Degree Pipe Insulation.
d. Manson Insulation Inc.; Alley-K.
e. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, without factory-applied jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Products: Subject to compliance with requirements, provide the following:

a. Ramco Insulation, Inc.; Super-Stik.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

1. Products: Subject to compliance with requirements, provide the following:

a. Ramco Insulation, Inc.; Thermokote V.

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

1. Products: Subject to compliance with requirements, provide the following:

a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.

1. Products: Subject to compliance with requirements, provide the following:

a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-84.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Aeroflex USA, Inc.; Aeroseal.
b. Armacell LLC; Armaflex 520 Adhesive.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
d. K-Flex USA; R-373 Contact Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
b. Eagle Bridges - Marathon Industries; 225.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Phenolic Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-96.
b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-33.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
b. Eagle Bridges - Marathon Industries; 225.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-20.
d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

G. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Dow Corning Corporation; 739, Dow Silicone.
b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
c. P.I.C. Plastics, Inc.; Welding Adhesive.
d. Speedline Corporation; Polyco VP Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
c. Vimasco Corporation; 713 and 714.

3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
4. Service Temperature Range: 0 to plus 180 deg F.
5. Color: White.

2.5 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass and Phenolic Products: Subject to compliance with requirements, provide one of the following:

    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
    b. Eagle Bridges - Marathon Industries; 405.
    c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
    d. Mon-Eco Industries, Inc.; 44-05.
    e. Pittsburgh Corning Corporation; Pittseal 444.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F.
5. Color: White or gray.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide the following:

    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.

1. Products: Subject to compliance with requirements, provide the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Chil-Glas Number 10.

B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab.
b. Vimasco Corporation; Elastafab 894.

2.8 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..

1. Products: Subject to compliance with requirements, provide the following:

a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

2.9 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Johns Manville; Zeston.
b. P.I.C. Plastics, Inc.; FG Series.
c. Proto Corporation; LoSmoke.
d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: Color as selected by Architect.

4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

    a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

C. Metal Jacket:

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
    b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
    c. RPR Products, Inc.; Insul-Mate.

2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

    a. Sheet and roll stock ready for shop or field sizing.
    b. Finish and thickness are indicated in field-applied jacket schedules.
    c. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper.
    d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
    e. Factory-Fabricated Fitting Covers:

        1) Same material, finish, and thickness as jacket.
        2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
        3) Tee covers.
        4) Flange and union covers.
        5) End caps.
        6) Beveled collars.
        7) Valve covers.
        8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.

    a. Sheet and roll stock ready for shop or field sizing.
    b. Material, finish, and thickness are indicated in field-applied jacket schedules.
    c. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper.
    d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
    e. Factory-Fabricated Fitting Covers:

        1) Same material, finish, and thickness as jacket.
        2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
        3) Tee covers.

4) Flange and union covers.
5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

D. Underground Direct-Buried Jacket: 125-mil-thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Pittsburgh Corning Corporation; Pittwrap.
b. Polyguard Products, Inc.; Insulrap No Torch 125.

2.10 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

a. ABI, Ideal Tape Division; 428 AWF ASJ.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
c. Compac Corporation; 104 and 105.
d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

a. ABI, Ideal Tape Division; 491 AWF FSK.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
c. Compac Corporation; 110 and 111.
d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.

7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, provide one of the following:

a. ABI, Ideal Tape Division; 370 White PVC tape.
b. Compac Corporation; 130.
c. Venture Tape; 1506 CW NS.

2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:

a. ABI, Ideal Tape Division; 488 AWF.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
c. Compac Corporation; 120.
d. Venture Tape; 3520 CW.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.11 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:

a. ITW Insulation Systems; Gerrard Strapping and Seals.
b. RPR Products, Inc.; Insul-Mate Strapping and Seals.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with closed seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with closed seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

C. Wire: 0.062-inch soft-annealed, stainless steel.

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. C & F Wire.

2.12 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers,:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Engineered Brass Company.
b. Insul-Tect Products Co.; a subsidiary of MVG Molded Products.
c. McGuire Manufacturing.
d. Plumberex.
e. Truebro; a brand of IPS Corporation.
f. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures,:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Truebro; a brand of IPS Corporation.
b. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.

2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

    a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 078400 "Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078400 "Firestopping."

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. 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.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers as needed. 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 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.7 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.

4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.9 INSTALLATION OF PHENOLIC INSULATION

A. General Installation Requirements:

1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation materials.
2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 0.062-inch wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.

B. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets with vapor retarders on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

C. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.

D. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

E. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.10 INSTALLATION OF POLYOLEFIN INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of polyolefin pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.11 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.12 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099100 "Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.13 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. 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, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.14 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.15 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. NPS 1 and Smaller: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inches thick.
b. Flexible Elastomeric: 1/2 inch thick.
c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
d. Phenolic: 1 inch thick.
e. Polyolefin: 1/2 inch thick.

2. NPS 1-1/4 and Larger: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inch thick.

b. Flexible Elastomeric: 1 inch thick.
c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
d. Phenolic: 1 inch thick.
e. Polyolefin: 1 inch thick.

B. Domestic Hot and Recirculated Hot Water:

NPS 1-1/4 and Smaller: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inches thick.
b. Flexible Elastomeric: 3/4 inch thick.
c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
d. Phenolic: 1 inch thick.
e. Polyolefin: 3/4 inch thick.

2. NPS 1-1/2 and Larger: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inches thick.
b. Flexible Elastomeric: 1 inch thick.
c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
d. Phenolic: 1 inch thick.
e. Polyolefin: 1 inch thick.

C. Domestic Chilled Water (Potable):

1. All Pipe Sizes: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inch thick.
b. Flexible Elastomeric: 1 inch thick.
c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
d. Phenolic: 1 inch thick.
e. Polyolefin: 1 inch thick.

D. Stormwater and Overflow:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inches thick.
b. Flexible Elastomeric: 1 inch thick.
c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
d. Phenolic: 1 inch thick.
e. Polyolefin: 1 inch thick.

E. Roof Drain and Overflow Drain Bodies:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inches thick.
b. Flexible Elastomeric: 1 inch thick.
c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
d. Phenolic: 1 inch thick.

e. Polyolefin: 1 inch thick.

F. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Flexible Elastomeric: 1/2 inch thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
c. Polyolefin: 1/2 inch thick.

G. Sanitary Waste Piping Where Heat Tracing Is Installed:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Cellular Glass: 2 inches thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches
c. Phenolic: 1-1/2 inches thick.

H. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inches thick.
b. Flexible Elastomeric: 3/4 inch thick.
c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
d. Phenolic: 1 inch thick.
e. Polyolefin: 3/4 inch thick.

I. Hot Service Drains:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inches thick.
b. Mineral-Fiber, Preformed Pipe, Type I or II: 1 inch thick.

J. Hot Service Vents:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inches thick.
b. Mineral-Fiber, Preformed Pipe, Type I or II: 1 inch thick.

3.16 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Domestic Water Piping:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Cellular Glass: 2 inches thick.
b. Flexible Elastomeric: 2 inches thick.
c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
d. Phenolic: 2 inches thick.
e. Polyolefin: 2 inches thick.

B. Sanitary Waste Piping Where Heat Tracing Is Installed:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Cellular Glass: 2 inches thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
c. Phenolic: 2 inches thick.

3.17 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. None.
2. PVC: 20 mils thick.
3. Aluminum, Corrugated: 0.016 inch thick.
4. Painted Aluminum: Corrugated: 0.016 inch thick.
5. Stainless Steel, Type 304 or Type 316, Smooth 2B Finish: 0.010 inch thick.

D. Piping, Exposed:

1. None.
2. PVC: 20 mils thick.
3. Aluminum, Corrugated: 0.016 inch thick.
4. Painted Aluminum: Corrugated: 0.016 inch thick.
5. Stainless Steel, Type 304 or Type 316, Smooth 2B Finish: 0.010 inch thick.

3.18 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. None.
2. PVC: 20 mils thick.
3. Aluminum, Corrugated: 0.016 inch thick.

4. Painted Aluminum: Corrugated: 0.016 inch thick.
5. Stainless Steel, Type 304 or Type 316, Smooth 2B Finish: 0.010 inch thick.

D. Piping, Exposed:

1. PVC: 20 mils thick.
2. Painted Aluminum: Corrugated: 0.016 inch thick.
3. Stainless Steel, Type 304 or Type 316, Smooth 2B Finish: 0.010 inch thick.

3.19 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION 220719

SECTION 220800 – COMMISSIONING OF PLUMBING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 019113 – Commissioning General Requirements.

C. Section 230800 – Commissioning of Mechanical Systems.

D. Section 230901 – Commissioning of Integrated Automation Systems.

E. Section 260800 – Commissioning of Electrical Systems.

F. Commissioning Plan.

1.2 DESCRIPTION OF WORK

A. The purpose of this section is to specify the Division 22 responsibilities and participation in the commissioning process. All contractors responsible for Division 22 installation or other activities shall have commissioning responsibilities described herein.

B. Work under this contract shall conform to requirements of Division 01, General Requirements, Conditions of the Contract, and Supplementary Conditions. This specification covers Commissioning of Plumbing Systems, which are a part of this project.

C. Commissioning shall be a team effort to ensure that all plumbing equipment and systems have been completely and properly installed and function together correctly to meet the design intent. Additionally, system performance parameters shall be monitored and documented for fine tuning of control sequences and operational procedures. Commissioning shall coordinate and document equipment installation, equipment start-up, control system calibration, testing and balancing, and verification and performance testing.

D. The Commissioning Team is defined in Specification 019113 Section 1.3 – Definitions. The plumbing trades represented on the Commissioning Team shall include but not be limited to; sheet metal, pipe and fitting, controls, test and balance, plumbing, chemical treatment and fire protection. The lead person for each trade who will actually perform or supervise the work is to be designated as the representative to the Commissioning Team. Responsibility for various steps of the commissioning process shall be divided among the members of the Commissioning Team, as described in this section.

E. Plumbing Contractor(s) are responsible for plumbing system installation, start-up, testing, preparation of O&M manuals, and operator training as defined in various Division 22 specification sections. Plumbing Contractor(s) are responsible for coordination, observation, and verification of commissioning as defined in this section and Section 019113. Neither

Section 019113 - Commissioning General Requirements nor Section 220800 – Commissioning of Plumbing systems shall relieve the Plumbing Contractor(s) from their obligations to complete all portions of work in a satisfactory and fully operational manner. Furthermore, Section 220800 – Commissioning of Plumbing systems shall not relieve the Electrical Contractor(s) or Controls Contractor(s) from any obligations set forth within Division 01, Division 23, Division 26, including Section 019113 – Commissioning General Requirements.

1.3 DEFINITIONS

A. Plumbing Contractor(s): The term Plumbing Contractor(s) utilized herein refers to any and all subcontracting companies or venders whom are responsible for the construction or other provisions regarding any of the systems which are being commissioned, as outlined in Specification 019113 Section 1.5 – Systems To Be Included In Commissioning, and are defined within Division 22 of the specifications. Subcontracting parties outside of the scope of the Systems to be Included in Commissioning or outside of the scope of Division 22 are not included.

B. Equipment Manufacturer(s): The term Equipment Manufacturer(s) utilized herein refers to any and all subcontracting companies whom are responsible for the provision of equipment or components which are being commissioned, as outlined in Specification 019113 Section 1.5 – Systems To Be Included In Commissioning, and are defined within Division 22 of the specifications. Equipment Manufacturer(s) shall refer to the direct representative of the maker and/or distributor of the equipment or component being provided. This may include either the actual equipment manufacturer or the supplier thereof, under the provisions that the supplier has a thorough knowledge of the equipment or component and is recognized by the actual equipment manufacturer as being a proper representative.

1.4 SCOPE OF WORK

A. The Plumbing Contractor(s) shall be required to Commission all equipment, components and accessories of each of the commissioned systems as outlined within Specification 019113 Section 1.5 – Systems To Be Included In Commissioning. In order to accomplish a complete commissioning process, the Plumbing Contractor(s) shall be required to fulfill all requirements set forth within Specification 220800 Section 1.5 – Roles and Responsibilities. Additionally, the Plumbing Contractor(s) shall be required to fulfill all requirements set forth within Specification 019113.

B. Through the Commissioning Process, the Plumbing Contractor(s) shall accomplish thorough documentation, organized scheduling and coordination, detailed installation verification, and detailed system functional verification. For this, the Plumbing Contractor(s) must cooperate and coordinate with the Commissioning Agent.

1.5 ROLES AND RESPONSIBILITIES

A. In addition to the Commissioning Agent, Owner and System Design Professional(s), the Commissioning Team is comprised of a minimum of one individual to represent each contracting company or venders whom are responsible for the construction or other provisions regarding any of the systems which are being commissioned, as outlined in Specification 019113 Section 1.5 – Systems To Be Included In Commissioning, and are defined within Division 22 of the specifications. See Specification 019113 Section 1.3 – Definitions for the definition of the Commissioning Team.

B. Contracting companies providing members shall include but not be limited to; sheet metal, pipe and fitting, controls, test and balance, plumbing, chemical treatment and fire protection contractors whose responsibilities are defined herein.

C. In addition to all roles and responsibilities defined herein, all Plumbing Contractor(s) shall be required to fulfill all requirements described within Specification 019113 Section 1.4 – Roles and Responsibilities.

D. Plumbing Contractor(s)

1. General Requirements:

   a. Include all cost to complete commissioning requirements for plumbing systems in the contract price. Contractor costs shall be reflected within the Schedule of Values as specified within Specification 019113 Section 2.2 – Schedule of Values.
   b. Ensure cooperation and participation of specialty Contractors and Sub-Contractors.
   c. Ensure participation of major Equipment Manufacturers in appropriate start-up, testing and training activities.
   d. Attend Commissioning Meetings for construction phase coordination as scheduled by the Commissioning Agent. Additionally, attend the Commissioning Kick-Off Meeting as scheduled by the Commissioning Agent.

2. Commissioning Schedule

   a. Prepare a Preliminary Schedule for plumbing systems and equipment, including component installation, start-up and checkout, and system start-up. Integrate commissioning activities into this Preliminary Schedule including Pre-Functional and Functional Performance Tests.
   b. Update the Preliminary Schedule and submit a Final Schedule which shall reflect all items within the Preliminary Schedule and shall also include but not be limited to: inspections, O&M manual submission, training sessions, pipe and duct system testing, flushing and cleaning, equipment start-up, TAB, and task completion. All Contractor(s) shall integrate schedule activities into one complete Final Schedule which shall be reflected within the Construction Manager's/General Contractor's overall project schedule. The Final Schedule shall be continuously updated throughout the Construction Phase.

3. Submittal Requirements:

   a. Comply with all Submittal requirements as outlined within Specification 019113 Section 2.3 – Submittals.
   b. Comply with all requirements as outlined within Specification 019113 Section 2.5 – Start-Up and Test Reports.
   c. Provide the following documentation to the Commissioning Agent for the purpose of construction updates:

      1) General construction progress and status reports
      2) Updated Architect, Owner, System Design Professional, and Contractor deficiency logs
      3) Minutes from all construction and coordination meetings not otherwise conducted by the Commissioning Agent

4) Pre Start-Up and Start-Up procedures
5) Value Engineering Proposals and a list of all accepted VE items
6) Pressure Test Reports, Flushing Reports and Start-Up Reports
7) Construction document changes resulting from plumbing Requests for Information

4. Pre-Functional Checklist Requirements:

   a. Detailed installation verification shall be performed on all installed equipment and systems to ensure that the installations conform to the contract documents, local and applicable codes, and standard practice. This shall be accomplished through the completion of Pre-Functional Checklists. The creation, distribution, completion and maintenance of Pre-Functional Checklists are detailed in Specification 019113 Section 2.4 – Pre-Functional Checklists.
   b. Complete Pre-Functional Checklists on all plumbing equipment and system components installed or provided by the Plumbing Contractors(s).
   c. Notify the Commissioning Agent a minimum of two weeks (14 days) in advance, of the time for start of the TAB work.
   d. Provide written notification to the Commissioning Agent for each system listed in Specification 019113 Section 1.5 – Systems To Be Included In Commissioning, that the system installation is complete in its entirety and that the system is fully operational, online, and ready for Functional Performance Testing.

5. Equipment and Systems Start-Up:

   a. Perform all initial check-out and start-up procedures as outlined within the specifications and as per the Equipment Manufacturer's recommendations. Provide full documentation of all start-up and check-out procedures and results. Documentations is to be submitted to the Commissioning Agent in conjunction with the associated Pre-Functional Checklist.
   b. Perform all pressure tests, weld tests, vibration analysis and any other system component test required by the specifications requiring a 3rd party test agency. Provide full documentation of all tests procedures and results. Documentation is to be submitted to the Commissioning Agent in conjunction with the associated Pre-Functional Checklist.
   c. Perform all Test, Adjustment and Balance requirements for hydronic piping systems and air distribution systems. Submit copies of the TAB Report to all interested and reviewing parties as required by the specifications and to the Commissioning Agent. The TAB Contractor shall assist as the TAB Report is spot-checked by the Commissioning Agent. See the Specification 220800 Section 1.5 – Roles and Responsibilities, Subsection E for additional TAB Contractor Requirements.
   d. Perform all equipment, system and component cleaning and flushing as required by the specifications and Equipment Manufacturer's recommendations. Provide full documentation of all cleaning and flushing procedures and test results (i.e. pH test results, etc.) Documentation is to be submitted to the Commissioning Agent in conjunction with the associated Pre-Functional Checklist.

6. Functional Performance Test Requirements:

    a. Detailed testing shall be performed on all installed equipment and systems to ensure that operation and performance conform to contract documents, local and applicable codes, and standard practice. This shall be accomplished through the completion of Functional Performance Tests. The creation, distribution and completion of Functional Performance Tests are detailed in Specification 019113 Section 2.6 – Functional Performance Tests.
    b. Provide all appropriate equipment and materials as necessary to execute and complete all Functional Performance Tests. Comply with all requirements as outlined within Specification 019113 Section 2.8 – Test Equipment.
    c. Provide appropriate technicians for participation during system verification and functional performance testing. Technicians shall demonstrate system performance to Commissioning Agent including all modes of system operation (e.g. normal, abnormal, emergency, etc.)
    d. Verify all functional performance tests prior to requesting test witness by the Commissioning Agent, demonstrate all Functional Performance test tasks in the presence of the Commissioning Agent and assist the Commissioning Agent in all verification and functional performance tests.
    e. Participate in verification of the TAB report, which will consist of repeating any selected measurement contained in the TAB report where required by the Commissioning Agent for verification or diagnostic purposes. Typically, TAB Verification shall occur in conjunction with Functional Performance Testing.
    f. Cancellation or delays of any system tests or Functional Performance Testing upon the day of that particular scheduled test, due to lack of preparation or status of installation shall be considered a failed test due to the additional time required by the Commissioning Agent to witness electrical testing. These additional tests shall be treated in accordance with Specification 019113 Section 3.6-A.

7. Training Requirements:

    a. Comprehensive training of O&M personnel shall be performed by the Plumbing Contractor(s) and Equipment Manufacturer(s) prior to turnover of the systems to the Owner. Training shall include but not be limited to classroom instruction and hands-on instruction of the installed equipment and systems.
    b. The Training Schedule is to be coordinated and completed by the Plumbing Contractor(s). The Training Schedule is to be updated and maintained as construction progresses. The Training Schedule and all updates shall be coordinated with and approved of by the Owner.
    c. Contractor(s) responsible for the installation or provision of any piece of equipment or system shall attend, at minimum, the initial training session for that equipment or system.
    d. All Training Documentation shall be assembled and organized in a binder or set of binders. Coordinate with all other Contractor(s) to provide one complete bound Training Record. This requirement shall not be negated, unless other specific complete Project Training Record requirements, encompassing ALL project training documentation, is outlined elsewhere within the specifications.

8. Close-out Requirements:

    a. Remedy all deficiencies identified during commissioning. Provide all materials, equipment, labor, etc. to accomplish these remedies.
    b. Provide a complete set of Record Documents (As-Built Drawings and Specifications) to the Architect and/or Design Professional as required by the project specifications.
    c. Provide a complete set of O&M Manuals and Project Training Record to the Architect and/or Design Professional as required by the project specifications.
    d. Provide a complete copy of Equipment and System Warranties to the Architect and/or Design Professional as required by the project specifications.

E. Test, Adjust, and Balance Contractor(s):

1. Comply with all requirements as outlined within Specification 220800 Section 1.5 Sub-Section D – Plumbing Contractor(s).
2. Submit the TAB procedures to the Design Professional for review and acceptance. TAB procedures must include the TAB Plan, TAB Forms and TAB Report Format. These documents must be approved prior to proceeding with the Test, Adjustment and Balance.
3. Issue a statement that TAB work has been completed. Submit through the Contractor(s) a copy of the preliminary version of the Test and Balance Report to the Commissioning Agent and System Design Professional. Submit for review, a Final Version of the Test and Balance Report to the Commissioning Agent and System Design Professional within the amount of time allotted within the Specifications. The Commissioning Agent and Systems Design Professional must both accept the Final TAB Report.
4. The Commissioning Agent shall be provided with a copy of the Test, Adjustment and Balance Report a minimum of two weeks (14 days) prior to the scheduled spot check of the balanced system. The report may be a Preliminary or Final version. A representative of the Test and Balance firm shall be required to assist with the spot check. The Test and Balance firm shall provide calibrated testing equipment as per Specification 019113 Section 2.8 - Test Equipment. Equipment shall be similar in style and type as used to initially perform Test, Adjustment and Balance procedures.
5. Participate in verification of the TAB report, which will consist of repeating any selected measurement contained in the TAB report where required by the Commissioning Agent for verification or diagnostic purposes.

F. Automatic Controls and Building Automation System Contractor(s):

1. Comply with all requirements as outlined within Specification 220800 Section 1.5 Sub-Section D – Plumbing Contractor(s).
2. Review design for controllability with respect to selected equipment.
3. Verify proper hardware specification exists for functional performance required by specification and sequence of operation.
4. Verify proper safeties and interlocks are included in design.
5. Verify proper sizing of control valves and actuators based on design pressure drops. Verify control valve authority to control coil properly.
6. Verify proper sizing of control dampers. Verify damper authority to control air stream. Verify proper damper positioning for mixing to prevent stratification. Verify actuator vs. damper sections for smooth operation.
7. Verify proper selection of sensor ranges.

8. In addition to all other submittal requirements outlined with in Specifications 019113 and 220800, provide the following submittals to the Commissioning Agent:

    a. Hardware and software submittals.
    b. Control panel construction shop drawings.
    c. Narrative description of each control sequence for each piece of equipment controlled.
    d. Diagrams showing all control points, sensor locations, point names, actuators, controllers and, where necessary, points of access, superimposed on diagrams of the physical equipment.
    e. Logic diagrams showing the logic flow of the system.
    f. A list of all control points, including analog inputs, analog outputs, digital inputs, and digital outputs. Include the values of all parameters for each system point. Provide a separate list for each stand-alone control unit.
    g. A complete control language program listing, including all software routines employed in operating the control system. Also provide a program write-up, organized in the same manner as the control software. This narrative shall describe the logic flow of the software and the functions of each routine and sub-routine. It should also explain individual math or logic operations that are not clear from reading the software listing.
    h. Application software and project applications code manuals.
    i. Operations and Maintenance Staff comments on the BAS Graphics Submittal. Include all Controls Contractor responses.

9. Verify proper installation and performance of controls / BAS hardware and software provided by others.
10. Issue a Statement of Calibration for each system which states that all system points and interfaces have been properly calibrated and adjusted.
11. Provide controls graphics submittals to the Commissioning Agent and to the Owner and Owner's Maintenance Personnel for approval. Do not proceed with controls graphics programming without integration of the Owner's Maintenance Personnel comments.
12. Provide thorough training to operating personnel on hardware operations and programming, and the application program for the system.
13. Demonstrate system performance to Commissioning Agent including all modes of system operation (e.g. normal, abnormal, emergency).
14. Provide control system technician for use during system verification and functional performance testing.
15. Provide system modifications as required.
16. Provide support and coordination with TAB contractor on all interfaces between their scopes of work. Provide all devices, such as portable operator's terminals, for TAB use in completing TAB procedures.
17. The Controls Contractor(s) shall provide trending as required to confirm, disconfirm or correct any deficiencies identified during Commissioning. The Commissioning Agent will provide the list of systems and points for trending.

G. Fire Protection Contractor(s):

1. Comply with all requirements as outlined within Specification 220800 Section 1.5 Sub-Section D – Plumbing Contractor(s).

2. Fire Protection Contractor shall demonstrate operation of all dynamic components of the Fire Protection System. These shall include but not be limited to the operation of Valve Tamper Switches, Flow Switches, Deluge Valves, Air Compressors for Dry Pipe Systems, Pressure Switches, manually operated valves, etc.
3. Testing shall be required twice. The first test shall be performed by the Fire Protection Contractor(s) to internally verify the functionality of systems. The second test shall be a demonstration to the Authority Having Jurisdiction.
4. Review installation for manufacturer's specific requirements. Verify safeties, limits, relays and all other equipment specific settings are correct. Verify these settings optimize equipment performance and efficiencies.
5. Perform, approve and document all start-up services as outlined within the specifications for each piece of equipment, component and accessory. Perform all standard manufacturer services as outlined on manufacturer supplied forms. Additionally, perform all other requirements specifically called for within the project specifications, not otherwise performed in a manufacturer standard startup service. Provide additional documentation for these services on forms with manufacturer's letterhead.
6. Demonstrate performance of equipment as required within Functional Performance Tests.

H. Equipment Manufacturer(s):

1. Comply with all requirements as outlined within Specification 220800 Section 1.5 Sub-Section D – Plumbing Contractor(s).
2. Assist in scheduling of training sessions. Provide training of Owner's Maintenance Personnel with adequacy required for full comprehension of equipment and maintenance procedures.
3. Review installation for Equipment Manufacturer's specific requirements. Verify safeties, limits, relays and all other equipment specific settings are correct. Verify these settings optimize equipment performance and efficiencies.
4. Perform, approve and document all start-up services as outlined within the specifications for each piece of equipment, component and accessory. Perform all standard manufacturer services as outlined on manufacturer supplied forms. Additionally, perform all other requirements specifically called for within the project specifications, not otherwise performed in a manufacturer standard startup service. Provide additional documentation for these services on forms with manufacturer's letterhead.
5. Demonstrate performance of equipment as required within Functional Performance Tests.

1.6 DOCUMENTATION

A. The Commissioning Agent shall oversee and maintain the development of Commissioning Documentation. The Commissioning Documentation shall be kept in three ring binders, and organized by system and sub-system when practical. All pages shall be numbered, and a table of contents page(s) shall be provided. The Commissioning Documentation shall include the following which is to be maintained by the Contractor(s):

1. Start-Up and Check-Out Documentation: Organized and arranged with its associated Pre-Functional Checklist.
2. System and Component tests (i.e. Weld Test Reports, Cleaning & Flushing Reports, etc.): Organized and arranged with its associated Pre-Functional Checklist.

3. Pre-Functional Checklist: Organized and arranged as per provided by the Commissioning Agent. Typically these forms are organized by System and Sub-System and according to the order of standard specifications as outlined by American Institute of Architects (AIA.)
4. Test, Adjustment and Balance Report: The approved Final Report shall be provided to the Commissioning Agent for inclusion into the Final Commissioning Report.
5. Functional Performance Tests: All tests performed by the installing contractors for internal checkout and for witness by the Commissioning Agent shall be kept by the Contractor(s), organized and arranged by System and Sub-System, and turned over to the Commissioning Agent for inclusion into the Final Commissioning Report.
6. Project Training Record: The Training Record shall be provided with a Table of Contents followed by the updated Training Schedule and finally followed by each Training Session Agenda and Record. The Training Session Agenda and Record shall be organized by System and Sub-System.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. The appropriate Contractor(s) shall furnish all special tools and equipment required during the commissioning process. A list of all tools and equipment to be used during commissioning shall be submitted to the Commissioning Agent for approval. The owner shall furnish necessary utilities for the commissioning process. Additional test equipment requirements are found in Specification 019113 Section 2.8 – Test Equipment.

2.2 TEST EQUIPMENT - PROPRIETARY

A. Proprietary test equipment and software required by any equipment manufacturer for programming and/or start-up, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist in the commissioning process as needed. Proprietary test equipment (and software) shall become the property of the owner upon completion of the commissioning process.

PART 3 - EXECUTION

3.1 GENERAL

A. A pre-construction meeting of all Commissioning Team members shall be held at a time and place designated by the owner. The purpose shall be to familiarize all parties with the commissioning process, and to ensure that the responsibilities of each party are clearly understood.

B. A Final Commissioning Plan shall be developed by the Commissioning Agent. The Plumbing Contractor(s) shall assist the Commissioning Agent in preparing the Commissioning Plan by providing all necessary information pertaining to the actual equipment and installation in a timely manner. If contractor initiated system changes have been made that alter the commissioning process, the Commissioning Agent shall notify the Owner.

C. The Commissioning Process shall follow the schedule and procedures set forth within the Final Commissioning Plan.

D. The Plumbing Contractor(s) shall complete all phases of work so the systems can be started, tested, balanced, and acceptance procedures undertaken. This includes the complete installation of all equipment, materials, pipe, duct, wire, insulation, controls, etc., per the contract documents and related directives, clarifications, and change orders.

E. The Plumbing Contractor(s) shall coordinate all Commissioning Activities into the project as required herein and as outlined within the Commissioning Plan. The Plumbing Contractor(s) shall complete all required Commissioning and Construction Activities correctly and on schedule.

3.2 PARTICIPATION IN ACCEPTANCE PROCEDURES

A. The Plumbing Contractor(s) shall provide skilled technicians to start-up and debug all systems within Division 22. These same technicians shall be made available to assist the Commissioning Agent in completing the commissioning program. Work schedules, time required for testing, etc., shall be requested by the Commissioning Agent and coordinated by the Plumbing Contractor(s). Plumbing Contractor(s) shall ensure that the qualified technician(s) are available and present during the agreed upon schedules and of sufficient duration to complete the necessary tests, adjustments, and/or problem resolutions.

B. System performance problems and discrepancies may require additional technician time, Commissioning Agent time, reconstruction of systems, and/or replacement of system components. The additional technician time shall be made available for subsequent commissioning periods, at no cost to the owner, until the required system performance is obtained.

C. The Commissioning Agent reserves the right to question the appropriateness and qualifications of the technicians relative to each item of equipment, system, and/or sub-system. Qualifications of technicians shall include expert knowledge relative to the specific equipment involved and willingness to work with the Commissioning Agent. The Plumbing Contractor(s) shall provide adequate documentation and tools to start-up and test the equipment, system, and/or sub-system.

3.3 DEFICIENCY RESOLUTION

A. In some systems, miss-adjustments, misapplied equipment, and/or deficient performance under varying loads will result in additional work being required to commission the systems. This work shall be completed under the direction of the Owner, with input from the contractor and equipment supplier. Whereas all members shall have input and the opportunity to discuss, debate, and work out problems, the Owner and/or Architect shall have final jurisdiction over any additional work done to achieve performance.

B. Corrective work shall be completed in a timely fashion to permit the completion of the commissioning process. Any and all schedule items affected by this work shall be reflected on the Commissioning and Overall Project Schedules.

3.4 ADDITIONAL COMMISSIONING

A. The Plumbing Contractor, and associated sub-contractors, shall include time for additional commissioning required as a result of failure of a pre-functional or a functional test. Incomplete or incorrect Pre-Functional Checklists reviewed by the Commissioning Agent shall require an additional inspection to verify the re-completed PFC is complete and accurate. Functional

Performance Tests witnessed by the Commissioning Agent which fail, shall require retesting, again witnessed by the Commissioning Agent. These documents must be re-checked or re-witnessed in order for the system to be approved and accepted by the Commissioning Agent.

B. The Commissioning Agent will invoice the Owner for additional time required to witness any retesting due to failed PFC's or FPT's, and the Owner at his discretion may deduct this cost from the Construction Manager's Application for Payment. It is the Mechanical Contractor's responsibility to properly de-bug systems and verify successful system performance prior to inviting the Commissioning Agent to witness the test.

3.5 SEASONAL COMMISSIONING

A. Seasonal commissioning pertains to testing under full load conditions during peak heating and peak cooling seasons, as well as part load conditions in the spring and fall. Initial commissioning shall be done as soon as contract work is completed, regardless of season. Subsequent commissioning may be undertaken at any time thereafter to ascertain adequate performance during the different seasons.

3.6 PRE-FUNCTIONAL CHECKLISTS AND FUNCTIONAL PERFORMANCE TESTS

A. The Commissioning Agent shall be responsible for preparing the Pre-Functional Checklist. The Plumbing Contractor(s) shall be responsible for completing their applicable sections. Detailed descriptions of Pre-Functional Checklists are outlined in Section 019113-2.4.

B. The Commissioning Agent shall be responsible for preparing the Functional Performance Tests. The Commissioning Agent and Contractor (s) shall schedule the tests and assemble the commissioning team members who shall be responsible for the tests. Participating contractors, manufacturers, suppliers, etc. shall include all costs to do the work involved in these tests in their proposals. Detailed descriptions of Functional Performance Tests are outlined in Section 019113-2.6.

C. Following is a list of tasks and supporting information that shall be required:

1. Plumbing Contractor(s) - provide the services of a technician(s) who is (are) familiar with the construction and operation of this system. Provide access to the contract plans, shop drawings, and equipment cut sheets of all installed equipment.
2. Controls Contractor - provide the services of a controls engineer who is familiar with the details of the project. Provide details of the control system, schematics, and a narrative description of control sequences of operation.
3. Electrical contractor - provide a foreman electrician familiar with the electrical interlocks, interfaces with emergency power supply, and interfaces with alarm and life-safety systems. Provide access to the contract plans, and all as-built schematics of sub-systems, interfaces, and interlocks.

D. Documentation and Reporting Requirements:

1. Any contractors with responsibilities related to the equipment to be installed, i.e. mechanical, electrical, TAB, controls, Construction Manager or General Contractor, shall be responsible for completing their related portion of the Pre-Functional Checklist and Functional Performance Test forms and shall sign off on its completion.

E. The Commissioning Agent shall direct and witness the field verification of the Final TAB report. The TAB Contractor shall perform measurements as directed by the Commissioning Agent.

1. The Commissioning Agent shall select report data for verification at random.
2. The TAB contractor shall be given sufficient advance notice of the date of field verification. However, they shall not be informed in advance of the data points to be verified. The TAB contractor must use the same instruments (by model and serial number) that were used when the original data were collected.
3. Failure of an item is defined as:

    a. For all readings other than sound, a deviation of more than 10 percent.
    b. For sound pressure readings, a deviation of 3 decibels. (Note: variations in background noise must be considered).

4. A failure of more than 10 percent of the selected items shall result in the rejection of the TAB report.

F. If deficiencies are identified during verification, the construction manager must be notified, and action taken to remedy the deficiency. The final tabulated checklist data sheets shall be reviewed by the Design Professional and the Commissioning Agent, to determine if verification is complete, and the operating system is functioning in accordance with the contract documents.

END OF SECTION 220800

SECTION 221113 - FACILITY WATER DISTRIBUTION PIPING

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. This Section includes water-distribution piping and related components outside the building for water service.

B. Utility-furnished products include water meters that will be furnished to the site, ready for installation.

1.3 DEFINITIONS

A. PVC: Polyvinyl chloride plastic.

1.4 ACTION SUBMITTALS

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

B. Shop Drawings: Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.

1. Wiring Diagrams: Power, signal, and control wiring for alarms.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.

B. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For water valves and specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

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 ASTM F 645 for selection, design, and installation of thermoplastic water piping.

E. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.

F. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.

G. NSF Compliance:

1. Comply with NSF 14 for plastic potable-water-service piping.
2. Comply with NSF 61 Annex G for materials for water-service piping and specialties for domestic water.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:

1. Ensure that valves are dry and internally protected against rust and corrosion.
2. Protect valves against damage to threaded ends and flange faces.
3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. During Storage: Use precautions for valves, including fire hydrants, according to the following:

1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

F. Protect flanges, fittings, and specialties from moisture and dirt.

G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.9 PROJECT CONDITIONS

A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of service.
2. Do not proceed with interruption of water-distribution service without Owner's written permission.

1.10 COORDINATION

A. Coordinate connection to water main with utility company.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Soft Copper Tube: ASTM B 88, Type K, water tube, annealed temper.

1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.
2. Copper, Pressure-Seal Fittings:

a. Manufacturers: Subject to compliance with requirements, provide products by the following:

1) Viega LLC.

b. NPS 2 and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.

c. NPS 2-1/2 to NPS 4: Bronze fitting with stainless-steel grip ring and EPDM O-ring seal in each end.

B. Hard Copper Tube: ASTM B 88, Type K water tube, drawn temper.

1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.
2. Copper, Pressure-Seal Fittings:

a. Manufacturers: Subject to compliance with requirements, provide products by the following:

1) Viega LLC.

b. NPS 2 and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.

c. NPS 2-1/2 to NPS 4: Bronze fitting with stainless-steel grip ring and EPDM O-ring seal in each end.

C. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.

D. 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.

2.2 PVC PIPE AND FITTINGS

A. PVC, Schedule 40 Pipe: ASTM D 1785.

1. PVC, Schedule 40 Socket Fittings: ASTM D 2466.

B. PVC, Schedule 80 Pipe: ASTM D 1785.

1. PVC, Schedule 80 Socket Fittings: ASTM D 2467.
2. PVC, Schedule 80 Threaded Fittings: ASTM D 2464.

2.3 JOINING MATERIALS

A. Brazing Filler Metals: AWS A5.8, BCuP Series.

B. Bonding Adhesive for Fiberglass Piping: As recommended by fiberglass piping manufacturer.

C. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

2.4 PIPING SPECIALTIES

A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

B. Tubular-Sleeve Pipe Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. JCM Industries, Inc.
   b. Viking Johnson.

2. Description: Metal, bolted, sleeve-type, reducing or transition coupling, with center sleeve, gaskets, end rings, and bolt fasteners and with ends of same sizes as piping to be joined.

   a. Standard: AWWA C219.
   b. Center-Sleeve Material: Manufacturer's standard.
   c. Gasket Material: Natural or synthetic rubber.
   d. Pressure Rating: 150 psig minimum.
   e. Metal Component Finish: Corrosion-resistant coating or material.

C. Split-Sleeve Pipe Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

   a. Victaulic Company.

2. Description: Metal, bolted, split-sleeve-type, reducing or transition coupling with sealing pad and closure plates, O-ring gaskets, and bolt fasteners.

   a. Standard: AWWA C219.
   b. Sleeve Material: Manufacturer's standard.
   c. Sleeve Dimensions: Of thickness and width required to provide pressure rating.
   d. Gasket Material: O-rings made of EPDM rubber, unless otherwise indicated.
   e. Pressure Rating: 200 psig minimum.
   f. Metal Component Finish: Corrosion-resistant coating or material.

D. Flexible Connectors:

1. Nonferrous-Metal Piping: Bronze hose covered with bronze wire braid; with copper-tube, pressure-type, solder-joint ends or bronze flanged ends brazed to hose.
2. Ferrous-Metal Piping: Stainless-steel hose covered with stainless-steel wire braid; with ASME B1.20.1, threaded steel pipe nipples or ASME B16.5, steel pipe flanges welded to hose.

E. Dielectric Fittings:

1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

2. Dielectric Unions:

    a. Description:

        1) Standard: ASSE 1079.
        2) Pressure Rating: 125 psig minimum at 180 deg F.
        3) End Connections: Solder-joint copper alloy and threaded ferrous.

3. Dielectric Flanges:

    a. Description:

        1) Standard: ASSE 1079.
        2) Factory-fabricated, bolted, companion-flange assembly.
        3) Pressure Rating: 125 psig minimum at 180 deg F.
        4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

4. Dielectric-Flange Insulating Kits:

    a. Description:

        1) Nonconducting materials for field assembly of companion flanges.
        2) Pressure Rating: 150 psig.
        3) Gasket: Neoprene or phenolic.
        4) Bolt Sleeves: Phenolic or polyethylene.
        5) Washers: Phenolic with steel backing washers.

5. Dielectric Nipples:

    a. Description:

        1) Standard: IAPMO PS 66.
        2) Electroplated steel nipple. complying with ASTM F 1545.
        3) Pressure Rating: 300 psig at 225 deg F.
        4) End Connections: Male threaded or grooved.
        5) Lining: Inert and noncorrosive, propylene.

2.5 CORROSION-PROTECTION PIPING ENCASEMENT

A. Encasement for Underground Metal Piping:

1. Standards: ASTM A 674 or AWWA C105.
2. Form: Sheet or tube.
3. Material: High-density, crosslaminated PE film of 0.004-inch minimum thickness.
4. Color: Black.

2.6 GATE VALVES

A. AWWA, Cast-Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. American AVK Co.
   b. Clow Valve Company; a subsidiary of McWane, Inc.
   c. Kennedy Valve Company; a division of McWane, Inc.
   d. M & H Valve Company; a division of McWane, Inc.
   e. Mueller Co.

2.7 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Tapping-Sleeve Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Clow Valve Company; a subsidiary of McWane, Inc.
   b. Kennedy Valve Company; a division of McWane, Inc.
   c. Mueller Co.

2. Description: Sleeve and valve compatible with drilling machine.

   a. Standard: MSS SP-60.
   b. Tapping Sleeve: Cast- or ductile-iron or stainless-steel, two-piece bolted sleeve with flanged outlet for new branch connection. Include sleeve matching size and type of pipe material being tapped and with recessed flange for branch valve.
   c. Valve: AWWA, cast-iron, nonrising-stem, resilient-seated gate valve with one raised face flange mating tapping-sleeve flange.

B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches in diameter.

1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

C. Indicator Posts: UL 789, FMG-approved, vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.

2.8 CHECK VALVES

A. AWWA Check Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. American AVK Co.
   b. Clow Valve Company; a subsidiary of McWane, Inc.
   c. Kennedy Valve Company; a division of McWane, Inc.
   d. M & H Valve Company; a division of McWane, Inc.

2. Description: Swing-check type with resilient seat. Include interior coating according to AWWA C550 and ends to match piping.

   a. Standard: AWWA C508.
   b. Pressure Rating: 175 psig.

2.9 DETECTOR CHECK VALVES

A. Detector Check Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Victaulic Company.
   b. Watts; a Watts Water Technologies company.
   c. Zurn Industries, LLC.

2. Description: Galvanized cast-iron body, bolted cover with air-bleed device for access to internal parts, and flanged ends. Include one-piece bronze disc with bronze bushings, pivot, and replaceable seat. Include threaded bypass taps in inlet and outlet for bypass meter connection. Set valve to allow minimal water flow through bypass meter when major water flow is required.

   a. Standards: UL 312 and FMG approved.
   b. Pressure Rating: 175 psig.
   c. Water Meter: AWWA C700, disc type, at least one-fourth size of detector check valve. Include meter, bypass piping, gate valves, check valve, and connections to detector check valve.

3. Description: Iron body, corrosion-resistant clapper ring and seat ring material, flanged ends, with connections for bypass and installation of water meter.

   a. Standards: UL 312 and FMG approved.
   b. Pressure Rating: 175 psig.

2.10 WATER METERS

A. Water meters will be furnished by utility company.

B. Manufacturers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AMCO Water Metering Systems.
b. Mueller Co.

C. Displacement-Type Water Meters:

1. Description: With bronze main case.

a. Standard: AWWA C700.
b. Registration: Flow in gallons.

2.11 DETECTOR-TYPE WATER METERS

A. Detector-Type Water Meters:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Mueller Co.

B. Description: Main line, proportional meter with second meter on bypass. Register flow in gallons.

1. Standards: AWWA C703, UL listed, and FMG approved.
2. Pressure Rating: 150 psig.
3. Bypass Meter: AWWA C701, turbine type, bronze case.

a. Size: At least one-half nominal size of main-line meter.

C. Remote Registration System:

1. Description: Utility company standard; direct-reading type. Include meter modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly.

a. Standard: AWWA C706.
b. Registration: Flow in gallons.

2.12 PRESSURE-REDUCING VALVES

A. Water Regulators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Honeywell Water Controls.
    b. Watts; a Watts Water Technologies company.

2. Standard: ASSE 1003.

3. Pressure Rating: Initial pressure of 150 psig.
4. Size: 2 NPS.
5. Design Flow Rate: 60 gpm.
6. Design Inlet Pressure: psig.
7. Design Outlet Pressure Setting: psig.
8. Body: Bronze with chrome-plated finish for NPS 2 and smaller; cast iron for NPS 2-1/2 and NPS 3.
9. Valves for Booster Heater Water Supply: Include integral bypass.
10. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

2.13 RELIEF VALVES

A. Air-Release Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Crispin-Multiplex Manufacturing Co.
    b. GA Industries, Inc.
    c. Val-Matic Valve & Manufacturing Corp.

2. Description: Hydromechanical device to automatically release accumulated air.

    a. Standard: AWWA C512.
    b. Pressure Rating: 300 psig.
    c. Body Material: Cast iron.
    d. Trim Material: Stainless steel, brass, or bronze.
    e. Water Inlet Size: 3/4 NPS.
    f. Air Outlet Size: 3/4 NPS.

2.14 VACUUM BREAKERS

A. Pressure Vacuum Breaker Assembly:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Flowmatic Corporation.
    b. Watts; a Watts Water Technologies company.
    c. Zurn Industries, LLC.

2. Standard: ASSE 1020.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
5. Size: see drawings.
6. Accessories: Ball valves on inlet and outlet.

2.15 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Watts; a Watts Water Technologies company.
    b. Wilkins.
    c. Zurn Industries, LLC.

2. Standard: ASSE 1013 or AWWA C511
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
5. Size: 2-1/2 NPS.
6. Design Flow Rate: 60 gpm.
7. Selected Unit Flow Range Limits: 15-90 gpm.
8. Pressure Loss at Design Flow Rate: 12 psig for NPS 2-1/2 and larger.
9. 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 larger.
10. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
11. Configuration: Designed for horizontal, straight through flow.
12. Accessories:

    a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; OS&Y 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. Backflow Preventer Test Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Conbraco Industries, Inc.
b. Watts; a Watts Water Technologies company.
c. Zurn Industries, LLC.

2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

2.16 WATER METER BOXES

A. Description: Cast-iron body and cover for disc-type water meter, with lettering "WATER METER" in cover; and with slotted, open-bottom base section of length to fit over service piping.

1. Option: Base section may be cast-iron, PVC, clay, or other pipe.

B. Description: Cast-iron body and double cover for disc-type water meter, with lettering "WATER METER" in top cover; and with separate inner cover; air space between covers; and slotted, open-bottom base section of length to fit over service piping.

C. Description: Polymer-concrete body and cover for disc-type water meter, with lettering "WATER" in cover; and with slotted, open-bottom base section of length to fit over service piping. Include vertical and lateral design loadings of 15,000 lb minimum over 10 by 10 inches square.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Refer to Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.

B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.

C. Do not use flanges or unions for underground piping.

D. Flanges, unions, grooved-end-pipe couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.

E. Underground water-service piping NPS 3/4 to NPS 3 shall be any of the following:

1. Soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.

F. Underground water-service piping NPS 4 to NPS 8 shall be any of the following:

1. Soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.
2. Ductile-iron, push-on-joint pipe; ductile-iron, push-on-joint fittings; and gasketed joints.
3. PE, AWWA pipe; PE, AWWA fittings; and heat-fusion joints.
4. PVC, Schedule 40 pipe; PVC, Schedule 40 socket fittings; and solvent-cemented joints.

G. Water Meter Box Water-Service Piping NPS 3/4 to NPS 2 shall be same as underground water-service piping.

H. Aboveground Water-Service Piping NPS 3/4 to NPS 3 shall be the following:

1. Hard copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.

I. Aboveground water-service piping NPS 4 to NPS 8 shall be any of the following:

1. Ductile-iron, grooved-end pipe; ductile-iron, grooved-end appurtenances; and grooved joints.
2. PVC, Schedule 80 pipe; PVC, Schedule 80 socket fittings; and solvent- joints.

3.3 VALVE APPLICATIONS

A. General Application: Use mechanical-joint-end valves for NPS 3 and larger underground installation. Use threaded- or flanged-end valves for installation in vaults. Use UL/FMG, nonrising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for NPS 2 and smaller installation.

B. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Underground Valves, NPS 3 and Larger: AWWA, cast-iron, nonrising-stem, resilient seated gate valves with valve box.
2. Use the following for valves in vaults and aboveground:

   a. Gate Valves, NPS 2 and Smaller: Bronze, nonrising stem.
   b. Gate Valves, NPS 3 and Larger: AWWA, cast iron, OS&Y rising stem, metal seated
   c. Check Valves: AWWA C508, swing type.

3. Pressure-Reducing Valves: Use for water-service piping in vaults and aboveground to control water pressure.

4. Relief Valves: Use for water-service piping in vaults and aboveground.

    a. Air-Release Valves: To release accumulated air.
    b. Air/Vacuum Valves: To release or admit large volume of air during filling of piping.
    c. Combination Air Valves: To release or admit air.

5. Detector Check Valves: Use for water-service piping in vaults and aboveground to detect unauthorized use of water.

3.4 PIPING INSTALLATION

A. Water-Main Connection: Arrange with utility company for tap of size and in location indicated in water main.

B. Make connections larger than NPS 2 with tapping machine according to the following:

1. Install tapping sleeve and tapping valve according to MSS SP-60.
2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.

C. Make connections NPS 2 and smaller with drilling machine according to the following:

1. Install service-saddle assemblies and corporation valves in size, quantity, and arrangement required by utility company standards.
2. Install service-saddle assemblies on water-service pipe to be tapped. Position outlets for corporation valves.
3. Use drilling machine compatible with service-saddle assemblies and corporation valves. Drill hole in main. Remove drilling machine and connect water-service piping.
4. Install corporation valves into service-saddle assemblies.
5. Install manifold for multiple taps in water main.
6. Install curb valve in water-service piping with head pointing up and with service box.

D. Bury piping with depth of cover over top at least 30 inches, with top at least 12 inches below level of maximum frost penetration, and according to the following:

1. Under Driveways: With at least 36 inches cover over top.
2. Under Railroad Tracks: With at least 48 inches cover over top.
3. In Loose Gravelly Soil and Rock: With at least 12 inches additional cover.

E. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.

F. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.

1. Terminate water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.

G. Sleeves are specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

H. Mechanical sleeve seals are specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

I. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

J. See Section 221116 "Domestic Water Piping" for potable-water piping inside the building.

3.5 JOINT CONSTRUCTION

A. Make pipe joints according to the following:

1. Copper-Tubing, Pressure-Sealed Joints: Use proprietary crimping tool and procedure recommended by copper, pressure-seal-fitting manufacturer.
2. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
3. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
4. Ductile-Iron Piping, Grooved Joints: Cut-groove pipe. Assemble joints with grooved-end, ductile-iron-piping couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions.
5. PE Piping Insert-Fitting Joints: Use plastic insert fittings and fasteners according to fitting manufacturer's written instructions.
6. PVC Piping Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139 and pipe manufacturer's written instructions.
7. Fiberglass Piping Bonded Joints: Use adhesive and procedure recommended by piping manufacturer.
8. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

    a. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.
    b. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.

3.6 ANCHORAGE INSTALLATION

A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:

1. Concrete thrust blocks.
2. Locking mechanical joints.
3. Set-screw mechanical retainer glands.
4. Bolted flanged joints.
5. Heat-fused joints.
6. Pipe clamps and tie rods.

B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:

1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
2. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.
3. Bonded-Joint Fiberglass, Water-Service Piping: According to AWWA M45.
4. Fire-Service-Main Piping: According to NFPA 24.

C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.7 VALVE INSTALLATION

A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.

B. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.

C. UL/FMG, Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.

D. UL/FMG, Valves Other Than Gate Valves: Comply with NFPA 24.

E. MSS Valves: Install as component of connected piping system.

F. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.

G. Pressure-Reducing Valves: Install in vault or aboveground between shutoff valves.

H. Relief Valves: Comply with AWWA C512. Install aboveground with shutoff valve on inlet.

3.8 DETECTOR-CHECK VALVE INSTALLATION

A. Install in vault or aboveground.

B. Install for proper direction of flow. Install bypass with water meter, gate valves on each side of meter, and check valve downstream from meter.

C. Support detector check valves, meters, shutoff valves, and piping on brick or concrete piers.

3.9 WATER METER INSTALLATION

A. Install water meters, piping, and specialties according to utility company's written instructions.

B. Water Meters: Install displacement-type water meters, NPS 2 and smaller, in meter boxes with shutoff valves on water meter inlets. Include valves on water meter outlets and valved bypass around meters unless prohibited by authorities having jurisdiction.

C. Water Meters: Install turbine-type water meters, NPS 3 and larger, in meter vaults. Include shutoff valves on water meter inlets and outlets and valved bypass around meters. Support meters, valves, and piping on brick or concrete piers.

D. Water Meters: Install detector-type water meters in meter vault according to AWWA M6. Include shutoff valves on water meter inlets and outlets and full-size valved bypass around meters. Support meters, valves, and piping on brick or concrete piers.

3.10 ROUGHING-IN FOR WATER METERS

A. Rough-in piping and specialties for water meter installation according to utility company's written instructions.

3.11 VACUUM BREAKER ASSEMBLY INSTALLATION

A. Install pressure vacuum breaker assemblies of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.

B. Do not install pressure vacuum breaker assemblies in vault or other space subject to flooding.

3.12 BACKFLOW PREVENTER INSTALLATION

A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.

B. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.

C. Do not install bypass piping around backflow preventers.

D. Support NPS 2-1/2 and larger backflow preventers, valves, and piping near floor and on brick or concrete piers.

3.13 WATER METER BOX INSTALLATION

A. Install water meter boxes in paved areas flush with surface.

B. Install water meter boxes in grass or earth areas with top 2 inches above surface.

3.14 CONCRETE VAULT INSTALLATION

A. Install precast concrete vaults according to ASTM C 891.

3.15 PROTECTIVE ENCLOSURE INSTALLATION

A. Install concrete base level and with top approximately 2 inches above grade.

B. Install protective enclosure over valves and equipment.

C. Anchor protective enclosure to concrete base.

3.16 CONNECTIONS

A. See Section 330500 "Common Work Results for Utilities" for piping connections to valves and equipment.

B. Connect water-distribution piping to utility water main. Use tapping sleeve and tapping valve.

C. Connect water-distribution piping to interior domestic water piping.

D. Connect waste piping from concrete vault drains to sanitary sewerage system. See Section 221313 "Facility Sanitary Sewers" for connection to sanitary-sewer and storm-drainage system.

E. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

F. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.17 FIELD QUALITY CONTROL

A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.

1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig. Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

C. Prepare reports of testing activities.

3.18 IDENTIFICATION

A. Install continuous underground detectable warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Section 312000 "Earth Moving."

B. Permanently attach equipment nameplate or marker indicating plastic water-service piping, on main electrical meter panel.

3.19 CLEANING

A. Clean and disinfect water-distribution piping as follows:

1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:

    a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
    b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
    c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
    d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.

B. Prepare reports of purging and disinfecting activities.

END OF SECTION 221113

SECTION 221116 - DOMESTIC WATER PIPING

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. Under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.
2. Encasement for piping.

B. Related Requirements:

1. Section 221113 "Facility Water Distribution Piping" for water-service piping and water meters outside the building from source to the point where water-service piping enters the building.

1.3 ACTION SUBMITTALS

A. Product Data: For transition fittings and dielectric fittings.

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.

C. System purging and disinfecting activities report.

D. Field quality-control reports.

1.4 FIELD CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:

1. Notify Architect no fewer than two days in advance of proposed interruption of water service.
2. Do not interrupt water service without Architect's written permission.

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.

B. Potable-water piping and components shall comply with NSF 14 and NSF 61 Annex G. Plastic piping components shall be marked with "NSF-pw."

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.

B. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.

C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.

D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

F. Copper Unions:

1. MSS SP-123.
2. Cast-copper-alloy, hexagonal-stock body.
3. Ball-and-socket, metal-to-metal seating surfaces.
4. Solder-joint or threaded ends.

G. Copper Pressure-Seal-Joint Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Elkhart Products Corporation.
b. NIBCO INC.
c. Viega LLC.

2. Fittings for NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber, O-ring seal in each end.

3. Fittings for NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber, O-ring seal in each end.

H. Copper Push-on-Joint Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Victaulic Company.

2. Description:

a. Cast-copper fitting complying with ASME B16.18 or wrought-copper fitting complying with ASME B 16.22.
b. Stainless-steel teeth and EPDM-rubber, O-ring seal in each end instead of solder-joint ends.

I. Appurtenances for Grooved-End Copper Tubing:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Anvil International.
b. Grinnell Mechanical Products.
c. Victaulic Company.

2. Bronze Fittings for Grooved-End, Copper Tubing: ASTM B 75 copper tube or ASTM B 584 bronze castings.
3. Mechanical Couplings for Grooved-End Copper Tubing:

a. Copper-tube dimensions and design similar to AWWA C606.
b. Ferrous housing sections.
c. EPDM-rubber gaskets suitable for hot and cold water.
d. Bolts and nuts.
e. Minimum Pressure Rating: 300 psig.

2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys.

D. Flux: ASTM B 813, water flushable.

E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

F. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

G. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.4 ENCASEMENT FOR PIPING

A. Standard: ASTM A 674 or AWWA C105/A21.5.

B. Form: Tube.

C. Color: Black.

2.5 TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Coupling: AWWA C219.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Jay R. Smith Mfg. Co.
b. Smith-Blair, Inc.
c. Viking Johnson.

D. Plastic-to-Metal Transition Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Charlotte Pipe and Foundry Company.
b. Uponor.

2. Description:

a. PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
b. One end with threaded brass insert and one solvent-cement-socket or threaded end.

E. Plastic-to-Metal Transition Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Colonial Engineering, Inc.
   b. NIBCO INC.

2. Description:

   a. PVC four-part union.
   b. Brass or stainless-steel threaded end.
   c. Solvent-cement-joint or threaded plastic end.
   d. Rubber O-ring.
   e. Union nut.

2.6 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. HART Industrial Unions, LLC.
   b. Watts; a Watts Water Technologies company.
   c. Zurn Industries, LLC.

2. Standard: ASSE 1079.
3. Pressure Rating: 125 psig minimum at 180 deg F.
4. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Matco-Norca.
   b. Watts; a Watts Water Technologies company.
   c. Zurn Industries, LLC.

2. Standard: ASSE 1079.
3. Factory-fabricated, bolted, companion-flange assembly.
4. Pressure Rating: 125 psig minimum at 180 deg F.
5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Pipeline Seal and Insulator, Inc.

2. Nonconducting materials for field assembly of companion flanges.
3. Pressure Rating: 150 psig.
4. Gasket: Neoprene or phenolic.
5. Bolt Sleeves: Phenolic or polyethylene.
6. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Matco-Norca.
   b. Precision Plumbing Products.
   c. Victaulic Company.

2. Standard: IAPMO PS 66.

3. Electroplated steel nipple complying with ASTM F 1545.
4. Pressure Rating and Temperature: 300 psig at 225 deg F.
5. End Connections: Male threaded or grooved.
6. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.

D. Install underground copper tube in PE encasement according to ASTM A 674 or AWWA C105/A21.5.

E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 221119 "Domestic Water Piping Specialties."

F. Install shutoff valve immediately upstream of each dielectric fitting.

G. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."

H. Install domestic water piping level without pitch and plumb.

I. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

J. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

K. 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.

L. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

M. Install piping to permit valve servicing.

N. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

O. Install piping free of sags and bends.

P. Install fittings for changes in direction and branch connections.

Q. Install PEX piping with loop at each change of direction of more than 90 degrees.

R. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

S. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping."

T. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 221123 "Domestic Water Pumps."

U. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gages for Plumbing Piping."

V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.

E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.

G. Push-on Joints for Copper Tubing: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on-joint fittings by inserting tube to measured depth.

H. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.

I. Joint Construction for Grooved-End Copper Tubing: Make joints according to AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.

J. 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.

K. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.4 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:

1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
2. Fittings for NPS 2 and Larger: Sleeve-type coupling.

C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings.

3.5 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:

    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

D. 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.
7. NPS 8: 10 feet with 3/4-inch rod.

E. Install supports for vertical copper tubing every 10 feet.

F. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.8 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

B. Label pressure piping with system operating pressure.

3.9 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Piping Inspections:

a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.

c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.10 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.

2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

    a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
    b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Fill and isolate system according to either of the following:

        1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
        2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

    c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
    d. Repeat procedures if biological examination shows contamination.
    e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.12 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

D. Under-building-slab, domestic water, building-service piping, NPS 3 and smaller, shall be the following:

1. Soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.

E. Under-building-slab, domestic water piping, NPS 2 and smaller, shall be the following:

1. Hard or soft copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and brazed.

F. Aboveground domestic water piping, NPS 2 and smaller, shall be the following:

1. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
2. Hard copper tube, ASTM B 88, Type L; cast-or wrought-copper, solder-joint fittings; and soldered joints.

G. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be the following:

1. Hard copper tube, ASTM B 88, Type L; cast- or 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 or gate 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 ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
3. Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves.
4. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

C. Iron grooved-end valves may be used with grooved-end piping.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Temperature-actuated, water mixing valves.
6. Strainers.
7. Outlet boxes.
8. Hose stations.
9. Hose bibbs.
10. Wall hydrants.
11. Drain valves.
12. Water-hammer arresters.
13. Air vents.
14. Trap-seal primer valves.
15. Trap-seal primer systems.
16. Flexible connectors.
17. Water meters.

B. Related Requirements:

1. Section 220519 "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
2. Section 221116 "Domestic Water Piping" for water meters.
3. Section 224713 "Drinking Fountains" for water filters for water coolers.
4. Section 224723 "Remote Water Coolers" for water filters for water coolers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For domestic water piping specialties.

1. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Potable-water piping and components shall comply with NSF 61 Annex G and NSF 14. Mark "NSF-pw" on plastic piping components.

2.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Watts; a Watts Water Technologies company.
b. Zurn Industries, LLC.

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. MIFAB, Inc.
b. Watts; a Watts Water Technologies company.
c. Zurn Industries, LLC.

2. Standard: ASSE 1011.
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.

2.4 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Watts; a Watts Water Technologies company.
   b. Zurn Industries, LLC.

2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle third of flow range.
5. Size: 2-1/2 NPS.
6. Design Flow Rate: 60 gpm.
7. Pressure Loss at Design Flow Rate: 12 psig for NPS 2-1/2 and larger.
8. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
9. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
10. Configuration: Designed for horizontal, straight-through flow.
11. Accessories:

    a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
    b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
    c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

2.5 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Watts; a Watts Water Technologies company.
   b. Zurn Industries, LLC.

2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig.
4. Size: 2-1/2 NPS.
5. Design Flow Rate: 60 gpm.
6. Body: Bronze with chrome-plated finish for NPS 2 and smaller; cast iron for NPS 2-1/2 and NPS 3.
7. Valves for Booster Heater Water Supply: Include integral bypass.

8. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

2.6 BALANCING VALVES

A. Cast-Iron Calibrated Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Armstrong International, Inc.
   b. NIBCO INC.
   c. Watts; a Watts Water Technologies company.

2. Type: Adjustable with Y-pattern globe valve, two readout ports, and memory-setting indicator.
3. Size: Same as connected piping, but not smaller than NPS 2-1/2.

B. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

2.7 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Primary, Thermostatic, Water Mixing Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Armstrong International, Inc.
   b. Lawler Manufacturing Company, Inc.
   c. Leonard Valve Company.

2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Type: Exposed-mounted, thermostatically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded union inlets and outlet.
7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Tempered-Water Setting: 120 deg F.
9. Valve Finish: Rough bronze.
10. Piping Finish: Copper.

2.8 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum unless otherwise indicated.

2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size:

    a. Strainers NPS 2 and Smaller: 0.020 inch.
    b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.

6. Drain: Factory-installed, hose-end drain valve.

2.9 OUTLET BOXES

A. Icemaker Outlet Boxes:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Oatey.

2. Mounting: Recessed.
3. Material and Finish: Plastic box and faceplate.
4. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.
5. Supply Shutoff Fitting: NPS 1/2 gate, globe, or ball valve and NPS 1/2 copper, water tubing.

2.10 WALL HYDRANTS

A. Vacuum Breaker Wall Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Mifab.

2. Standard: ASSE 1019, Type A or Type B.
3. Type: Freeze-resistant, automatic draining with integral air-inlet valve.
4. Classification: Type A, for automatic draining with hose removed or 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.

2.11 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.

2.12 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. MIFAB, Inc.
   b. Precision Plumbing Products.
   c. Watts; a Watts Water Technologies company.

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.

2.13 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. MIFAB, Inc.
   b. Precision Plumbing Products.
   c. Watts; a Watts Water Technologies company.

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.

B. Drainage-Type, Trap-Seal Primer Device:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Jay R. Smith Mfg. Co.

2. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 minimum, trap makeup connection.
3. Size: NPS 1-1/4 minimum.
4. Material: Chrome-plated, cast brass.

2.14 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Metraflex Company (The).

B. 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.

C. 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.

2.15 WATER METERS

A. Displacement-Type Water Meters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ABB.
b. Mueller Co.

2. Description:

a. Standard: AWWA C700.
b. Pressure Rating: 150-psig working pressure.
c. Body Design: Nutating disc; totalization meter.
d. Registration: In gallons or cubic feet as required by utility company.
e. Case: Bronze.
f. End Connections: Threaded.

B. Remote Registration System: Direct-reading type complying with AWWA C706; modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Locate backflow preventers in same room as connected equipment or system.
2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
3. Do not install bypass piping around backflow preventers.

B. Install water regulators with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.

C. Install water-control valves with inlet and outlet shutoff valves. 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 cabinet-type units recessed in or surface mounted on wall as specified.

F. Install Y-pattern strainers for water on supply side of each water pressure-reducing valve.

G. Install outlet boxes recessed in wall or surface mounted on wall. Install 2-by-4-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "Rough Carpentry."

H. Install water-hammer arresters in water piping according to PDI-WH 201.

I. 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.

J. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.

3.2 CONNECTIONS

A. Comply with requirements for ground equipment in Section 260526 "Grounding and Bonding for Electrical Systems."

3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Pressure vacuum breakers.
2. Reduced-pressure-principle backflow preventers.
3. Water pressure-reducing valves.
4. Calibrated balancing valves.
5. Primary, thermostatic, water mixing valves.
6. Primary water tempering valves.
7. Outlet boxes.
8. Supply-type, trap-seal primer valves.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test each reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.

B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION 221119

SECTION 221123 - DOMESTIC WATER PUMPS

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. In-line, seal-less centrifugal pumps.

1.3 DEFINITIONS

A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include materials of construction, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. LEED Submittals:

1. Product Data for Prerequisite EA 2: Documentation indicating that units comply with applicable requirements in ASHRAE/IESNA 90.1, without amendments, Section 7 - "Service Water Heating."

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water pumps to include in operation and maintenance manuals.

1.6 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. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with pump manufacturer's written rigging instructions for handling.

1.8 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 IN-LINE, SEALLESS CENTRIFUGAL PUMPS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Armstrong Pumps, Inc.
2. Bell & Gossett; a Xylem brand.
3. Grundfos Pumps Corp.
4. TACO Incorporated.

B. Description: Factory-assembled and -tested, in-line, close-coupled, canned-motor, seal-less, overhung-impeller centrifugal pumps.

C. Pump Construction:

1. Pump and Motor Assembly: Hermetically sealed, replaceable-cartridge type with motor and impeller on common shaft and designed for installation with pump and motor shaft horizontal.
2. Casing: Bronze, with threaded or companion-flange connections.
3. Impeller: Plastic.
4. Motor: Single speed, unless otherwise indicated.

D. Capacities and Characteristics:

1. See Schedule.

2.2 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2.3 CONTROLS

A. Timers: Electric, for control of hot-water circulation pump.

1. Type: Programmable, seven-day clock with manual override on-off switch.
2. Enclosure: NEMA 250, Type 1, suitable for wall mounting.
3. Operation of Pump: On or off.
4. Transformer: Provide if required.
5. Power Requirement: 24-V ac.
6. Programmable Sequence of Operation: Up to two on-off cycles each day for seven days.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.

3.2 PUMP INSTALLATION

A. Comply with HI 1.4.

B. Install in-line, seal-less centrifugal pumps with shaft horizontal unless otherwise indicated.

C. Install continuous-thread hanger rods and spring hangers of size required to support pump weight.

1. Comply with requirements for hangers and supports specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

D. Install pressure switches in water supply piping.

E. Install thermostats in hot-water return piping.

F. Install timers on wall in Janitor Room 108 adjacent to pump.

3.3 CONNECTIONS

A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to pumps to allow service and maintenance.

C. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.

D. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping. Comply with requirements for valves specified in Section 220523 “General Duty Valves for Plumbing Piping” and comply with requirements for strainers specified in Section 221119 "Domestic Water Piping Specialties."

1. Install pressure gage at suction of each pump and pressure gage at discharge of each pump. Install at integral pressure-gage tappings where provided or install pressure-gage connectors in suction and discharge piping around pumps. Comply with requirements for pressure gages and snubbers specified in Section 220519 "Meters and Gages for Plumbing Piping."

E. Connect timers to pumps that they control.

3.4 IDENTIFICATION

A. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment" for identification of pumps.

3.5 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. Set thermostats, timers, for automatic starting and stopping operation of pumps.
5. Perform the following startup checks for each pump before starting:

    a. Verify bearing lubrication.
    b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
    c. Verify that pump is rotating in the correct direction.

6. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
7. Start motor.
8. Open discharge valve slowly.
9. Adjust temperature settings on thermostats.
10. Adjust timer settings.

3.6 ADJUSTING

A. Adjust domestic water pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust initial temperature set points.

C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

END OF SECTION 221123

SECTION 221313 - FACILITY SANITARY SEWERS

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. Ductile-iron, gravity sewer pipe and fittings.
2. PVC pipe and fittings.
3. Expansion joints and deflection fittings.
4. Cleanouts.
5. Manholes.

1.3 DEFINITIONS

A. FRP: Fiberglass-reinforced plastic.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Pipe and fittings.
2. Expansion joints and deflection fittings.
3. Cleanouts.

B. Shop Drawings: For manholes. Include plans, elevations, sections, details, and frames and covers.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings:

1. Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from sewer system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.

2. Show system piping in profile. Draw profiles to horizontal scale of not less than 1 inch equals 50 feet and to vertical scale of not less than 1 inch equals 5 feet. Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing system piping.

B. Product Certificates: For each type of pipe and fitting.

C. Field quality-control reports.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect pipe, pipe fittings, and seals from dirt and damage.

B. Handle manholes according to manufacturer's written rigging instructions.

1.7 FIELD CONDITIONS

A. Interruption of Existing Sanitary Sewerage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Architect no fewer than two days in advance of proposed interruption of service.
2. Do not proceed with interruption of service without Architect's written permission.

PART 2 - PRODUCTS

2.1 DUCTILE-IRON, GRAVITY SEWER PIPE AND FITTINGS

A. Pipe: ASTM A 746, for push-on joints.

B. Standard Fittings: AWWA C110/A21.10, ductile or gray iron, for push-on joints.

C. Compact Fittings: AWWA C153/A21.53, ductile iron, for push-on joints.

D. Gaskets: AWWA C111/A21.11, rubber.

2.2 PVC PIPE AND FITTINGS

A. PVC Cellular-Core Sewer Piping:

1. Pipe: ASTM F 891, Sewer and Drain Series, PS 50 minimum stiffness, PVC cellular-core pipe with plain ends for solvent-cemented joints.
2. Fittings: ASTM D 3034, SDR 35, PVC socket-type fittings.

B. PVC Corrugated Sewer Piping:

1. Pipe: ASTM F 949, PVC corrugated pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM F 949, PVC molded or fabricated, socket type.
3. Gaskets: ASTM F 477, elastomeric seals.

C. PVC Profile Sewer Piping:

1. Pipe: ASTM F 794, PVC profile, gravity sewer pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM D 3034, PVC with bell ends.
3. Gaskets: ASTM F 477, elastomeric seals.

D. PVC Type PSM Sewer Piping:

1. Pipe: ASTM D 3034, SDR 35, PVC Type PSM sewer pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM D 3034, PVC with bell ends.
3. Gaskets: ASTM F 477, elastomeric seals.

E. PVC Gravity Sewer Piping:

1. Pipe and Fittings: ASTM F 679, T-1wall thickness, PVC gravity sewer pipe with bell-and-spigot ends and with integral ASTM F 477, elastomeric seals for gasketed joints.

F. PVC Pressure Piping:

1. Pipe: AWWA C900, Class 100 PVC pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: AWWA C900, Class 100 PVC pipe with bell ends.
3. Gaskets: ASTM F 477, elastomeric seals.

2.3 NONPRESSURE-TYPE TRANSITION COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling; for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and include corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:

1. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
2. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.

C. Nonpressure-Type, Rigid Couplings:

1. Description: ASTM C 1461, sleeve-type, reducing- or transition-type mechanical coupling; molded from ASTM C 1440, TPE material; with corrosion-resistant-metal tension band and tightening mechanism on each end.

2. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. ANACO-Husky.

2.4 PRESSURE-TYPE PIPE COUPLINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Jay R. Smith Mfg. Co.
2. JCM Industries, Inc.
3. Victaulic Company.

B. Tubular-Sleeve Couplings: AWWA C219, with center sleeve, gaskets, end rings, and bolt fasteners.

C. Metal, bolted, sleeve-type, reducing or transition coupling; for joining underground pressure piping. Include 150-psig minimum pressure rating and ends of same sizes as piping to be joined.

D. Center-Sleeve Material: Manufacturer's standard.

E. Gasket Material: Natural or synthetic rubber.

F. Metal Component Finish: Corrosion-resistant coating or material.

2.5 EXPANSION JOINTS AND DEFLECTION FITTINGS

A. Ductile-Iron Expansion Joints:

1. Description: Three-piece assembly of telescoping sleeve with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110/A21.10 or AWWA C153/A21.53. Include rating for 250-psig minimum working pressure and for expansion indicated.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Jay R. Smith Mfg. Co.
    b. JCM Industries, Inc.

2.6 BACKWATER VALVES

A. PVC Backwater Valves:

1. Description: Horizontal type; with PVC body, PVC removable cover, and PVC swing check valve.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Sioux Chief Manufacturing Company, Inc.
    b. Zurn Industries, LLC.

2.7 CLEANOUTS

A. Cast-Iron Cleanouts:

1. Description: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. MIFAB, Inc.
    b. Watts; a Watts Water Technologies company.
    c. Zurn Industries, LLC.

3. Top-Loading Classification(s): Heavy Duty.
4. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

B. PVC Cleanouts:

1. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Sioux Chief Manufacturing Company, Inc.
    b. Zurn Industries, LLC.
    c. Charlotte Pipe

2.8 MANHOLES

A. Standard Precast Concrete Manholes:

1. Description: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Diameter: 48 inches minimum unless otherwise indicated.
3. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
4. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section; with separate base slab or base section with integral floor.
5. Riser Sections: 4-inch minimum thickness, of length to provide depth indicated.
6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated; with top of cone of size that matches grade rings.

7. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
8. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
9. Steps: Individual FRP steps, FRP ladder, or ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 inches.
10. Adjusting Rings: Interlocking HDPE rings, with level or sloped edge in thickness and diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.
11. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, with diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope.

B. Manhole Frames and Covers:

1. Description: Ferrous; 24-inch ID by 7- to 9-inch riser, with 4-inch-minimum-width flange and 26-inch-diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "SANITARY SEWER."
2. Material: ASTM A 536, Grade 60-40-18 ductile iron unless otherwise indicated.

C. Manhole-Cover Inserts:

1. Description; Manufactured, plastic form, of size to fit between manhole frame and cover and designed to prevent stormwater inflow. Include handle for removal and gasket for gastight sealing.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. FRW Industries.
    b. Knutson Enterprises.
    c. L. F. Manufacturing, Inc.

3. Type: Solid.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details to indicate general location and arrangement of underground sanitary sewer piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.

C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.

F. Install gravity-flow, nonpressure, drainage piping according to the following:

1. Install piping pitched down in direction of flow, at minimum slope of 1 percent unless otherwise indicated.
2. Install piping NPS 6 and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place-concrete supports or anchors.
3. Install piping with 36-inch minimum cover.
4. Install hub-and-spigot, cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
5. Install hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
6. Install ductile-iron, gravity sewer piping according to ASTM A 746.
7. Install ABS sewer piping according to ASTM D 2321 and ASTM F 1668.
8. Install PVC cellular-core sewer piping according to ASTM D 2321 and ASTM F 1668.
9. Install PVC corrugated sewer piping according to ASTM D 2321 and ASTM F 1668.
10. Install PVC profile sewer piping according to ASTM D 2321 and ASTM F 1668.
11. Install PVC Type PSM sewer piping according to ASTM D 2321 and ASTM F 1668.
12. Install PVC gravity sewer piping according to ASTM D 2321 and ASTM F 1668.
13. Install fiberglass sewer piping according to ASTM D 3839 and ASTM F 1668.
14. Install nonreinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."
15. Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."

G. Install corrosion-protection piping encasement over the following underground metal piping according to ASTM A 674 or AWWA C105/A21.5:

1. Hub-and-spigot, cast-iron soil pipe.
2. Hubless cast-iron soil pipe and fittings.

3. Ductile-iron pipe and fittings.
4. Expansion joints and deflection fittings.

H. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure, drainage piping according to the following:

1. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
2. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
3. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
4. Join ductile-iron, gravity sewer piping according to AWWA C600 for push-on joints.
5. Join ABS sewer piping according to ASTM D 2321 for elastomeric-seal joints.
6. Join PVC cellular-core sewer piping according to ASTM D 2321 and ASTM F 891 for solvent-cemented joints.
7. Join PVC corrugated sewer piping according to ASTM D 2321.
8. Join PVC profile sewer piping according to ASTM D 2321 for elastomeric-seal joints or ASTM F 794 for gasketed joints.
9. Join PVC Type PSM sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasket joints.
10. Join PVC gravity sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasket joints.
11. Join fiberglass sewer piping according to ASTM D 4161 for elastomeric-seal joints.
12. Join nonreinforced-concrete sewer piping according to ASTM C 14 and ACPA's "Concrete Pipe Installation Manual" for rubber-gasket joints.
13. Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasket joints.
14. Join dissimilar pipe materials with nonpressure-type, flexible or rigid couplings.

B. Join force-main, pressure piping according to the following:

1. Join ductile-iron pressure piping according to AWWA C600 or AWWA M41 for push-on joints.
2. Join ductile-iron special fittings according to AWWA C600 or AWWA M41 for push-on joints.
3. Join PVC pressure piping according to AWWA M23 for gasketed joints.
4. Join PVC water-service piping according to ASTM D 2855.
5. Join dissimilar pipe materials with pressure-type couplings.

3.4 MANHOLE INSTALLATION

A. General: Install manholes complete with appurtenances and accessories indicated.

B. Install precast concrete manhole sections with sealants according to ASTM C 891.

C. Install FRP manholes according to manufacturer's written instructions.

D. Form continuous concrete channels and benches between inlets and outlet.

E. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere unless otherwise indicated.

F. Install manhole-cover inserts in frame and immediately below cover.

3.5 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318.

3.6 BACKWATER VALVE INSTALLATION

A. Install horizontal-type backwater valves in piping manholes or pits.

B. Install combination horizontal and manual gate-type valves in piping and in manholes.

C. Install terminal-type backwater valves on end of piping and in manholes. Secure units to sidewalls.

3.7 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts, and use cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.

1. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
2. Use Medium-Duty, top-loading classification cleanouts in paved foot-traffic
3. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.
4. Use Extra-Heavy-Duty, top-loading classification cleanouts in roads.

B. Set cleanout frames and covers in earth in cast-in-place-concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding grade.

C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.8 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping to building's sanitary building drains specified in Section 221316 "Sanitary Waste and Vent Piping."

B. Connect force-main piping to building's sanitary force mains specified in Section 221316 "Sanitary Waste and Vent Piping." Terminate piping where indicated.

C. Make connections to existing piping and underground manholes.

1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye fitting plus 6-inch overlap with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
2. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
3. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes by cutting opening into existing unit large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of, and be flush with, inside wall unless otherwise indicated. On outside of pipe or manhole wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.

    a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.
    b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

4. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

3.9 CLOSING ABANDONED SANITARY SEWER SYSTEMS

A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:

1. Close open ends of piping with at least 8-inch- thick, brick masonry bulkheads.
2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.

B. Abandoned Manholes: Excavate around manhole as required and use either procedure below:

1. Remove manhole and close open ends of remaining piping.
2. Remove top of manhole down to at least 36 inches below final grade. Fill to within 12 inches of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.

C. Backfill to grade according to Section 312000 "Earth Moving."

3.10 IDENTIFICATION

A. Comply with requirements in Section 312000 "Earth Moving" for underground utility identification devices. Arrange for installation of green warning tapes directly over piping and at outside edges of underground manholes.

1. Use warning tape or detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground manholes.

3.11 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate report for each system inspection.
2. Defects requiring correction include the following:

    a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
    c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
    d. Infiltration: Water leakage into piping.
    e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to requirements of authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.
5. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:

    a. Fill sewer piping with water. Test with pressure of at least 10-foot head of water, and maintain such pressure without leakage for at least 15 minutes.
    b. Close openings in system and fill with water.
    c. Purge air and refill with water.
    d. Disconnect water supply.
    e. Test and inspect joints for leaks.

6. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:

    a. Test plastic gravity sewer piping according to ASTM F 1417.
    b. Test concrete gravity sewer piping according toASTM C 1628.

7. Manholes: Perform hydraulic test according to ASTM C 969.

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.12 CLEANING

A. Clean dirt and superfluous material from interior of piping. Flush with potable water.

END OF SECTION 221313

SECTION 221316 - SANITARY WASTE AND VENT PIPING

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. Pipe, tube, and fittings.
2. Specialty pipe fittings.
3. Encasement for underground metal piping.

B. Related Requirements:

1. Section 221313 "Facility Sanitary Sewers" for sanitary sewerage piping and structures outside the building.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 FIELD CONDITIONS

A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Architect no fewer than two days in advance of proposed interruption of sanitary waste service.
2. Do not proceed with interruption of sanitary waste service without Architect's written permission.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water.
2. Waste, Force-Main Piping: 100 psig.

2.2 PIPING MATERIALS

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service class(es).

B. Gaskets: ASTM C 564, rubber.

C. Caulking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.4 PVC PIPE AND FITTINGS

A. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

B. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

C. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.

D. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

E. Adhesive Primer: ASTM F 656.

F. Solvent Cement: ASTM D 2564.

2.5 ENCASEMENT FOR UNDERGROUND METAL PIPING

A. Standard: ASTM A 674 or AWWA C105/A 21.5.

B. Material: Linear low-density polyethylene film of 0.008-inch minimum thickness.

C. Form: Sheet.

D. Color: Black.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.

1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
2. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.

1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
2. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.

a. Straight tees, elbows, and crosses may be used on vent lines.

3. Do not change direction of flow more than 90 degrees.
4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.

    a. Reducing size of waste piping in direction of flow is prohibited.

K. Lay buried building waste piping beginning at low point of each system.

1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
3. Maintain swab in piping and pull past each joint as completed.

L. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:

1. Building Sanitary Waste: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
2. Horizontal Sanitary Waste Piping: 2 percent downward in direction of flow.
3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

N. Install aboveground PVC piping according to ASTM D 2665.

O. Install underground PVC piping according to ASTM D 2321.

P. Plumbing Specialties:

1. Install backwater valves in sanitary waster gravity-flow piping.

    a. Comply with requirements for backwater valves specified in Section 221319 "Sanitary Waste Piping Specialties."

2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.

    a. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."

3. Install drains in sanitary waste gravity-flow piping.

    a. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."

Q. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

R. Install sleeves for piping penetrations of walls, ceilings, and floors.

1. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

S. Install sleeve seals for piping penetrations of concrete walls and slabs.

1. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

T. Install escutcheons for piping penetrations of walls, ceilings, and floors.

1. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1.

1. Cut threads full and clean using sharp dies.
2. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
c. Do not use pipe sections that have cracked or open welds.

D. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 appendixes.
3. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 appendixes.

3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in ODs.
2. In Waste Drainage Piping: Shielded, nonpressure transition couplings.

3.5 VALVE INSTALLATION

A. Comply with requirements in Section 220523 “General Duty Valves for Plumbing Piping" for general-duty valve installation requirements.

B. Backwater Valves: Install backwater valves in piping subject to backflow.

1. Horizontal Piping: Horizontal backwater valves. Use normally closed type unless otherwise indicated.
2. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.
3. Install backwater valves in accessible locations.
4. Comply with requirements for backwater valve specified in Section 221319 "Sanitary Waste Piping Specialties."

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
5. Vertical Piping: MSS Type 8 or Type 42, clamps.
6. Install individual, straight, horizontal piping runs:

    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
8. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support horizontal piping and tubing within 12 inches of each fitting and coupling.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

E. 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 and NPS 8: 60 inches with 3/4-inch rod.
5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

F. Install supports for vertical cast-iron soil piping every 15 feet.

G. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
2. NPS 3: 48 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
4. NPS 6 and NPS 8: 48 inches with 3/4-inch rod.
5. NPS 10 and NPS 12: 48 inches with 7/8-inch rod.

H. Install supports for vertical PVC piping every 48 inches.

I. Support piping and tubing not listed above according to MSS SP-58 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect waste and vent piping to the following:

1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
5. Comply with requirements for cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
6. Equipment: Connect waste piping as indicated.

    a. Provide shutoff valve if indicated and union for each connection.
    b. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

E. Make connections according to the following unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.8 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping.

B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.9 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary waste and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.

    a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.

    a. Expose work that was covered or concealed before it was tested.

3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.

    a. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water.
    b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
    c. Inspect joints for leaks.

4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.

    a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg.

b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
c. Air pressure must remain constant without introducing additional air throughout period of inspection.
d. Inspect plumbing fixture connections for gas and water leaks.

5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.10 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

D. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

E. Repair damage to adjacent materials caused by waste and vent piping installation.

3.11 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, soil and waste piping NPS 4 and smaller shall be the following:

1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

C. Aboveground, vent piping NPS 4 and smaller the following:

1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

D. Underground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:

1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
2. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

END OF SECTION 221316

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Backwater valves.
2. Cleanouts.
3. Air-admittance valves.
4. Roof flashing assemblies.
5. Through-penetration firestop assemblies.
6. Miscellaneous sanitary drainage piping specialties.

B. Related Requirements:

1. Section 221423 "Storm Drainage Piping Specialties" for trench drains for storm water, channel drainage systems for storm water, roof drains, and catch basins.

1.3 DEFINITIONS

A. PVC: Polyvinyl chloride.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rated capacities, operating characteristics, and accessories for the following:

B. Shop Drawings:

1. Show fabrication and installation details for frost-resistant vent terminals.
2. Wiring Diagrams: Power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For sanitary waste piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTIONS

A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14 for plastic sanitary waste piping specialty components.

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

2.2 CLEANOUTS

A. Cast-Iron Exposed Cleanouts:

1. Standard: ASME A112.36.2M.
2. Size: Same as connected drainage piping.
3. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
4. Closure: Countersunk, cast-iron plug.
5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Cast-Iron Exposed Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Sioux Chief Manufacturing Company, Inc.
    b. Watts; a Watts Water Technologies company.
    c. Zurn Industries, LLC.

2. Standard: ASME A112.36.2M for threaded, adjustable housing cleanout.

3. Size: Same as connected branch.
4. Type: Threaded, adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Required.
7. Outlet Connection: Threaded.
8. Closure: Brass plug with straight threads and gasket.
9. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Material and Finish: Rough bronze.
11. Frame and Cover Shape: Round.

12. Top Loading Classification: Heavy 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. MIFAB, Inc.
    b. Watts; a Watts Water Technologies company.
    c. Zurn Industries, LLC.

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 as required to match connected piping.
5. Closure Plug:

    a. Brass.
    b. Countersunk head.
    c. Drilled and threaded for cover attachment screw.
    d. Size: Same as or not more than one size smaller than cleanout size.

6. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
7. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

2.3 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Acorn Engineering Company.
    b. Thaler Metal Industries Ltd.
    c. Zurn Industries, LLC.

2. Description: Manufactured assembly made of 4.0-lb/sq. ft., 0.0625-inch-thick, lead flashing collar and skirt extending at least 6 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.

    a. Low-Silhouette Vent Cap: With vandal-proof vent cap.

2.4 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. ProSet Systems Inc.

2. Standard: UL 1479 assembly of sleeve-and-stack fitting with firestopping plug.
3. Size: Same as connected soil, waste, or vent stack.
4. Sleeve: Molded-PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
5. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.

2.5 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains:

1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564 rubber gaskets.
2. Size: Same as connected waste piping.

B. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.

    a. NPS 2: 4-inch-minimum water seal.
    b. NPS 2-1/2 and Larger: 5-inch-minimum water seal.

C. Floor-Drain, Trap-Seal Primer Fittings:

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

D. 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.

E. 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.

F. 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.

G. 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.

H. Fittings in "Expansion Joints" Paragraph below are designed for use with roof drains but may also be used with conductors and sanitary drainage and vent systems if required.

I. Expansion Joints:

1. Standard: ASME A112.6.4.
2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.
4. Size: Same as connected soil, waste, or vent piping.

2.6 MOTORS

A. General requirements for motors are specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, motor shall be large enough, so driven load will not require motor to operate in service factor range above 1.0.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install backwater valves in building drain piping.

1. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. 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 flashing assemblies on sanitary stack vents and vent stacks that extend through roof. Comply with requirements in Section 076000 "Flashing and Sheet Metal."

F. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof. Comply with requirements in Section 076000 "Flashing and Sheet Metal."

G. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.

1. Comply with requirements in Section 078400 "Firestopping."

H. Assemble open drain fittings and install with top of hub 2 inches above floor.

I. Install deep-seal traps on floor drains and other waste outlets, if indicated.

J. 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.

K. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

L. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.

M. Install vent caps on each vent pipe passing through roof.

N. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

O. Install wood-blocking reinforcement for wall-mounting-type specialties.

P. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 CONNECTIONS

A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FLASHING INSTALLATION

A. Comply with requirements in Section 076000 "Flashing and Sheet Metal."

B. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required.

C. 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.

D. Set flashing on floors and roofs in solid coating of bituminous cement.

E. Secure flashing into sleeve and specialty clamping ring or device.

F. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Section 076000 "Flashing and Sheet Metal."

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.

1. Nameplates and signs are specified in Section 220553 "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 221319

SECTION 221319.13 - SANITARY DRAINS

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. Floor drains.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene styrene.

B. FRP: Fiberglass-reinforced plastic.

C. HDPE: High-density polyethylene.

D. PE: Polyethylene.

E. PP: Polypropylene.

F. PVC: Polyvinyl chloride.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 DRAIN ASSEMBLIES

A. Sanitary drains shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14 for plastic sanitary piping specialty components.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains - See drawing P-900 for floor drain scheduling.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. MIFAB, Inc.
b. Watts; a Watts Water Technologies company.
c. Zurn Industries, LLC.

2. Standard: ASME A112.6.

3. Pattern: Sanitary drain.
4. Body Material: Cast iron.
5. Seepage Flange: Required.
6. Anchor Flange: Required.
7. Clamping Device: Not required.
8. Outlet: Bottom.
9. Backwater Valve: Not required.
10. Coating on Interior and Exposed Exterior Surfaces: Acid-resistant enamel.
11. Sediment Bucket: Not required.
12. Top or Strainer Material: Stainless steel.
13. Top of Body and Strainer Finish: Stainless steel.
14. Top Shape: Round.
15. Top Loading Classification: Medium Duty.
16. Funnel: Not required.
17. Inlet Fitting: Gray iron and trap-seal primer valve connection.
18. Trap Material: Cast iron.
19. Trap Pattern: Standard P-trap.
20. Trap Features: Trap-seal primer valve drain connection.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
3. Set with grates depressed according to the following drainage area radii:

a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.

4. Install floor-drain flashing collar or flange, so no leakage occurs between drain and adjoining flooring.

    a. Maintain integrity of waterproof membranes where penetrated.

5. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

B. Install trench drains at low points of surface areas to be drained.

1. Set grates of drains flush with finished surface, unless otherwise indicated.

C. Comply with ASME A112.3.1 for installation of stainless-steel channel drainage systems.

1. Install on support devices, so that top will be flush with adjacent surface.

D. Install FRP channel drainage system components on support devices, so that top will be flush with adjacent surface.

E. Install plastic channel drainage system components on support devices, so that top will be flush with adjacent surface.

F. Install open drain fittings with top of hub 2 inches above floor.

3.2 CONNECTIONS

A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Comply with requirements in Section 221319 "Sanitary Waste Piping Specialties" for backwater valves, air admittance devices and miscellaneous sanitary drainage piping specialties.

C. Install piping adjacent to equipment to allow service and maintenance.

D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 LABELING AND IDENTIFYING

A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

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 221319.13

SECTION 221413 - FACILITY STORM DRAINAGE PIPING

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. Pipe, tube, and fittings.
2. Encasement for underground metal piping.

1.3 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.

1.4 ACTION SUBMITTALS

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

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.

C. Shop Drawings: For roof drainage system. Include calculations, plans, and details.

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF/ANSI 14, "Plastics Piping System Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Storm-Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Architect no fewer than two days in advance of proposed interruption of storm-drainage service.
2. Do not proceed with interruption of storm-drainage service without Architect's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in the following for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service and Extra Heavy classes.

B. Gaskets: ASTM C 564, rubber.

C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. CISPI, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following

a. ANACO-Husky.
b. Dallas Specialty & Mfg. Co.
c. Fernco Inc.
d. Matco-Norca, Inc.
e. MIFAB, Inc.
f. Mission Rubber Company; a division of MCP Industries, Inc.
g. Stant.
h. Tyler Pipe.

2. Standards: ASTM C 1277 and CISPI 310.
3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

C. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ANACO-Husky.
b. Clamp-All Corp.
c. Dallas Specialty & Mfg. Co.
d. MIFAB, Inc.
e. Mission Rubber Company; a division of MCP Industries, Inc.
f. Stant.
g. Tyler Pipe.

2. Standards: ASTM C 1277 and ASTM C 1540.
3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

D. Cast-Iron, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. MG Piping Products Company.

2. Standard: ASTM C 1277.
3. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.4 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

B. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.

C. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

D. Adhesive Primer: ASTM F 656.

1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Solvent Cement: ASTM D 2564.

1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5 ENCASEMENT FOR UNDERGROUND METAL PIPING

A. Standard: ASTM A 674 or AWWA C105.

B. Material: High-density, crosslaminated PE film of 0.004-inch or LLDPE film of 0.008-inch minimum thickness.

C. Form: Sheet.

D. Color: Black.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

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 from layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Make changes in direction for storm drainage 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.

K. Lay buried building storm 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.

L. 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.

M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.

N. Install steel piping according to applicable plumbing code.

O. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."

P. Install aboveground ABS piping according to ASTM D 2661.

Q. Install aboveground PVC piping according to ASTM D 2665.

R. Install underground PVC piping according to ASTM D 2321.

S. Install engineered controlled-flow drain specialties and storm drainage piping in locations indicated.

1. Install encasement on piping according to ASTM A 674 or AWWA C105.

T. Plumbing Specialties:

1. Install backwater valves in storm drainage gravity-flow piping. Comply with requirements for backwater valves specified in Section 221423 "Storm Drainage Piping Specialties."
2. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping. Comply with requirements for cleanouts specified in Section 221423 "Storm Drainage Piping Specialties."
3. Install drains in storm drainage gravity-flow piping. Comply with requirements for drains specified in Section 221423 "Storm Drainage Piping Specialties."

U. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Hub-and-Spigot, Cast-Iron Soil Piping Calked Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum calked 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-piping coupling joints.

D. Plastic, Nonpressure-Piping, Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
3. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.4 VALVE INSTALLATION

A. General valve installation requirements are specified in Section 220523 “General Duty Valves for Plumbing Piping.”

B. 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. Comply with requirements for backwater valves specified in Section 221423 "Storm Drainage Piping Specialties."

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install fiberglass pipe hangers for horizontal piping in corrosive environments.
3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.

5. Vertical Piping: MSS Type 8 or Type 42, clamps.
6. Individual, Straight, Horizontal Piping Runs:

    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
8. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

E. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
2. NPS 3: 48 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
4. NPS 6 and NPS 8: 48 inches with 3/4-inch rod.
5. NPS 10 and NPS 12: 48 inches with 7/8-inch rod.

F. Install supports for vertical PVC piping every 48 inches.

G. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.

1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.
2. Comply with requirements for backwater valves, cleanouts, and drains specified in Section 221423 "Storm Drainage Piping Specialties."

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

E. Make connections according to the following unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.7 IDENTIFICATION

A. Identify exposed storm drainage piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

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.
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 or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Test Procedure: Test storm drainage piping on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts until completion of inspection, water level must not drop. Inspect joints for leaks.
4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. 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.

3.10 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground storm drainage piping NPS 6 and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI, heavy-duty, hubless-piping couplings; and coupled joints.
3. Cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints.

C. Underground storm drainage piping NPS 6 and smaller shall be any of the following:

1. Extra Heavy class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI, heavy-duty, cast-iron, hubless-piping couplings; and coupled joints.
3. Cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints.

D. Underground, storm drainage piping NPS 8 and larger shall be any of the following:

1. Extra Heavy class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI, heavy-duty, cast-iron, hubless-piping couplings; and coupled joints.
3. Cellular-core, sewer and drain series, PVC pipe; PVC socket fittings; and solvent-cemented joints.
4. Dissimilar Pipe-Material Couplings: Unshielded, non-pressure transition couplings.

END OF SECTION 221413

SECTION 221423 - STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Roof drains.
2. Miscellaneous storm drainage piping specialties.
3. Cleanouts.
4. Backwater valves.
5. Through-penetration firestop assemblies.
6. Flashing materials.

1.3 ACTION SUBMITTALS

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

1.4 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 METAL ROOF DRAINS

A. Cast-Iron, Large-Sump, General-Purpose Roof Drains:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Josam Company.
b. Marathon Roofing Products.
c. MIFAB, Inc.
d. Smith, Jay R. Mfg. Co.
e. Tyler Pipe.

f. Watts Water Technologies, Inc.
g. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.6.4, for general-purpose roof drains.
3. Body Material: Cast iron.
4. Dimension of Body: Nominal 14-inch diameter.
5. Combination Flashing Ring and Gravel Stop: Required.
6. Flow-Control Weirs: Required.
7. Outlet: Bottom.
8. Extension Collars: Required.
9. Underdeck Clamp: Required.
10. Expansion Joint: Required.
11. Sump Receiver Plate: Required.
12. Dome Material: Cast iron.
13. Perforated Gravel Guard: Stainless steel.
14. Vandal-Proof Dome: Not required.
15. Water Dam: 2 inches high.

2.2 CLEANOUTS

A. Test Tees:

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.
d. Tyler Pipe.
e. Watts Water Technologies, Inc.
f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M and ASTM A 74, ASTM A 888, or CISPI 301, for cleanout test tees.
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 Plug: Countersunk or raised head, brass.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Wall Cleanouts:

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.
d. Tyler Pipe.
e. Watts Water Technologies, Inc.

f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M, for cleanouts. Include wall access.
3. Size: Same as connected drainage piping.
4. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch 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.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

2.3 BACKWATER VALVES

A. Cast-Iron, Horizontal Backwater Valves:

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.
d. Tyler Pipe.
e. Watts Water Technologies, Inc.
f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.14.1, for backwater valves.
3. Size: Same as connected piping.
4. Body Material: Cast iron.
5. Cover: Cast iron with bolted access check valve.
6. End Connections: Hub and spigot.
7. Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang open for airflow unless subject to backflow condition.
8. Extension: ASTM A 74, Service class; full-size, cast-iron soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.

2.4 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. ProSet Systems Inc.

2. Standard: ASTM E 814, for through-penetration firestop assemblies.
3. Certification and Listing: Intertek Testing Service NA for through-penetration firestop assemblies.
4. Size: Same as connected pipe.

5. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
6. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
7. Special Coating: Corrosion resistant on interior of fittings.

2.5 FLASHING MATERIALS

A. Copper Sheet: ASTM B 152/B 152M, 12 oz./sq. ft.

B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.

C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.

D. Fasteners: Metal compatible with material and substrate being fastened.

E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

F. Solder: ASTM B 32, lead-free alloy.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions.

1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
2. Install expansion joints, if indicated, in roof drain outlets.
3. Position roof drains for easy access and maintenance.

B. Install downspout adapters on outlet of back-outlet parapet roof drains and connect to sheet metal downspouts.

C. Install downspout boots at grade with top 12 inches above grade. Secure to building wall.

D. Install cleanouts in aboveground piping and building drain piping according to the following instructions unless otherwise indicated:

1. Use cleanouts the same size as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate cleanouts at each change in direction of piping greater than 45 degrees.

3. Locate cleanouts at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate cleanouts at base of each vertical soil and waste stack.

E. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

F. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

G. Install horizontal backwater valves in floor with cover flush with floor.

H. Install drain-outlet backwater valves in outlet of drains.

I. Install test tees in vertical conductors and near floor.

J. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.

K. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface unless otherwise indicated.

L. Assemble channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.

M. Install through-penetration firestop assemblies in plastic conductors at concrete floor penetrations.

N. Install sleeve flashing device with each conductor passing through floors with waterproof membrane.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Section 221413 "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of 6.0-lb/sq. ft. lead sheets, 0.0938-inch thickness or thicker. Solder joints of 4.0-lb/sq. ft. lead sheets, 0.0625-inch thickness or thinner.
2. Copper Sheets: Solder joints of copper sheets.

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 the pipe size, with a minimum length of 10 inches and with 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 221429 - SUMP PUMPS

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. Submersible sump pumps.
2. Sump-pump basins and basin covers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Wiring Diagrams: For power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pumps and controls, to include in operation and maintenance manuals.

1.5 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. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with pump manufacturer's written rigging instructions for handling.

PART 2 - PRODUCTS

2.1 SUBMERSIBLE SUMP PUMPS

A. Submersible, Fixed-Position, Single-Seal Sump Pumps:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings, Stancor; or comparable product by one of the following:

    a. Barnes; Crane Pumps & Systems.
    b. Bell & Gossett Domestic Pump; ITT Corporation.
    c. Weil Pump Company, Inc.

3. Description: Factory-assembled and -tested sump-pump unit.
4. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sump pump as defined in HI 1.1-1.2 and HI 1.3.
5. Pump Casing: Cast iron, with strainer inlet, legs that elevate pump to permit flow into impeller, and vertical discharge for piping connection.
6. Pump and Motor Shaft: Stainless steel, with factory-sealed, grease-lubricated ball bearings.
7. Seal: Mechanical.
8. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
9. Controls:

    a. Enclosure: NEMA 250, Type 4X; wall-mounted.
    b. Switch Type: Mechanical-float type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.
    c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
    d. High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with mechanical-float switch matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.

10. Control-Interface Features:

    a. Remote Alarm Contacts: For remote alarm interface.
    b. Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:

        1) On-off status of pump.
        2) Alarm status.

2.2 SUMP PUMP CAPACITIES AND CHARACTERISTICS

A. Unit Capacity: 74.

B. Number of Pumps: One.

C. Each Pump:

1. Capacity: 74 GPM.
2. Total Dynamic Head: 29 FT.
3. Speed: 1750 RPM.
4. Discharge Size: 2”.
5. Electrical Characteristics:

    a. Motor Horsepower: 0.5.
    b. Volts: 120.
    c. Phases: Single.
    d. Hertz: 60.

D. Unit Electrical Characteristics:

1. Full-Load Amperes: 4.

2.3 SUMP-PUMP BASINS AND BASIN COVERS

A. Basins: Factory-fabricated, watertight, cylindrical, basin sump with top flange and sidewall openings for pipe connections.

1. Material: Cast iron.
2. Reinforcement: Mounting plates for pumps, fittings, and accessories.
3. Anchor Flange: Same material as or compatible with basin sump, cast in or attached to sump, in location and of size required to anchor basin in concrete slab.

B. Basin Covers: Fabricate metal cover with openings having gaskets, seals, and bushings; for access to pumps, pump shafts, control rods, discharge piping, vent connections, and power cables.

1. Reinforcement: Steel or cast iron, capable of supporting foot traffic for basins installed in foot-traffic areas.

C. Capacities and Characteristics:

1. Capacity: 26 gal.
2. Diameter: 18 inches.
3. Depth: 24 inches.
4. Inlet No. 1:

    a. Drainage Pipe Size: 2 NPS.
    b. Type: Flanged outside.

5. Sidewall Outlet:

    a. Discharge Pipe Size: 2 NPS.
    b. Type: Hubbed inside.

6. Cover Material: Cast iron.
7. Cover Diameter: not less than outside diameter of basin top flange.
8. Manhole Required in Cover: No.
9. Vent Size: Not required.

2.4 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."

    1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

B. Motors for submersible pumps shall be hermetically sealed.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation and filling are specified in Section 312000 "Earth Moving."

3.2 EXAMINATION

A. Examine roughing-in for plumbing piping to verify actual locations of storm drainage piping connections before sump pump installation.

3.3 INSTALLATION

A. Pump Installation Standards: Comply with HI 1.4 for installation of sump pumps.

3.4 CONNECTIONS

A. Comply with requirements for piping specified in Section 221413 "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Pumps and controls will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Insert startup steps if any.

3.7 ADJUSTING

A. Adjust pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust control set points.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps. One hour of onsite training to be provided.

END OF SECTION 221429

SECTION 223300 - ELECTRIC, DOMESTIC-WATER HEATERS

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. Commercial, electric, storage, domestic-water heaters.
2. Domestic-water heater accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type and size of domestic-water heater indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. LEED Submittals:

1. Product Data for Prerequisite EA 2: Documentation indicating that units comply with applicable requirements in ASHRAE/IESNA 90.1, Section 7, "Service Water Heating."

C. Shop Drawings:

1. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of commercial, electric, domestic-water heater, from manufacturer.

B. Source quality-control reports.

C. Field quality-control reports.

D. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For electric, domestic-water heaters to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

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

B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 Annex G, "Drinking Water System Components - Health Effects."

1.7 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric, domestic-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 Periods: From date of Substantial Completion.

a. Commercial, Electric, Storage, Domestic-Water Heaters:

1) Storage Tank: Three years.
2) Controls and Other Components: Three years.

PART 2 - PRODUCTS

2.1 COMMERCIAL, ELECTRIC, DOMESTIC-WATER HEATERS

A. Commercial, Electric, Storage, Domestic-Water Heaters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Bradford White Corporation.
b. Lochinvar, LLC.
c. Rheem Manufacturing Company.
d. Smith, A. O. Corporation.
e. State Industries.

2. Standard: UL 1453.

3. Storage-Tank Construction: Non-ASME-code, steel vertical arrangement.

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 Annex G barrier materials for potable-water tank linings, including extending lining material into tappings.

4. Factory-Installed Storage-Tank Appurtenances:

a. Anode Rod: Replaceable magnesium.
b. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
c. Insulation: Comply with ASHRAE/IESNA 90.1.
d. Jacket: Steel with enameled finish.
e. Heating Elements: Electric, screw-in or bolt-on immersion type arranged in multiples of three.
f. Temperature Control: Adjustable thermostat.
g. Safety Controls: High-temperature-limit and low-water cutoff devices or systems.
h. Relief Valves: ASME rated and stamped for combination temperature-and-pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.

2.2 DOMESTIC-WATER HEATER ACCESSORIES

A. Drain Pans: Corrosion-resistant metal with raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads or with ASME B1.20.7 garden-hose threads.

B. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1.

C. Heat-Trap Fittings: ASHRAE 90.2.

D. Pressure-Reducing Valves: ASSE 1003 for water. Set at 25-psig-maximum outlet pressure unless otherwise indicated.

E. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.

2.3 SOURCE QUALITY CONTROL

A. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.

B. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

A. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric, domestic-water heaters on concrete base.

1. Exception: Omit concrete bases for commercial, electric, domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
2. Maintain manufacturer's recommended clearances.
3. Arrange units so controls and devices that require servicing are accessible.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
7. Install anchor bolts to elevations required for proper attachment to supported equipment.
8. Anchor domestic-water heaters to substrate.

B. Install electric, domestic-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.

1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220523 “General Duty Valves for Plumbing Pipng.”

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 electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."

E. Install thermometers on outlet piping of electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."

F. Install thermometers on inlet and outlet piping of residential, solar, electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."

G. Install pressure-reducing valve with integral bypass relief valve in electric, domestic-water booster-heater inlet piping and water hammer arrester in booster-heater outlet piping. Set pressure-reducing valve for outlet pressure of 25 psig. Comply with requirements for pressure-reducing valves and water hammer arresters specified in Section 221119 "Domestic Water Piping Specialties."

H. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.

I. Fill electric, domestic-water heaters with water.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain commercial, electric, domestic-water heaters. One hour of onsite training to be provided.

END OF SECTION 223300

SECTION 224213.13 - COMMERCIAL WATER CLOSETS

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. Water closets.
2. Flushometer valves.
3. Toilet seats.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for water closets.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. LEED Submittals:

1. Product Data for Prerequisite WE Credit: Documentation indicating flow and water consumption requirements.

C. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flushometer valves and electronic sensors to include in operation and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that are packaged with protective covering for storage and identified with labels describing contents.

1. Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than one of each type.

PART 2 - PRODUCTS

2.1 WALL-MOUNTED WATER CLOSETS

A. Water Closets, P-1 on drawing P-901, Wall mounted, top spud, accessible.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings, Sloan; or comparable product by one of the following:

a. American Standard America.
b. Briggs Plumbing Products, Inc.
c. Capizzi.
d. Crane Plumbing, L.L.C.
e. Ferguson Enterprises, Inc.; ProFlo Brand.
f. Gerber Plumbing Fixtures LLC.
g. Kohler Co.
h. Mansfield Plumbing Products LLC.
i. Peerless Pottery Sales, Inc.
j. TOTO USA, INC.
k. Zurn Industries, LLC; Commercial Brass and Fixtures.

2. Bowl:

a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
b. Material: Vitreous china.
c. Type: Siphon jet.
d. Style: Flushometer valve.
e. Height: Standard.
f. Rim Contour: Elongated.
g. Water Consumption: 1.28 gal. per flush.
h. Spud Size and Location: NPS 1-1/2; top.

3. Flushometer Valve: Sloan.
4. Toilet Seat: Church.
5. Support:

a. Standard: ASME A112.6.1M.
b. Description: Waste-fitting assembly as required to match drainage piping material and arrangement with faceplates, couplings gaskets, and feet; bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

c. Water-Closet Mounting Height: Standard.

B. Water Closets P-1A on drawing P-901, Wall mounted, back spud, accessible.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings Sloan; or comparable product by one of the following:

a. American Standard America.
b. Crane Plumbing, L.L.C.
c. Ferguson Enterprises, Inc.; ProFlo Brand.
d. Gerber Plumbing Fixtures LLC.
e. Kohler Co.
f. TOTO USA, INC.
g. Zurn Industries, LLC; Commercial Brass and Fixtures.

2. Bowl:

a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
b. Material: Vitreous china.
c. Type: Siphon jet.
d. Style: Flushometer valve.
e. Height: Standard.
f. Rim Contour: Elongated.
g. Water Consumption: 1.28 gal. per flush.
h. Spud Size and Location: NPS 1-1/2; back.

3. Flushometer Valve: Sloan.
4. Toilet Seat: Church.
5. Support:

a. Standard: ASME A112.6.1M.
b. Description: Waste-fitting assembly, as required to match drainage piping material and arrangement with faceplates, couplings gaskets, and feet; bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.
c. Water-Closet Mounting Height: handicapped/elderly height according to ICC/ANSI A117.1.

2.2 FLUSHOMETER VALVES

A. Hydraulic-Actuator, Push-Button, Diaphragm Flushometer Valves, Sloan, refer to Drawing P-901.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings, Sloan; or comparable product by one of the following:

a. Coyne & Delany Co.
b. Gerber Plumbing Fixtures LLC.
c. Zurn Industries, LLC; Commercial Brass and Fixtures.

2. Standard: ASSE 1037.
3. Minimum Pressure Rating: 125 psig.
4. Features: Include integral check stop and backflow-prevention device.
5. Material: Brass body with corrosion-resistant components.
6. Exposed Flushometer-Valve Finish: Chrome plated.
7. Panel Finish: Chrome plated or stainless steel.
8. Style: Exposed.
9. Actuator: Solenoid complying with UL 1951, and listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
10. Trip Mechanism: Hard-wired electronic sensor complying with UL 1951, and listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
11. Consumption: 1.28 gal. per flush.
12. Minimum Inlet: NPS 1.
13. Minimum Outlet: NPS 1-1/4.

2.3 TOILET SEATS

A. Toilet Seats, P-901:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings, Church, or comparable product by one of the following:

    a. American Standard America.
    b. Bemis Manufacturing Company.
    c. Centoco Manufacturing Corporation.
    d. Jones Stephens Corp.; Comfort Seat Brand.
    e. Kohler Co.
    f. Olsonite Seat Co.
    g. Sanderson Plumbing Products, Inc.
    h. Sperzel of Lexington.
    i. TOTO USA, INC.
    j. Zurn Industries, LLC; Commercial Brass and Fixtures.

2. Standard: IAPMO/ANSI Z124.5.
3. Material: Plastic.
4. Type: Commercial (Heavy duty).
5. Shape: Elongated rim, open front.
6. Hinge: Self-sustaining.
7. Hinge Material: Noncorroding metal.
8. Seat Cover: Not required.
9. Color: White.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before water-closet installation.

B. Examine walls and floors for suitable conditions where water closets will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Water-Closet Installation:

1. Install level and plumb according to roughing-in drawings.
2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
3. Install accessible, wall-mounted water closets at mounting height for handicapped/elderly, according to ICC/ANSI A117.1.

B. Support Installation:

1. Use carrier supports with waste-fitting assembly and seal.
2. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.

C. Flushometer-Valve Installation:

1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
4. Install actuators in locations that are easy for people with disabilities to reach.
5. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

D. Install toilet seats on water closets.

E. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

F. Joint Sealing:

1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to water-closet color.
3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to water closets, allow space for service and maintenance.

3.4 ADJUSTING

A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.

B. Adjust water pressure at flushometer valves to produce proper flow.

C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for installed water closets and fittings.

C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

END OF SECTION 224213.13

SECTION 224213.16 - COMMERCIAL URINALS

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. Urinals.
2. Flushometer valves.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for urinals.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. LEED Submittals:

1. Product Data for Prerequisite WE 1: Documentation indicating flow and water consumption requirements.

C. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flushometer valves and electronic sensors to include in operation and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that are packaged with protective covering for storage and identified with labels describing contents.

1. Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than one of each type.

PART 2 - PRODUCTS

2.1 WALL-HUNG URINALS

A. Urinals P-2/P-2A on P-900: Wall hung, back outlet, blowout.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings, Sloan Valve Company; or comparable product by one of the following:

a. American Standard America.
b. Capizzi.
c. Kohler Co.

2. Fixture:

a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
b. Material: Vitreous china.
c. Water Consumption: Water saving.
d. Spud Size and Location: NPS 1-1/4; back.
e. Outlet Size and Location: NPS 2; back.
f. Color: White.

3. Waste Fitting:

a. Standard: ASME A112.18.2/CSA B125.2 for coupling.
b. Size: NPS 2.

4. Support: ASME A112.6.1M, Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture. Include rectangular, steel uprights.

2.2 URINAL FLUSHOMETER VALVES

A. Hydraulic-Actuator, Push-Button, Diaphragm Flushometer Valves, P-900:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings, Sloan Valve Company; or comparable product by one of the following:

a. Coyne & Delany Co.
b. Zurn Industries.

2. Standard: ASSE 1037.
3. Minimum Pressure Rating: 125 psig.
4. Features: Include integral check stop and backflow-prevention device.
5. Material: Brass body with corrosion-resistant components.
6. Exposed Flushometer-Valve Finish: Chrome plated.
7. Panel Finish: Chrome plated or stainless steel.

8. Style: Exposed.
9. Consumption: 0.125 gal. per flush.
10. Minimum Inlet: NPS 3/4.
11. Minimum Outlet: NPS 1-1/4.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before urinal installation.

B. Examine walls and floors for suitable conditions where urinals will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Urinal Installation:

1. Install urinals level and plumb according to roughing-in drawings.
2. Install wall-hung, back-outlet urinals onto waste fitting seals and attached to supports.
3. Install wall-hung, bottom-outlet urinals with tubular waste piping attached to supports.
4. Install accessible, wall-mounted urinals at mounting height for the handicapped/elderly, according to ICC/ANSI A117.1.
5. Install trap-seal liquid in waterless urinals.

B. Support Installation:

1. Install supports, affixed to building substrate, for wall-hung urinals.
2. Use off-floor carriers with waste fitting and seal for back-outlet urinals.
3. Use carriers without waste fitting for urinals with tubular waste piping.
4. Use chair-type carrier supports with rectangular steel uprights for accessible urinals.

C. Flushometer-Valve Installation:

1. Install flushometer-valve water-supply fitting on each supply to each urinal.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install lever-handle flushometer valves for accessible urinals with handle mounted on open side of compartment.
4. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

D. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.

3. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

E. Joint Sealing:

1. Seal joints between urinals and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to urinal color.
3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

A. Connect urinals with water supplies and soil, waste, and vent piping. Use size fittings required to match urinals.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to urinals, allow space for service and maintenance.

3.4 ADJUSTING

A. Operate and adjust urinals and controls. Replace damaged and malfunctioning urinals, fittings, and controls.

B. Adjust water pressure at flushometer valves to produce proper flow.

C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

A. Clean urinals and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for installed urinals and fittings.

C. Do not allow use of urinals for temporary facilities unless approved in writing by Owner.

END OF SECTION 224213.16

SECTION 224216.13 - COMMERCIAL LAVATORIES

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. Lavatories.
2. Faucets.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for lavatories.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. LEED Submittals:

1. Product Data for Prerequisite WE Credit: Documentation indicating flow and water consumption requirements.

C. Shop Drawings: Include diagrams for power, signal, and control wiring of automatic faucets.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lavatories and faucets to include in operation and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Servicing and adjustments of automatic faucets.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.

PART 2 - PRODUCTS

2.1 VITREOUS-CHINA, COUNTER-MOUNTED LAVATORIES

A. Lavatory P-901: Rectangular, self-rimming, vitreous china, counter mounted.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard America.
b. Kohler Co.
c. TOTO USA, INC.

2. Fixture:

a. Standard: ASME A112.19.2/CSA B45.1.
b. Type: Under-mount.
c. Nominal Size: Rectangular, 21 by 14 inches.
d. Faucet-Hole Punching: One hole.
e. Faucet-Hole Location: Top.
f. Color: White.
g. Mounting Material: Sealant.

3. Faucet: "Solid-Brass, Automatically Operated Lavatory Faucets" Article.

2.2 SOLID-BRASS, AUTOMATICALLY OPERATED LAVATORY FAUCETS

A. NSF Standard: Comply with NSF/ANSI 61 Annex G, "Drinking Water System Components - Health Effects," for faucet materials that will be in contact with potable water.

B. Lavatory Faucets P-3: Automatic-type, hard-wired, electronic-sensor-operated, mixing solid-brass valve.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Chicago Faucets; Geberit Company.
b. American Standard America
c. Kohler Co.

2. Standards: ASME A112.18.1/CSA B125.1 and UL 1951.
3. 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.
4. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
5. Body Type: Single hole.
6. Body Material: Commercial solid brass.
7. Finish: Polished chrome plate.
8. Maximum Flow Rate: 0.5 gpm.
9. Mounting Type: Deck, concealed.
10. Spout: Rigid.
11. Spout Outlet: Spray.
12. Drain: Not part of faucet.

2.3 LAMINAR-FLOW, FAUCET-SPOUT OUTLETS

A. NSF Standard: Comply with NSF/ANSI 61 Annex G, "Drinking Water System Components - Health Effects," for faucet-spout-outlet materials that will be in contact with potable water.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AM Conservation Group, Inc.
2. Chronomite Laboratories, Inc.
3. NEOPERL, Inc.

C. Description: Chrome-plated-brass, faucet-spout outlet that produces non-aerating, laminar stream. Include external or internal thread that mates with faucet outlet for attachment to faucets where indicated and flow-rate range that includes flow of faucet.

2.4 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF/ANSI 61 Annex G, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless-steel wall flange.

D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

E. Operation: Loose key.

F. Risers:

1. NPS 1/2.
2. ASME A112.18.6, braided- or corrugated-stainless-steel, flexible hose riser.

2.5 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain: Grid type with NPS 1-1/4 offset and straight tailpiece.

C. Trap:

1. Size: NPS 1-1/4.
2. Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch-thick brass tube to wall and chrome-plated, brass or steel wall flange.
3. Material: Stainless-steel, two-piece trap and swivel elbow with 0.012-inch-thick stainless-steel tube to wall; and stainless-steel wall flange.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before lavatory installation.

B. Examine counters and walls for suitable conditions where lavatories will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install lavatories level and plumb according to roughing-in drawings.

B. Install supports, affixed to building substrate, for wall-mounted lavatories.

C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, according to ICC/ANSI A117.1.

D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

E. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

A. After completing installation of lavatories, inspect and repair damaged finishes.

B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed lavatories and fittings.

D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.13

SECTION 224216.16 - COMMERCIAL SINKS

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. Service basins.
2. Service sinks.
3. Utility sinks.
4. Sink faucets.
5. Laminar-flow, faucet-spout outlets.
6. Supply fittings.
7. Waste fittings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for sinks.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. LEED Submittals:

1. Product Data for Prerequisite WE 1: Documentation indicating flow and water consumption requirements.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sinks to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.

PART 2 - PRODUCTS

2.1 SERVICE BASINS

A. Service Basins P-4 on drawing P-900: Terrazzo, floor mounted.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane Plumbing, L.L.C.
b. Florestone Products Co., Inc.
c. Stern-Williams Co., Inc.

2. Fixture:

a. Standard: IAPMO PS 99.
b. Shape: Rectangular.
c. Nominal Size: 24 by 36 inches
d. Height: 12 inches.
e. Tiling Flange: Not required.
f. Rim Guard: On all top surfaces.
g. Color: Not applicable.
h. Drain: Grid with NPS 3 outlet.

3. Mounting: On floor and flush to wall.
4. Faucet: Stern Williams.

2.2 SINK FAUCETS

A. NSF Standard: Comply with NSF/ANSI 61 Annex G, "Drinking Water System Components - Health Effects," for faucet-spout materials that will be in contact with potable water.

B. Sink Faucets P-900: Manual type, two-lever-handle mixing valve.

1. Commercial, Solid-Brass Faucets.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Stern-Williams.
2) Sloan Valve Company.
3) Zurn Industries, LLC.

2. Standard: ASME A112.18.1/CSA B125.1.

3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
4. Body Type: Widespread.
5. Body Material: Commercial, solid brass brass.
6. Finish: Polished chrome plate.
7. Maximum Flow Rate: 2.5 gpm.
8. Handle(s): Lever.
9. Mounting Type: Back/wall, exposed.
10. Spout Type: Rigid, solid brass with wall brace.
11. Vacuum Breaker: Required for hose outlet.
12. Spout Outlet: Laminar flow.

2.3 LAMINAR-FLOW, FAUCET-SPOUT OUTLETS

A. NSF Standard: Comply with NSF/ANSI 61 Annex 61, "Drinking Water System Components - Health Effects," for faucet-spout-outlet materials that will be in contact with potable water.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AM Conservation Group, Inc.
2. Chronomite Laboratories, Inc.
3. NEOPERL, Inc.

C. Description: Chrome-plated brass, faucet-spout outlet that produces non-aerating, laminar stream. Include external or internal thread that mates with faucet outlet for attachment to faucets where indicated and flow-rate range that includes flow of faucet.

2.4 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF/ANSI 61 Annex G, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless-steel wall flange.

D. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

E. Operation: Wheel handle.

F. Risers:

1. NPS 1/2.
2. Chrome-plated, rigid-copper pipe.

2.5 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain: Grid type with NPS 2 offset and straight tailpiece.

C. Trap:

1. Size: NPS 2.
2. Material: Stainless-steel, two-piece trap and swivel elbow with 0.012-inch-thick stainless-steel tube to wall; and stainless-steel wall flange.

2.6 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before sink installation.

B. Examine walls, floors, and counters for suitable conditions where sinks will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install sinks level and plumb according to roughing-in drawings.

B. Install supports, affixed to building substrate, for wall-hung sinks.

C. Install accessible wall-mounted sinks at handicapped/elderly mounting height according to ICC/ANSI A117.1.

D. Set floor-mounted sinks in leveling bed of cement grout.

E. Install water-supply piping with stop on each supply to each sink faucet.

1. Exception: Use ball or gate valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 220523 “General Duty Valves for Plumbing Piping”
2. Install stops in locations where they can be easily reached for operation.

F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

G. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

H. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 CONNECTIONS

A. Connect sinks with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Operate and adjust sinks and controls. Replace damaged and malfunctioning sinks, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

3.5 CLEANING AND PROTECTION

A. After completing installation of sinks, inspect and repair damaged finishes.

B. Clean sinks, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed sinks and fittings.

D. Do not allow use of sinks for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.16

SECTION 224713 - DRINKING FOUNTAINS

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 drinking fountains and related components.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of drinking fountain.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include operating characteristics, and furnished specialties and accessories.

B. LEED Submittals:

1. Product Data for Prerequisite WE Documentation indicating flow and water consumption requirements.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For drinking fountains to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 DRINKING FOUNTAINS

A. Drinking Fountains P-900: Stainless steel, wall mounted.

1. Stainless-Steel Drinking Fountains:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Elkay Manufacturing Co.
2) Stern-Williams Co., Inc.

3) Tri Palm International, LLC.

2. Standards:

   a. Comply with ASME A112.19.3/CSA B45.4.
   b. Comply with NSF 61 Annex G.

3. Type Receptor: On horizontal support.
4. Receptor Shape: Round.
5. Back Panel: Stainless-steel wall plate behind drinking fountain.
6. Bubblers: Two, with adjustable stream regulator, located on deck.
7. Control: Push button.
8. Drain: Grid type with NPS 1-1/4 tailpiece.
9. Supply: NPS 3/8 with shutoff valve.
10. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 chrome-plated brass P-trap and waste.
11. Support: ASME A112.6.1M, Type III lavatory carrier.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.

B. Examine walls and floors for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.

B. Set pedestal drinking fountains on floor.

C. Install recessed drinking fountains secured to wood blocking in wall construction.

D. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.

E. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball or gate valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220523 “General Duty Valves for Plumbing Piping."

F. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

G. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

H. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Install ball or gate shutoff valve on water supply to each fixture. Comply with valve requirements specified in Section 220523 “General Duty Valves for Plumbing Piping."

D. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Adjust fixture flow regulators for proper flow and stream height.

3.5 CLEANING

A. After installing fixtures, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

C. Provide protective covering for installed fixtures.

D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224713

SECTION 224723 - REMOTE WATER COOLERS

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 remote water coolers and related components.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of remote water coolers.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. LEED Submittals:

1. Product Data for Prerequisite WE 1: Documentation indicating flow and water consumption requirements.

C. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For remote water coolers to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filter Cartridges: Equal to 100 percent of quantity installed for each type and size indicated, but no fewer than 50 percent of each.

PART 2 - PRODUCTS

2.1 REMOTE WATER COOLERS

A. Remote Water Coolers P-10 on drawing P-900: Remote chiller equipment.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Elkay Manufacturing Co.
   b. Haws Corporation.
   c. Tri Palm International, LLC.

2. Standards:

   a. Comply with NSF 61 Annex G.
   b. Comply with UL 1951.
   c. Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant unless otherwise indicated.

3. 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.
4. Chassis: Galvanized or corrosion-resistant-coated steel.
5. Chiller: Hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, and refrigerant.
6. Controls: Adjustable thermostat.
7. Capacities and Characteristics:

   a. Cooled Water: 9.6 gph.
   b. Ambient-Air Temperature: 90 deg F.
   c. Inlet-Water Temperature: 80 deg F.
   d. Cooled-Water Temperature: 50 deg F.
   e. Electrical Characteristics:

      1) Motor Horsepower: 1/4.
      2) Volts: 120-V ac.
      3) Phase: Single.
      4) Hertz: 60.
      5) Full-Load Amperes: 5.8.

8. Filter: One or more water filters complying with NSF 42 and NSF 53 for cyst and lead reduction to below EPA standards; with capacity sized for unit peak flow rate.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water-supply and sanitary drainage piping systems to verify actual locations of piping connections before fixture installation.

B. Examine walls and floors for suitable conditions where remote water coolers will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install remote water coolers level and plumb according to roughing-in drawings.

B. Install water-supply piping with shutoff valve on supply to each remote water cooler to be connected to domestic-water distribution piping. Use ball or gate valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220523 “General Duty Valves for Plumbing Piping."

C. Set remote water coolers on floor unless otherwise indicated.

D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 CONNECTIONS

A. Connect fixtures with water supplies. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Install ball or gate shutoff valve on water supply to each fixture. Install valve upstream from filter for water cooler. Comply with valve requirements specified in Section 220523 “General Duty Valves for Plumbing Piping."

D. Install ball or gate valves with valved bypass on water connections to remote water coolers Comply with valve requirements specified in Section 220523 “General Duty Valves for Plumbing Piping."

3.4 ADJUSTING

A. Adjust water-cooler temperature settings.

3.5 CLEANING

A. After installing remote water cooler, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

END OF SECTION 224723

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

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 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.

1.3 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 NEMA MG 1 unless otherwise indicated.

B. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 104 deg F 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. Multispeed Motors: Separate winding for each speed.

F. Rotor: Random-wound, squirrel cage.

G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

H. Temperature Rise: Match insulation rating.

I. Insulation: Class F.

J. 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.

K. 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.

C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

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 230517 - SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

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. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal fittings.
4. Grout.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SLEEVES

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

D. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

F. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

G. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

2.2 STACK-SLEEVE FITTINGS

A. Manufacturers: Subject to compliance with requirements.

B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL FITTINGS

A. Manufacturers: Subject to compliance with requirements.

B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

2.4 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."

E. 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 for firestopping specified in Section 078400 "Firestopping."

3.2 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076000 "Flashing and Sheet Metal."
3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Using grout, seal the space around outside of stack-sleeve fittings.

B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078400 "Firestopping."

3.3 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

3.4 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:

a. Piping Smaller Than NPS 6: Cast-iron wall sleeves.
b. Piping NPS 6 and Larger: Cast-iron wall sleeves.

2. Exterior Concrete Walls below Grade:

a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system Sleeve-seal fittings.
b. Piping NPS 6 and Larger: Cast-iron wall sleeves with sleeve-seal system.

3. Concrete Slabs-on-Grade:

a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system Sleeve-seal fittings.
b. Piping NPS 6 and Larger: Cast-iron wall sleeves with sleeve-seal system.

4. Concrete Slabs above Grade:

a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves, PVC-pipe sleeves, Stack-sleeve fittings, Sleeve-seal fittings.
b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves, PVC-pipe sleeves, Stack-sleeve fittings.

5. Interior Partitions:

a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
b. Piping NPS 6 and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION 230517

SECTION 230518 - ESCUTCHEONS FOR HVAC PIPING

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. Escutcheons.
2. Floor plates.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

B. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.

2.2 FLOOR PLATES

A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

B. Split-Casting Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. Escutcheons for New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
b. Chrome-Plated Piping: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
c. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
g. Bare Piping in Equipment Rooms: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping: One-piece, floor-plate type.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 230518

SECTION 230523 - GENERAL-DUTY VALVES FOR HVAC PIPING

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. Brass ball valves.
2. Bronze swing check valves.

B. Related Sections:

1. Section 230553 "Identification for HVAC Piping and Equipment" for valve tags and schedules.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Nonrising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to HVAC 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. Valve Actuator Types:

1. Handwheel: For valves other than quarter-turn types.
2. Handlever: For quarter-turn valves NPS 6 and smaller.
3. Wrench: For plug valves with square heads. Furnish Owner with one (1) wrench for every 10 plug valves, for each size square plug-valve head.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. 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.

F. 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.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRASS BALL VALVES

A. One-Piece, Full-Port, Brass Ball Valves with Brass Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Kitz Corporation.
b. Mitsubishi Diamond Back.
c. NIBCO INC.
d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
e. Henry Technologies.
f. Sporlan.
g. Superior.
h. Ranco.

2. Description:

a. Standard: UL 891N.
b. CWP Rating: 700 psig.
c. Body Design: One piece.
d. Body Material: Forged brass.
e. Ends: Flare.
f. Seal Cap: Brass.
g. Seats: PTFE or TFE.
h. Stem: Brass.
i. Ball: Chrome-plated brass.
j. Port: FULL.
k. Valve: Schrader.

2.3 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. American Valve, Inc.
b. Crane Co.; Crane Valve Group; Crane Valves.

c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Division.
e. Hammond Valve.
f. Kitz Corporation.
g. Milwaukee Valve Company.
h. NIBCO INC.
i. Powell Valves.
j. Red-White Valve Corporation.
k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
l. Zy-Tech Global Industries, Inc.

2. Description:

a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 200 psig.
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: Bronze.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 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 check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball valves.
2. Throttling Service except Steam: Ball valves.
3. Pump-Discharge Check Valves:

a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.

END OF SECTION 230523

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

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. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Equipment supports.

B. Related Sections:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 233113 "Metal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

3. Design seismic-restraint hangers and supports for piping and equipment.

1.5 ACTION SUBMITTALS

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

B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Pipe stands.
4. Equipment supports.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.7 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

C. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Allied Tube & Conduit.
    b. Cooper B-Line, Inc.
    c. Flex-Strut Inc.
    d. GS Metals Corp.
    e. Thomas & Betts Corporation.
    f. Unistrut Corporation; Tyco International, Ltd.
    g. Wesanco, Inc.

2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Metallic Coating: Electroplated zinc or Hot-dipped galvanized.

2.4 THERMAL-HANGER SHIELD INSERTS

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. Carpenter & Paterson, Inc.
2. Clement Support Services.
3. ERICO International Corporation.
4. National Pipe Hanger Corporation.
5. PHS Industries, Inc.
6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.

7. Piping Technology & Products, Inc.
8. Rilco Manufacturing Co., Inc.
9. Value Engineered Products, Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.6 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.7 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-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 INSTALLATION

A. Metal 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 the building structure.

B. Metal 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 for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

D. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

F. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

G. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

H. Install lateral bracing with pipe hangers and supports to prevent swaying.

I. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

J. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

L. Insulated Piping:

1. Attach clamps and spacers to piping.

   a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
   b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
   c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

   a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
   b. NPS 4: 12 inches long and 0.06 inch thick.
   c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
   d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
   e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 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 a minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are 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 carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

F. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

G. Use padded hangers for piping that is subject to scratching.

H. Use thermal-hanger shield inserts for insulated piping and tubing.

I. 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 up to 1050 deg F, pipes NPS 4 to NPS 24, 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 36, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. 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 or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.

19. 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.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.

12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

M. 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.

N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 230529

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

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. Equipment labels.
2. Pipe labels.
3. Stencils.
4. Valve tags.

1.3 ACTION SUBMITTALS

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

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

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.

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 partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, 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 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.

1. Stencil Material: Fiberboard or metal.
2. Stencil Paint: Exterior, gloss, acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

2.4 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link or beaded chain; or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

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 Section 099100 "Painting".

B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles, complying with ASME A13.1, on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

C. 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.

D. Pipe Label Color Schedule:

1. Refrigerant Piping:

a. Background Color: Black.
b. Letter Color: White.

3.4 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

a. Refrigerant: 1-1/2 inches, round.

2. Valve-Tag Color:

a. Refrigerant: Natural.

3. Letter Color:

a. Refrigerant: Black.

3.5 WARNING-TAG INSTALLATION

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

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

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. Balancing Air Systems:

    a. Constant-volume air systems.
    b. Multizone systems.

2. Testing, Adjusting, and Balancing Equipment:

    a. Condensing units.
    b. Heat-transfer coils.

3. Duct leakage tests.
4. Control system verification.

1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. BAS: Building automation systems.

C. NEBB: National Environmental Balancing Bureau.

D. TAB: Testing, adjusting, and balancing.

E. TABB: Testing, Adjusting, and Balancing Bureau.

F. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

G. TDH: Total dynamic head.

1.4 ACTION SUBMITTALS

A. LEED Submittals:

1. Air-Balance Report for Prerequisite IEQ 1: Documentation indicating that work complies with ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
2. TAB Report for Prerequisite EA 2: Documentation indicating that work complies with ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

C. System Readiness Checklists: Within 30 days of Contractor's Notice to Proceed, submit system readiness checklists as specified in "Preparation" Article.

D. Examination Report: Submit a summary report of the examination review required in "Examination" Article.

E. Certified TAB reports.

F. Sample report forms.

G. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.6 QUALITY ASSURANCE

A. TAB Specialists Qualifications: Certified by AABC NEBB or TABB.

1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC NEBB or TABB.
2. TAB Technician: Employee of the TAB specialist and certified by AABC NEBB or TABB as a TAB technician.

B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

PART 2 - PRODUCTS (Not Applicable)

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.

B. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

F. Examine equipment performance data including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

J. Examine terminal units, such as fan coil units, and verify that they are accessible and their controls are connected and functioning.

K. Examine strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.

L. Examine control valves for proper installation for their intended function of throttling, diverting, or mixing fluid flows.

M. Examine operating safety interlocks and controls on HVAC equipment.

N. 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 the following:

1. Equipment and systems to be tested.
2. Strategies and step-by-step procedures for balancing the systems.
3. Instrumentation to be used.
4. Sample forms with specific identification for all equipment.

B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. Airside:

a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
b. Duct systems are complete with terminals installed.
c. Volume, smoke, and fire dampers are open and functional.
d. Clean filters are installed.
e. Fans are operating, free of vibration, and rotating in correct direction.
f. Variable-frequency controllers' startup is complete and safeties are verified.
g. Automatic temperature-control systems are operational.
h. Ceilings are installed.
i. Windows and doors are installed.
j. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check 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 outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

2. Measure fan static pressures as follows:

a. Measure static pressure directly at the fan outlet or through the flexible connection.
b. Measure static pressure directly at the fan inlet or through the flexible connection.
c. Measure static pressure across each component that makes up the air-handling system.
d. Report artificial loading of filters at the time static pressures are measured.

3. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.

1. Measure airflow of submain and branch ducts.
2. Adjust submain and branch duct volume dampers for specified airflow.
3. Re-measure each submain and branch duct after all have been adjusted.

C. Adjust air inlets and outlets for each space to indicated airflows.

1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
2. Measure inlets and outlets airflow.
3. Adjust each inlet and outlet for specified airflow.
4. Re-measure each inlet and outlet after they have been adjusted.

D. Verify final system conditions.

1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
2. Re-measure and confirm that total airflow is within design.
3. Re-measure all final fan operating data, rpms, volts, amps, and static profile.
4. Mark all final settings.
5. Test system in economizer mode. Verify proper operation and adjust if necessary.
6. Measure and record all operating data.
7. Record final fan-performance data.
8. Airflow.

3.6 DUCT LEAKAGE TESTS

A. Witness the duct pressure testing performed by Installer.

B. Verify that proper test methods are used and that leakage rates are within specified tolerances.

C. Report deficiencies observed.

3.7 CONTROLS VERIFICATION

A. In conjunction with system balancing, perform the following:

1. Verify temperature control system is operating within the design limitations.
2. Confirm that the sequences of operation are in compliance with Contract Documents.
3. Verify that controllers are calibrated and function as intended.
4. Verify that controller set points are as indicated.
5. Verify the operation of lockout or interlock systems.
6. Verify the operation of valve and damper actuators.
7. Verify that controlled devices are properly installed and connected to correct controller.
8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.

B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

3.8 TOLERANCES

A. Set HVAC system's airflow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.9 PROGRESS REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems balancing devices. Recommend changes and additions to systems balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

3.10 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.
3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. 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; do not include Shop Drawings and Product Data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB specialist.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:

    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. 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.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, 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. Position of balancing devices.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:

a. Unit identification.
b. Location.
c. Make and type.
d. Model number and unit size.
e. Manufacturer's serial number.
f. Unit arrangement and class.
g. Discharge arrangement.
h. Sheave make, size in inches, and bore.
i. Center-to-center dimensions of sheave and amount of adjustments in inches.
j. Number, make, and size of belts.
k. Number, type, and size of filters.

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Filter static-pressure differential in inches wg.
f. Preheat-coil static-pressure differential in inches wg.
g. Cooling-coil static-pressure differential in inches wg.
h. Heating-coil static-pressure differential in inches wg.
i. Outdoor airflow in cfm.
j. Return airflow in cfm.
k. Outdoor-air damper position.

l. Return-air damper position.
m. Vortex damper position.

F. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Center-to-center dimensions of sheave and amount of adjustments in inches.

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

G. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

a. System and air-handling-unit number.
b. Location and zone.
c. Traverse air temperature in deg F.
d. Duct static pressure in inches wg.
e. Duct size in inches.
f. Duct area in sq. ft.
g. Indicated airflow rate in cfm.
h. Indicated velocity in fpm.
i. Actual airflow rate in cfm.
j. Actual average velocity in fpm.
k. Barometric pressure in psig.

H. Air-Terminal-Device Reports:

1. Unit Data:

a. System and air-handling unit identification.
b. Location and zone.
c. Apparatus used for test.
d. Area served.
e. Make.
f. Number from system diagram.
g. Type and model number.
h. Size.
i. Effective area in sq. ft.

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm.
b. Air velocity in fpm.
c. Preliminary airflow rate as needed in cfm.
d. Preliminary velocity as needed in fpm.
e. Final airflow rate in cfm.
f. Final velocity in fpm.
g. Space temperature in deg F.

I. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.11 VERIFICATION OF TAB REPORT

A. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

B. If TAB work fails, proceed as follows:

1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.

C. Prepare test and inspection reports.

3.12 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION 230713 - DUCT INSULATION

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 insulating the following duct services:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in unconditioned space.
4. Indoor, exposed return located in unconditioned space.

B. Related Sections:

1. Section 233113 "Metal Ducts" for duct liners.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
3. Detail application of field-applied jackets.
4. Detail application at linkages of control devices.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Field quality-control reports.

1.5 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.6 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 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. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type II for sheet materials.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Aeroflex USA, Inc.; Aerocel.
b. Armacell LLC; AP Armaflex.
c. K-Flex USA; Insul-Sheet, K-Flex Gray Duct Liner, and K-FLEX LS.

F. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Armacell LLC; Tubolit.
b. Nomaco Insulation; IMCOLOCK, IMCOSHEET, NOMALOCK, and NOMAPLY.

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Aeroflex USA, Inc.; Aeroseal.
b. Armacell LLC; Armaflex 520 Adhesive.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.K-Flex USA; R-373 Contact Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.Eagle Bridges - Marathon Industries; 225.
b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
b. Eagle Bridges - Marathon Industries; 225.

c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Dow Corning Corporation; 739, Dow Silicone.
b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
c. P.I.C. Plastics, Inc.; Welding Adhesive.
d. Speedline Corporation; Polyco VP Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
b. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

2.4 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
    b. Vimasco Corporation; 713 and 714.

3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
4. Service Temperature Range: 0 to plus 180 deg F.
5. Color: White.

2.5 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.Eagle Bridges - Marathon Industries; 405.
    b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
    c. Mon-Eco Industries, Inc.; 44-05.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. in. for covering ducts.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Chil-Glas No. 5.

B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for ducts.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab.
b. Vimasco Corporation; Elastafab 894.

2.8 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

2.9 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. ABI, Ideal Tape Division; 428 AWF ASJ.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
c. Compac Corporation; 104 and 105.
d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. ABI, Ideal Tape Division; 491 AWF FSK.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
c. Compac Corporation; 110 and 111.
d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. ABI, Ideal Tape Division; 370 White PVC tape.
b. Compac Corporation; 130.
c. Venture Tape; 1506 CW NS.

2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.

5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. ABI, Ideal Tape Division; 488 AWF.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
c. Compac Corporation; 120.
d. Venture Tape; 3520 CW.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.10 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. ITW Insulation Systems; Gerrard Strapping and Seals.
b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) AGM Industries, Inc.; CWP-1.
2) GEMCO; CD.
3) Midwest Fasteners, Inc.; CD.
4) Nelson Stud Welding; TPA, TPC, and TPS.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

    a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

        1) AGM Industries, Inc.; CHP-1.
        2) GEMCO; Cupped Head Weld Pin.
        3) Midwest Fasteners, Inc.; Cupped Head.
        4) Nelson Stud Welding; CHP.

3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

    a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

        1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
        2) GEMCO; Perforated Base.
        3) Midwest Fasteners, Inc.; Spindle.

    b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
    c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
    d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

    a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

        1) GEMCO; Nylon Hangers.
        2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.

    b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
    c. Spindle: Nylon, 0.106-inch-diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
    d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

    a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

        1) AGM Industries, Inc.; Tactoo Self-Adhering Insul-Hangers.
        2) GEMCO; Peel & Press.
        3) Midwest Fasteners, Inc.; Self Stick.

    b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
    c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
    d. Adhesive-backed base with a peel-off protective cover.

6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

    a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

        1) AGM Industries, Inc.; RC-150.
        2) GEMCO; R-150.
        3) Midwest Fasteners, Inc.; WA-150.
        4) Nelson Stud Welding; Speed Clips.

    b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

    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) GEMCO.
        2) Midwest Fasteners, Inc.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, stainless steel.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. C & F Wire.

2.11 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

C. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

1. Comply with requirements in Section 078400 "Firestopping" for firestopping and fire-resistive joint sealers.

E. Insulation Installation at Floor Penetrations:

1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078400 "Firestopping."

3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.6 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not overcompress insulation during installation.
    e. Impale insulation over pins and attach speed washers.
    f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not overcompress insulation during installation.
    e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.7 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.8 FIRE-RATED INSULATION SYSTEM INSTALLATION

A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.

B. Insulate duct access panels and doors to achieve same fire rating as duct.

C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Section 078400 "Firestopping."

3.9 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect ductwork, 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 duct system defined in the "Duct Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.10 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in unconditioned space.
4. Indoor, exposed return located in unconditioned space.
5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.

B. Items Not Insulated:

1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
2. Factory-insulated flexible ducts.
3. Factory-insulated plenums and casings.
4. Flexible connectors.
5. Vibration-control devices.
6. Factory-insulated access panels and doors.

3.11 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, round and flat-oval, supply-air, return-air, exhaust-air, and outdoor-air duct insulation shall be:

1. Mineral-Fiber Blanket: 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.

B. Concealed, rectangular, supply-air and return-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
2. Mineral-Fiber Board: 1-1/2 inches thick and 3-lb/cu. ft. nominal density.

C. Concealed, rectangular, outdoor-air, exhaust-air, and plenum duct insulation shall be the following:

1. Mineral-Fiber Board: 2 inches thick and 6-lb/cu. ft. nominal density.

D. Exposed, round and flat-oval, supply-air, return-air, exhaust-air, and outdoor-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.

E. Exposed, rectangular, supply-air and return-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
2. Mineral-Fiber Board: 1-1/2 inches thick and 3-lb/cu. ft. nominal density.

F. Exposed, rectangular, exhaust-air, exhaust-air, and plenum duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.
2. Mineral-Fiber Board: 1-1/2 inches thick and 3-lb/cu. ft. nominal density.

END OF SECTION 230713

SECTION 230800 COMMISSIONING OF MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 019113 – Commissioning General Requirements.

C. Section 220800 – Commissioning of Plumbing Systems.

D. Section 230901 – Commissioning of Integrated Automation Systems.

E. Section 260800 – Commissioning of Electrical Systems.

F. Commissioning Plan

1.2 DESCRIPTION OF WORK

A. The purpose of this section is to specify the Division 23 responsibilities and participation in the commissioning process. All contractors responsible for Division 23 installation or other activities shall have commissioning responsibilities described herein.

B. Work under this contract shall conform to requirements of Division 01, General Requirements, Conditions of the Contract, and Supplementary Conditions. This specification covers Commissioning of Mechanical Systems, which are a part of this project.

C. Commissioning shall be a team effort to ensure that all mechanical equipment and systems have been completely and properly installed and function together correctly to meet the design intent. Additionally, system performance parameters shall be monitored and documented for fine tuning of control sequences and operational procedures. Commissioning shall coordinate and document equipment installation, equipment start-up, control system calibration, testing and balancing, and verification and performance testing.

D. The Commissioning Team is defined in Specification 019113 Section 1.3 – Definitions. The mechanical trades represented on the Commissioning Team shall include but not be limited to; sheet metal, pipe and fitting, controls, test and balance, plumbing, chemical treatment and fire protection. The lead person for each trade who will actually perform or supervise the work is to be designated as the representative to the Commissioning Team. Responsibility for various steps of the commissioning process shall be divided among the members of the Commissioning Team, as described in this section.

E. Mechanical Contractor(s) are responsible for mechanical system installation, start-up, testing, balancing, preparation of O&M manuals, and operator training as defined in various Division 23 specification sections. Mechanical Contractor(s) are responsible for coordination, observation, and verification of commissioning as defined in this section and Section 019113.

Neither Section 019113 - Commissioning General Requirements nor Section 230800 – Commissioning of Mechanical Systems shall relieve the Mechanical Contractor(s) from their obligations to complete all portions of work in a satisfactory and fully operational manner. Furthermore, Section 230800 – Commissioning of Mechanical Systems shall not relieve the Electrical Contractor(s) or Telecommunications Contractor(s) from any obligations set forth within Division 01, Division 26, Division 27, including Section 019113 – Commissioning General Requirements.

1.3 DEFINITIONS

A. Mechanical Contractor(s): The term Mechanical Contractor(s) utilized herein refers to any and all subcontracting companies or venders whom are responsible for the construction or other provisions regarding any of the systems which are being commissioned, as outlined in Specification 019113 Section 1.5 – Systems to be Included in Commissioning, and are defined within Division 23 of the specifications. Subcontracting parties outside of the scope of the Systems to be Included in Commissioning or outside of the scope of Division 23 are not included.

B. Equipment Manufacturer(s): The term Equipment Manufacturer(s) utilized herein refers to any and all subcontracting companies whom are responsible for the provision of equipment or components which are being commissioned, as outlined in Specification 019113 Section 1.5 – Systems to be Included in Commissioning, and are defined within Division 23 of the specifications. Equipment Manufacturer(s) shall refer to the direct representative of the maker and/or distributor of the equipment or component being provided. This may include either the actual equipment manufacturer or the supplier thereof, under the provisions that the supplier has a thorough knowledge of the equipment or component and is recognized by the actual equipment manufacturer as being a proper representative.

1.4 SCOPE OF WORK

A. The Mechanical Contractor(s) shall be required to Commission all equipment, components and accessories of each of the commissioned systems as outlined within Specification 019113 Section 1.5 – Systems to be Included in Commissioning. In order to accomplish a complete commissioning process, the Mechanical Contractor(s) shall be required to fulfill all requirements set forth within Specification 230800 Section 1.5 – Roles and Responsibilities. Additionally, the Mechanical Contractor(s) shall be required to fulfill all requirements set forth within Specification 019113.

B. Through the Commissioning Process, the Mechanical Contractor(s) shall accomplish thorough documentation, organized scheduling and coordination, detailed installation verification, and detailed system functional verification. For this, the Mechanical Contractor(s) must cooperate and coordinate with the Commissioning Agent.

1.5 ROLES AND RESPONSIBILITIES

A. In addition to the Commissioning Agent, Owner and System Design Professional(s), the Commissioning Team is comprised of a minimum of one individual to represent each contracting company or venders whom are responsible for the construction or other provisions regarding any of the systems which are being commissioned, as outlined in Specification 019113 Section 1.5 – Systems to be Included in Commissioning, and are defined within

Division 23 of the specifications. See Specification 019113 Section 1.3 – Definitions for the definition of the Commissioning Team.

B. Contracting companies providing members shall include but not be limited to; sheet metal, pipe and fitting, controls, test and balance, plumbing, chemical treatment and fire protection contractors whose responsibilities are defined herein.

C. In addition to all roles and responsibilities defined herein, all Mechanical Contractor(s) shall be required to fulfill all requirements described within Specification 019113 Section 1.4 – Roles and Responsibilities.

D. Mechanical Contractor(s):

1. General Requirements:

    a. Include all cost to complete commissioning requirements for Mechanical Systems in the contract price. Contractor costs shall be reflected within the Schedule of Values as specified within Specification 019113 Section 2.2 – Schedule of Values.
    b. Ensure cooperation and participation of specialty Contractors and Sub-Contractors.
    c. Ensure participation of major Equipment Manufacturers in appropriate start-up, testing and training activities.
    d. Attend Commissioning Meetings for construction phase coordination as scheduled by the Commissioning Agent. Additionally, attend the Commissioning Kick-Off Meeting as scheduled by the Commissioning Agent.

2. Commissioning Schedule:

    a. Prepare a Preliminary Schedule for Mechanical Systems and equipment, including component installation, start-up and checkout, and system start-up. Integrate commissioning activities into this Preliminary Schedule including Pre-Functional and Functional Performance Tests.
    b. Update the Preliminary Schedule and submit a Final Schedule which shall reflect all items within the Preliminary Schedule and shall also include but not be limited to: inspections, O&M manual submission, training sessions, pipe and duct system testing, flushing and cleaning, equipment start-up, TAB, and task completion. All Contractor(s) shall integrate schedule activities into one complete Final Schedule which shall be reflected within the Construction Manager's/General Contractor's overall project schedule. The Final Schedule shall be continuously updated throughout the Construction Phase.

3. Submittal Requirements:

    a. Comply with all Submittal requirements as outlined within Specification 019113 Section 2.3 – Submittals.
    b. Comply with all requirements as outlined within Specification 019113 Section 2.5 – Start-Up and Test Reports.
    c. Provide the following documentation to the Commissioning Agent for the purpose of construction updates:

        1) General construction progress and status reports

2) Updated Architect, Owner, System Design Professional, and Contractor deficiency logs
3) Minutes from all construction and coordination meetings not otherwise conducted by the Commissioning Agent
4) Pre Start-Up and Start-Up procedures
5) Value Engineering Proposals and a list of all accepted VE items
6) Pressure Test Reports, Flushing Reports and Start-Up Reports
7) Construction document changes resulting from mechanical Requests for Information

4. Pre-Functional Checklist Requirements:

a. Detailed installation verification shall be performed on all installed equipment and systems to ensure that the installations conform to the contract documents, local and applicable codes, and standard practice. This shall be accomplished through the completion of Pre-Functional Checklists. The creation, distribution, completion and maintenance of Pre-Functional Checklists are detailed in Specification 019113 Section 2.4 – Pre-Functional Checklists.
b. Complete Pre-Functional Checklists on all mechanical equipment and system components installed or provided by the Mechanical Contractors(s).
c. Notify the Commissioning Agent a minimum of two weeks (14 days) in advance, of the time for start of the TAB work.
d. Provide written notification to the Commissioning Agent for each system listed in Specification 019113 Section 1.5 – Systems to be Included in Commissioning, that the system installation is complete in its entirety and that the system is fully operational, online, and ready for Functional Performance Testing.

5. Equipment and Systems Start-Up:

a. Perform all initial check-out and start-up procedures as outlined within the specifications and as per the Equipment Manufacturer's recommendations. Provide full documentation of all start-up and check-out procedures and results. Documentations is to be submitted to the Commissioning Agent in conjunction with the associated Pre-Functional Checklist.
b. Perform all pressure tests, weld tests, vibration analysis and any other system component test required by the specifications requiring a 3rd party test agency. Provide full documentation of all tests procedures and results. Documentation is to be submitted to the Commissioning Agent in conjunction with the associated Pre-Functional Checklist
c. Perform all Test, Adjustment and Balance requirements for hydronic piping systems and air distribution systems. Submit copies of the TAB Report to all interested and reviewing parties as required by the specifications and to the Commissioning Agent. The TAB Contractor shall assist as the TAB Report is spot-checked by the Commissioning Agent. See the Specification 230800 Section 1.5 – Roles and Responsibilities, Subsection E for additional TAB Contractor Requirements.
d. Perform all equipment, system and component cleaning and flushing as required by the specifications and Equipment Manufacturer's recommendations. Provide full documentation of all cleaning and flushing procedures and test results (i.e. pH test results, etc.) Documentation is to be submitted to the Commissioning Agent in conjunction with the associated Pre-Functional Checklist.

6. Functional Performance Test Requirements:

    a. Detailed testing shall be performed on all installed equipment and systems to ensure that operation and performance conform to contract documents, local and applicable codes, and standard practice. This shall be accomplished through the completion of Functional Performance Tests. The creation, distribution and completion of Functional Performance Tests are detailed in Specification 019113 Section 2.6 – Functional Performance Tests.
    b. Provide all appropriate equipment and materials as necessary to execute and complete all Functional Performance Tests. Comply with all requirements as outlined within Specification 019113 Section 2.8 – Test Equipment.
    c. Provide appropriate technicians for participation during system verification and functional performance testing. Technicians shall demonstrate system performance to Commissioning Agent including all modes of system operation (e.g. normal, abnormal, emergency, etc.)
    d. Verify all functional performance tests prior to requesting test witness by the Commissioning Agent, demonstrate all Functional Performance test tasks in the presence of the Commissioning Agent and assist the Commissioning Agent in all verification and functional performance tests.
    e. Participate in verification of the TAB report, which will consist of repeating any selected measurement contained in the TAB report where required by the Commissioning Agent for verification or diagnostic purposes. Typically, TAB Verification shall occur in conjunction with Functional Performance Testing.
    f. Cancellation or delays of any system tests or Functional Performance Testing upon the day of that particular scheduled test, due to lack of preparation or status of installation shall be considered a failed test due to the additional time required by the Commissioning Agent to witness electrical testing. These additional tests shall be treated in accordance with Specification 019113 Section 3.6-A.

7. Training Requirements:

    a. Comprehensive training of O&M personnel shall be performed by the Mechanical Contractor(s) and Equipment Manufacturer(s) prior to turnover of the systems to the Owner. Training shall include but not be limited to classroom instruction and hands-on instruction of the installed equipment and systems.
    b. The Training Schedule is to be coordinated and completed by the Mechanical Contractor(s). The Training Schedule is to be updated and maintained as construction progresses. The Training Schedule and all updates shall be coordinated with and approved of by the Owner.
    c. Contractor(s) responsible for the installation or provision of any piece of equipment or system shall attend, at minimum, the initial training session for that equipment or system.
    d. All Training Documentation shall be assembled and organized in a binder or set of binders. Coordinate with all other Contractor(s) to provide one complete bound Training Record. This requirement shall not be negated, unless other specific complete Project Training Record requirements, encompassing ALL project training documentation, is outlined elsewhere within the specifications.

8. Close-out Requirements:

    a. Remedy all deficiencies identified during commissioning. Provide all materials, equipment, labor, etc. to accomplish these remedies.
    b. Provide a complete set of Record Documents (As-Built Drawings and Specifications) to the Architect and/or Design Professional as required by the project specifications.
    c. Provide a complete set of O&M Manuals and Project Training Record to the Architect and/or Design Professional as required by the project specifications.
    d. Provide a complete copy of Equipment and System Warranties to the Architect and/or Design Professional as required by the project specifications.

E. Test, Adjust, and Balance Contractor(s):

1. Comply with all requirements as outlined within Specification 230800 Section 1.5 Sub-Section D – Mechanical Contractor(s).
2. Submit the TAB procedures to the Design Professional for review and acceptance. TAB procedures must include the TAB Plan, TAB Forms and TAB Report Format. These documents must be approved prior to proceeding with the Test, Adjustment and Balance.
3. Issue a statement that TAB work has been completed. Submit through the Contractor(s) a copy of the preliminary version of the Test and Balance Report to the Commissioning Agent and System Design Professional. Submit for review, a Final Version of the Test and Balance Report to the Commissioning Agent and System Design Professional within the amount of time allotted within the Specifications. The Commissioning Agent and Systems Design Professional must both accept the Final TAB Report.
4. The Commissioning Agent shall be provided with a copy of the Test, Adjustment and Balance Report a minimum of two weeks (14 days) prior to the scheduled spot check of the balanced system. The report may be a Preliminary or Final version. A representative of the Test and Balance firm shall be required to assist with the spot check. The Test and Balance firm shall provide calibrated testing equipment as per Specification 019113 Section 2.8 - Test Equipment. Equipment shall be similar in style and type as used to initially perform Test, Adjustment and Balance procedures.
5. Participate in verification of the TAB report, which will consist of repeating any selected measurement contained in the TAB report where required by the Commissioning Agent for verification or diagnostic purposes.

F. Automatic Controls and Building Automation System Contractor(s):

1. Comply with all requirements as outlined within Specification 230800 Section 1.5 Sub-Section D – Mechanical Contractor(s).
2. Review design for controllability with respect to selected equipment.
3. Verify proper hardware specification exists for functional performance required by specification and sequence of operation.
4. Verify proper safeties and interlocks are included in design.
5. Verify proper sizing of control valves and actuators based on design pressure drops. Verify control valve authority to control coil properly.
6. Verify proper sizing of control dampers. Verify damper authority to control air stream. Verify proper damper positioning for mixing to prevent stratification. Verify actuator vs. damper sections for smooth operation.
7. Verify proper selection of sensor ranges.

8. In addition to all other submittal requirements outlined with in Specifications 019113 and 230800, provide the following submittals to the Commissioning Agent:

    a. Hardware and software submittals.
    b. Control panel construction shop drawings.
    c. Narrative description of each control sequence for each piece of equipment controlled.
    d. Diagrams showing all control points, sensor locations, point names, actuators, controllers and, where necessary, points of access, superimposed on diagrams of the physical equipment.
    e. Logic diagrams showing the logic flow of the system.
    f. A list of all control points, including analog inputs, analog outputs, digital inputs, and digital outputs. Include the values of all parameters for each system point. Provide a separate list for each stand-alone control unit.
    g. A complete control language program listing, including all software routines employed in operating the control system. Also provide a program write-up, organized in the same manner as the control software. This narrative shall describe the logic flow of the software and the functions of each routine and sub-routine. It should also explain individual math or logic operations that are not clear from reading the software listing.
    h. Hardware Operation and Maintenance Manuals.
    i. Application software and project applications code manuals.
    j. Operations and Maintenance Staff comments on the BAS Graphics Submittal. Include all Controls Contractor responses.

G. Equipment Manufacturer(s):

1. Comply with all requirements as outlined within Specification 230800 Section 1.5 Sub-Section D – Mechanical Contractor(s).
2. Assist in scheduling of training sessions. Provide training of Owner's Maintenance Personnel with adequacy required for full comprehension of equipment and maintenance procedures.
3. Review installation for Equipment Manufacturer's specific requirements. Verify safeties, limits, relays and all other equipment specific settings are correct. Verify these settings optimize equipment performance and efficiencies.
4. Perform, approve and document all start-up services as outlined within the specifications for each piece of equipment, component and accessory. Perform all standard manufacturer services as outlined on manufacturer supplied forms. Additionally, perform all other requirements specifically called for within the project specifications, not otherwise performed in a manufacturer standard startup service. Provide additional documentation for these services on forms with manufacturer's letterhead.
5. Demonstrate performance of equipment as required within Functional Performance Tests.

1.6 DOCUMENTATION

A. The Commissioning Agent shall oversee and maintain the development of Commissioning Documentation. The Commissioning Documentation shall be kept in three ring binders, and organized by system and sub-system when practical. All pages shall be numbered, and a table of contents page(s) shall be provided. The Commissioning Documentation shall include the following which is to be maintained by the Contractor(s):

1. Start-Up and Check-Out Documentation: Organized and arranged with its associated Pre-Functional Checklist.
2. System and Component tests (i.e. Weld Test Reports, Cleaning & Flushing Reports, etc.): Organized and arranged with its associated Pre-Functional Checklist.
3. Pre-Functional Checklist: Organized and arranged as per provided by the Commissioning Agent. Typically these forms are organized by System and Sub-System and according to the order of standard specifications as outlined by American Institute of Architects (AIA.)
4. Test, Adjustment and Balance Report: The approved Final Report shall be provided to the Commissioning Agent for inclusion into the Final Commissioning Report.
5. Functional Performance Tests: All tests performed by the installing contractors for internal checkout and for witness by the Commissioning Agent shall be kept by the Contractor(s), organized and arranged by System and Sub-System, and turned over to the Commissioning Agent for inclusion into the Final Commissioning Report.
6. Project Training Record: The Training Record shall be provided with a Table of Contents followed by the updated Training Schedule and finally followed by each Training Session Agenda and Record. The Training Session Agenda and Record shall be organized by System and Sub-System.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. The appropriate Contractor(s) shall furnish all special tools and equipment required during the commissioning process. A list of all tools and equipment to be used during commissioning shall be submitted to the Commissioning Agent for approval. The owner shall furnish necessary utilities for the commissioning process. Additional test equipment requirements are found in Specification 019113 Section 2.8 – Test Equipment.

2.2 TEST EQUIPMENT - PROPRIETARY

A. Proprietary test equipment and software required by any equipment manufacturer for programming and/or start-up, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist in the commissioning process as needed. Proprietary test equipment (and software) shall become the property of the owner upon completion of the commissioning process.

PART 3 - EXECUTION

3.1 GENERAL

A. A pre-construction meeting of all Commissioning Team members shall be held at a time and place designated by the owner. The purpose shall be to familiarize all parties with the commissioning process, and to ensure that the responsibilities of each party are clearly understood.

B. A Final Commissioning Plan shall be developed by the Commissioning Agent. The Mechanical Contractor(s) shall assist the Commissioning Agent in preparing the Commissioning Plan by providing all necessary information pertaining to the actual equipment and installation in a timely manner. If contractor initiated system changes have been made that alter the commissioning process, the Commissioning Agent shall notify the Owner.

C. The Commissioning Process shall follow the schedule and procedures set forth within the Final Commissioning Plan.

D. The Mechanical Contractor(s) shall complete all phases of work so the systems can be started, tested, balanced, and acceptance procedures undertaken. This includes the complete installation of all equipment, materials, pipe, duct, wire, insulation, controls, etc., per the contract documents and related directives, clarifications, and change orders.

E. The Mechanical Contractor(s) shall coordinate all Commissioning Activities into the project as required herein and as outlined within the Commissioning Plan. The Mechanical Contractor(s) shall complete all required Commissioning and Construction Activities correctly and on schedule.

3.2 PARTICIPATION IN ACCEPTANCE PROCEDURES

A. The Mechanical Contractor(s) shall provide skilled technicians to start-up and debug all systems within Division 23. These same technicians shall be made available to assist the Commissioning Agent in completing the commissioning program. Work schedules, time required for testing, etc., shall be requested by the Commissioning Agent and coordinated by the Mechanical Contractor(s). Mechanical Contractor(s) shall ensure that the qualified technician(s) are available and present during the agreed upon schedules and of sufficient duration to complete the necessary tests, adjustments, and/or problem resolutions.

B. System performance problems and discrepancies may require additional technician time, Commissioning Agent time, reconstruction of systems, and/or replacement of system components. The additional technician time shall be made available for subsequent commissioning periods, at no cost to the owner, until the required system performance is obtained.

C. The Commissioning Agent reserves the right to question the appropriateness and qualifications of the technicians relative to each item of equipment, system, and/or sub-system. Qualifications of technicians shall include expert knowledge relative to the specific equipment involved and willingness to work with the Commissioning Agent. The Mechanical Contractor(s) shall provide adequate documentation and tools to start-up and test the equipment, system, and/or sub-system.

3.3 DEFICIENCY RESOLUTION

A. In some systems, miss-adjustments, misapplied equipment, and/or deficient performance under varying loads will result in additional work being required to commission the systems. This work shall be completed under the direction of the Owner, with input from the contractor and equipment supplier. Whereas all members shall have input and the opportunity to discuss, debate, and work out problems, the Owner and/or Architect shall have final jurisdiction over any additional work done to achieve performance.

B. Corrective work shall be completed in a timely fashion to permit the completion of the commissioning process. Any and all schedule items affected by this work shall be reflected on the Commissioning and Overall Project Schedules.

3.4 ADDITIONAL COMMISSIONING

A. The Mechanical Contractor, and associated sub-contractors, shall include time for additional commissioning required as a result of failure of a pre-functional or a functional test. Incomplete or incorrect Pre-Functional Checklists reviewed by the Commissioning Agent shall require an additional inspection to verify the re-completed PFC is complete and accurate. Functional Performance Tests witnessed by the Commissioning Agent which fail, shall require retesting, again witnessed by the Commissioning Agent. These documents must be re-checked or re-witnessed in order for the system to be approved and accepted by the Commissioning Agent.

B. The Commissioning Agent will invoice the Owner for additional time required to witness any retesting due to failed PFC’s or FPT’s, and the Owner at his discretion may deduct this cost from the Construction Manager’s Application for Payment. It is the Mechanical Contractor’s responsibility to properly de-bug systems and verify successful system performance prior to inviting the Commissioning Agent to witness the test.

3.5 SEASONAL COMMISSIONING

A. Seasonal commissioning pertains to testing under full load conditions during peak heating and peak cooling seasons, as well as part load conditions in the spring and fall. Initial commissioning shall be done as soon as contract work is completed, regardless of season. Subsequent commissioning may be undertaken at any time thereafter to ascertain adequate performance during the different seasons.

B. Heating equipment shall be tested during winter design extremes. Cooling equipment shall be tested during summer design extremes with a fully occupied building. Each contractor and supplier shall be responsible to participate in the initial and the alternate peak season tests of the systems as required to demonstrate performance.

3.6 PRE-FUNCTIONAL CHECKLISTS AND FUNCTIONAL PERFORMANCE TESTS

A. The Commissioning Agent shall be responsible for preparing the Pre-Functional Checklist. The Mechanical Contractor(s) shall be responsible for completing their applicable sections. Detailed descriptions of Pre-Functional Checklists are outlined in Section 019113-2.4.

B. The Commissioning Agent shall be responsible for preparing the Functional Performance Tests. The Commissioning Agent and Contractor (s) shall schedule the tests and assemble the commissioning team members who shall be responsible for the tests. Participating contractors, manufacturers, suppliers, etc. shall include all costs to do the work involved in these tests in their proposals. Detailed descriptions of Functional Performance Tests are outlined in Section 019113-2.6.

C. Following is a list of tasks and supporting information that shall be required:

1. Mechanical Contractor(s) - provide the services of a technician(s) who is (are) familiar with the construction and operation of this system. Provide access to the contract plans, shop drawings, and equipment cut sheets of all installed equipment.

D. Documentation and Reporting Requirements:

1. Any contractors with responsibilities related to the equipment to be installed, i.e. mechanical, electrical, TAB, controls, Construction Manager, shall be responsible for completing their related portion of the Pre-Functional Checklist and Functional Performance Test forms and shall sign off on its completion.

E. The Commissioning Agent shall direct and witness the field verification of the Final TAB report. The TAB Contractor shall perform measurements as directed by the Commissioning Agent.

1. The Commissioning Agent shall select report data for verification at random.
2. The TAB contractor shall be given sufficient advance notice of the date of field verification. However, they shall not be informed in advance of the data points to be verified. The TAB contractor must use the same instruments (by model and serial number) that were used when the original data were collected.
3. Failure of an item is defined as:

    a. For all readings other than sound, a deviation of more than 10 percent.
    b. For sound pressure readings, a deviation of 3 decibels. (Note: variations in background noise must be considered).

4. A failure of more than 10 percent of the selected items shall result in the rejection of the TAB report.

F. If deficiencies are identified during verification, the construction manager must be notified, and action taken to remedy the deficiency. The final tabulated checklist data sheets shall be reviewed by the Design Professional and the Commissioning Agent, to determine if verification is complete, and the operating system is functioning in accordance with the contract documents.

END OF SECTION 230800

SECTION 230900 - INSTRUMENTATION AND CONTROL FOR HVAC

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. 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. Related Sections include the following:

1. Section 230993 "Sequence of Operations for HVAC Controls" for requirements that relate to this Section.

1.3 DEFINITIONS

A. DDC: Direct digital control.

B. I/O: Input/output.

C. LonWorks: A control network technology platform for designing and implementing interoperable control devices and networks.

D. PID: Proportional plus integral plus derivative.

E. RTD: Resistance temperature detector.

1.4 SYSTEM PERFORMANCE

A. Comply with the following performance requirements:

1. Graphic Display: Display graphic with minimum 20 dynamic points with current data within 10 seconds.
2. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 8 seconds.
3. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.
4. Object Scan: Transmit change of state and change of analog values to control units or workstation within six seconds.

5. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations must receive alarms within five seconds of each other.
6. Program Execution Frequency: Run capability of applications as often as five seconds, but selected consistent with mechanical process under control.
7. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.
8. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:

    a. Water Temperature: Plus or minus 1 deg F.
    b. Water Flow: Plus or minus 5 percent of full scale.
    c. Water Pressure: Plus or minus 2 percent of full scale.
    d. Space Temperature: Plus or minus 1 deg F.
    e. Ducted Air Temperature: Plus or minus 1 deg F.
    f. Outside Air Temperature: Plus or minus 2 deg F.
    g. Dew Point Temperature: Plus or minus 3 deg F.
    h. Temperature Differential: Plus or minus 0.25 deg F.
    i. Relative Humidity: Plus or minus 5 percent.
    j. Airflow (Pressurized Spaces): Plus or minus 3 percent of full scale.
    k. Airflow (Measuring Stations): Plus or minus 5 percent of full scale.
    l. Airflow (Terminal): Plus or minus 10 percent of full scale.
    m. Air Pressure (Space): Plus or minus 0.01-inch wg.
    n. Air Pressure (Ducts): Plus or minus 0.1-inch wg.
    o. Electrical: Plus or minus 5 percent of reading.

1.5 ACTION SUBMITTALS

A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.

1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.
2. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.
3. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.

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. Bill of materials of equipment indicating quantity, manufacturer, and model number.
2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
3. Wiring Diagrams: Power, signal, and control wiring.

4. Details of control panel faces, including controls, instruments, and labeling.
5. Written description of sequence of operation.
6. Schedule of dampers including size, leakage, and flow characteristics.
7. Schedule of valves including flow characteristics.
8. DDC System Hardware:

    a. Wiring diagrams for control units with termination numbers.
    b. Schematic diagrams and floor plans for field sensors and control hardware.
    c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.

9. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.
10. Controlled Systems:

    a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
    b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
    c. Written description of sequence of operation including schematic diagram.
    d. Points list.

C. Samples for Initial Selection: For each color required, of each type of thermostat or sensor cover with factory-applied color finishes.

D. Samples for Verification: For each color required, of each type of thermostat or sensor cover.

1.6 INFORMATIONAL SUBMITTALS

A. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with LonWorks.

B. Qualification Data: For Installer and manufacturer.

C. Software Upgrade Kit: For Owner to use in modifying software to suit future systems revisions or monitoring and control revisions.

D. Field quality-control test reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Maintenance instructions and lists of spare parts for each type of control device.
2. Interconnection wiring diagrams with identified and numbered system components and devices.

3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
5. Calibration records and list of set points.

B. Software and Firmware Operational Documentation: Include the following:

1. Software operating and upgrade manuals.
2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.
5. Software license required by and installed for DDC workstations and control systems.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project.

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.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to equipment manufacturer.

B. System Software: Update to latest version of software at Project completion.

1.10 COORDINATION

A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

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.

2.2 CONTROL SYSTEM

A. Manufacturers: Subject to compliance with requirements, products shall include, but not be limited to:

1. Schneider Electric USA, Inc
2. Johnson Controls
3. Siemens
4. Honeywell.

B. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, and accessories to control mechanical systems.

C. 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. A remote operator workstation shall permit interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics. Provide a JACE interface for provided controllers and city-wide Niagara system.

D. Provide all materials and programming necessary for seamless connection to existing city-wide Niagara interface, and shall permit city personnel ready access and control of installed system.

2.3 DDC EQUIPMENT

A. 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 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.
d. Software applications, scheduling, and alarm processing.
e. Testing and developing control algorithms without disrupting field hardware and controlled environment.

3. Standard Application Programs:

a. Electric Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, night setback/setup, on-off control with differential sequencing, staggered start, antishort cycling, PID control, DDC with fine tuning, and trend logging.

b. HVAC Control Programs: Optimal run time, supply-air reset, and enthalpy switchover.
c. Chiller Control Programs: Control function of condenser-water reset, chilled-water reset, and equipment sequencing.
d. Programming Application Features: Include trend point; alarm processing and messaging; weekly, monthly, and annual scheduling; energy calculations; run-time totalization; and security access.
e. Remote communications.
f. Maintenance management.
g. Units of Measure: Inch-pound and SI (metric).

4. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
5. ASHRAE 135 Compliance: Control units shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.

B. 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 or diagnostic terminal unit.
4. ASHRAE 135 Compliance: Control units shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.

C. 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).
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.

D. 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.

E. 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 automatic system diagnostics; monitor system and report failures.
3. LonWorks Compliance: Communicate using EIA/CEA 709.1 datalink/physical layer protocol using LonTalk protocol.
4. Enclosure: Dustproof rated for operation at 32 to 120 deg F.
5. Enclosure: Waterproof rated for operation at 40 to 150 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 ELECTRONIC SENSORS

A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.

B. Thermistor Temperature Sensors and Transmitters:

1. Available 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: Concealed.
b. Set-Point Indication: Concealed.
c. Thermometer: Concealed.
d. Color:
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. Humidity Sensors: Bulk polymer sensor element.

1. Available 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: 5 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.

D. Pressure Transmitters/Transducers:

1. Available 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. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.
4. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; linear output 4 to 20 mA.

E. 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.

F. Room sensor accessories include the following:

1. Insulating Bases: For sensors located on exterior walls.
2. Guards: Locking; heavy-duty, transparent plastic; mounted on separate base.
3. Adjusting Key: As required for calibration and cover screws.

2.7 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 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.

C. 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.

D. 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.

E. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.

F. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.

G. 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. Available Manufacturers:

a. BEC Controls Corporation.
b. I.T.M. Instruments Inc.

2.8 FLOW MEASURING STATIONS

A. Duct Airflow Station: Combination of air straightener and multiport, self-averaging pitot tube station.

1. Available Manufacturers:

    a. Air Monitor Corporation.
    b. Wetmaster Co., Ltd.

2. Casing: Galvanized-steel frame, with 2” replaceable MERV 11 filter.
3. Flow Straightener: Aluminum honeycomb, 3/4-inch parallel cell, 3 inches deep.
4. Sensing Manifold: Copper manifold with bullet-nosed static pressure sensors positioned on equal area basis.

2.9 THERMOSTATS

A. Available Manufacturers: Subject to compliance with requirements, products shall include, but not be limited to, the following:

1. Daikin.
2. LG.
3. Mitisubishi.
4. Sauter Controls Corporation.
5. Trane.
6. Veris Industries.

B. Combination Thermostat and Fan Switches: Line-voltage thermostat with push-button or lever-operated fan switch.

1. Label switches "FAN ON-OFF".
2. Mount on single electric switch box.

C. 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. 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."

D. 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.

2.10 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 Section 230513 "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. Available Manufacturers:

a. Belimo Aircontrols (USA), Inc.
b. Insert manufacturer's name.

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-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: 40 to 104 deg F.
11. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F.
12. Run Time: 12 seconds open, 5 seconds closed.

2.11 DAMPERS

A. Available 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, parallel-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 oil-impregnated sintered bronze 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.

2.12 CONTROL CABLE

A. Electronic and fiber-optic cables for control wiring are specified in Section 271519 "Data Communications Horizontal Cabling."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that power supply is available to control units and operator workstation.

3.2 INSTALLATION

A. Install software in control units and remote operator workstation(s). City of Greenville IT Department will provide IP Address for JACE panel. Implement all features of programs to specified requirements and as appropriate to sequence of operation.

B. Connect and configure equipment and software to achieve sequence of operation specified.

C. 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.

D. Install guards on thermostats in the following locations:

1. Entrances.
2. Public areas.
3. Where indicated.

E. Install automatic dampers according to Section 233300 "Air Duct Accessories."

F. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.

G. Install labels and nameplates to identify control components according to Section 230553 "Identification for HVAC Piping and Equipment."

H. Install refrigerant instrument wells, valves, and other accessories according to Section 232300 "Refrigerant Piping."

I. Install duct volume-control dampers according to Section 233113 "Metal Ducts."

J. Install electronic and fiber-optic cables according to Section 271519 "Data Communications Horizontal Cabling."

3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. Install raceways, boxes, and cabinets according to Section 260533 "Raceways and Boxes for Electrical Systems."

B. Install building wire and cable according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Install signal and communication cable according to Section 271519 "Data 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.

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.

3.4 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 electronic 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 flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
5. Check temperature instruments and material and length of sensing elements.
6. Check control valves. Verify that they are in correct direction.
7. 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.

3.5 ADJUSTING

A. Calibrating and Adjusting:

1. Calibrate instruments.
2. Make three-point calibration test for both linearity and accuracy for each analog instrument.
3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
4. Control System Inputs and Outputs:

    a. Check analog inputs at 0, 50, and 100 percent of span.
    b. Check analog outputs using milliampere meter at 0, 50, and 100 percent output.
    c. Check digital inputs using jumper wire.
    d. Check digital outputs using ohmmeter to test for contact making or breaking.
    e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.

5. Flow:

    a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
    b. Manually operate flow switches to verify that they make or break contact.

6. Pressure:

    a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
    b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.

7. Temperature:

    a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
    b. Calibrate temperature switches to make or break contacts.

8. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
9. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
10. Provide diagnostic and test instruments for calibration and adjustment of system.

11. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.

B. Adjust initial temperature and humidity set points.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Eight hours of onsite training to be provided. Refer to Section 019113 "General Commissioning Requirements."

END OF SECTION 230900

SECTION 230901 COMMISSIONING OF INTEGRATED AUTOMATION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 019113 – Commissioning General Requirements.

C. Section 220800 – Commissioning of Plumbing Systems.

D. Section 230800 – Commissioning of Mechanical Systems.

E. Section 260800 – Commissioning of Electrical Systems.

F. Commissioning Plan.

1.2 DESCRIPTION OF WORK

A. The purpose of this section is to specify the Division 23 responsibilities and participation in the commissioning process. All contractors responsible for Division 23 installation or other activities shall have commissioning responsibilities described herein.

B. Work under this contract shall conform to requirements of Division 01, General Requirements, Conditions of the Contract, and Supplementary Conditions. This specification covers Commissioning of Integrated Automation Systems, which are a part of this project.

C. Commissioning shall be a team effort to ensure that all mechanical equipment and systems have been completely and properly installed and function together correctly to meet the design intent. Additionally, system performance parameters shall be monitored and documented for fine tuning of control sequences and operational procedures. Commissioning shall coordinate and document equipment installation, equipment start-up, control system calibration, testing and balancing, and verification and performance testing.

D. The Commissioning Team is defined in Specification 019113 Section 1.3 – Definitions. The trades represented on the Commissioning Team shall include but not be limited to; sheet metal, pipe and fitting, controls, test and balance, plumbing, chemical treatment and fire protection. The lead person for each trade who will actually perform or supervise the work is to be designated as the representative to the Commissioning Team. Responsibility for various steps of the commissioning process shall be divided among the members of the Commissioning Team, as described in this section.

E. Controls Contractor(s) are responsible for integrated automation systems installation, start-up, testing, preparation of O&M manuals, and operator training as defined in various Division 23 specification sections. Controls Contractor(s) are responsible for coordination, observation, and verification of commissioning as defined in this section and Section 019113. Neither Section 019113 - Commissioning General Requirements nor Section 230901 – Commissioning of Integrated Automation Systems shall relieve the Controls Contractor(s) from their obligations to complete all portions of work in a satisfactory and fully operational manner. Furthermore, Section 230910 – Commissioning of Integrated Automation Systems shall not relieve the Electrical Contractor(s) or Telecommunications Contractor(s) from any obligations set forth within Division 01, Division 26, Division 27, including Section 019113 – Commissioning General Requirements.

1.3 DEFINITIONS

A. Controls Contractor(s): The term Controls Contractor(s) utilized herein refers to any and all subcontracting companies or venders whom are responsible for the construction or other provisions regarding any of the systems which are being commissioned, as outlined in Specification 019113 Section 1.5 – Systems to be Included in Commissioning, and are defined within Division 23 of the specifications. Subcontracting parties outside of the scope of the Systems to be Included in Commissioning or outside of the scope of Division 23 are not included.

B. Equipment Manufacturer(s): The term Equipment Manufacturer(s) utilized herein refers to any and all subcontracting companies whom are responsible for the provision of equipment or components which are being commissioned, as outlined in Specification 019113 Section 1.5 – Systems to be Included in Commissioning, and are defined within Division 23 of the specifications. Equipment Manufacturer(s) shall refer to the direct representative of the maker and/or distributor of the equipment or component being provided. This may include either the actual equipment manufacturer or the supplier thereof, under the provisions that the supplier has a thorough knowledge of the equipment or component and is recognized by the actual equipment manufacturer as being a proper representative.

1.4 SCOPE OF WORK

A. The Controls Contractor(s) shall be required to Commission all equipment, components and accessories of each of the commissioned systems as outlined within Specification 019113 Section 1.5 – Systems to be Included in Commissioning. In order to accomplish a complete commissioning process, the Controls Contractor(s) shall be required to fulfill all requirements set forth within Specification 230901 Section 1.5 – Roles and Responsibilities. Additionally, the Controls Contractor(s) shall be required to fulfill all requirements set forth within Specification 019113.

B. Through the Commissioning Process, the Controls Contractor(s) shall accomplish thorough documentation, organized scheduling and coordination, detailed installation verification, and detailed system functional verification. For this, the Controls Contractor(s) must cooperate and coordinate with the Commissioning Agent.

1.5 ROLES AND RESPONSIBILITIES

A. In addition to the Commissioning Agent, Owner and System Design Professional(s), the Commissioning Team is comprised of a minimum of one individual to represent each contracting company or venders whom are responsible for the construction or other provisions regarding any of the systems which are being commissioned, as outlined in Specification 019113 Section 1.5 – Systems to be Included in Commissioning, and are defined within Division 23 of the specifications. See Specification 019113 Section 1.3 – Definitions for the definition of the Commissioning Team.

B. Contracting companies providing members shall include but not be limited to; HVAC, sheet metal, pipe and fitting, controls, test and balance, plumbing, chemical treatment and fire protection contractors whose responsibilities are defined herein.

C. In addition to all roles and responsibilities defined herein, all Controls Contractor(s) shall be required to fulfill all requirements described within Specification 019113 Section 1.4 – Roles and Responsibilities.

D. Controls Contractor(s):

1. General Requirements:

a. Include all cost to complete commissioning requirements for Integrated Automation Systems in the contract price. Contractor costs shall be reflected within the Schedule of Values as specified within Specification 019113 Section 2.2 – Schedule of Values.
b. Ensure cooperation and participation of specialty Contractors and Sub-Contractors.
c. Ensure participation of major Equipment Manufacturers in appropriate start-up, testing and training activities.
d. Attend Commissioning Meetings for construction phase coordination as scheduled by the Commissioning Agent. Additionally, attend the Commissioning Kick-Off Meeting as scheduled by the Commissioning Agent.

2. Commissioning Schedule:

a. Prepare a Preliminary Schedule for Integrated Automation Systems and equipment, including component installation, start-up and checkout, and system start-up. Integrate commissioning activities into this Preliminary Schedule including Pre-Functional and Functional Performance Tests.
b. Update the Preliminary Schedule and submit a Final Schedule which shall reflect all items within the Preliminary Schedule and shall also include but not be limited to: inspections, O&M manual submission, training sessions, equipment start-up, and task completion. All Contractor(s) shall integrate schedule activities into one complete Final Schedule which shall be reflected within the Construction Manager's overall project schedule. The Final Schedule shall be continuously updated throughout the Construction Phase.

3. Submittal Requirements:

    a. Comply with all Submittal requirements as outlined within Specification 019113 Section 2.3 – Submittals.
    b. Comply with all requirements as outlined within Specification 019113 Section 2.5 – Start-Up and Test Reports.
    c. Provide the following documentation to the Commissioning Agent for the purpose of construction updates:

        1) General construction progress and status reports
        2) Updated Architect, Owner, System Design Professional, and Contractor deficiency logs
        3) Minutes from all construction and coordination meetings not otherwise conducted by the Commissioning Agent
        4) Pre Start-Up and Start-Up procedures
        5) Value Engineering Proposals and a list of all accepted VE items
        6) Pressure Test Reports, Flushing Reports and Start-Up Reports
        7) Construction document changes resulting from mechanical Requests for Information

4. Pre-Functional Checklist Requirements:

    a. Detailed installation verification shall be performed on all installed equipment and systems to ensure that the installations conform to the contract documents, local and applicable codes, and standard practice. This shall be accomplished through the completion of Pre-Functional Checklists. The creation, distribution, completion and maintenance of Pre-Functional Checklists are detailed in Specification 019113 Section 2.4 – Pre-Functional Checklists.
    b. Complete Pre-Functional Checklists on all mechanical equipment and system components installed or provided by the Mechanical Contractors(s).
    c. Provide written notification to the Commissioning Agent for each system listed in Specification 019113 Section 1.5 – Systems To Be Included In Commissioning, that the system installation is complete in its entirety and that the system is fully operational, online, and ready for Functional Performance Testing.

5. Equipment and Systems Start-Up:

    a. Perform all initial check-out and start-up procedures as outlined within the specifications and as per the Equipment Manufacturer's recommendations. Provide full documentation of all start-up and check-out procedures and results. Documentations is to be submitted to the Commissioning Agent in conjunction with the associated Pre-Functional Checklist.

6. Functional Performance Test Requirements:

    a. Detailed testing shall be performed on all installed equipment and systems to ensure that operation and performance conform to contract documents, local and applicable codes, and standard practice. This shall be accomplished through the completion of Functional Performance Tests. The creation, distribution and completion of Functional Performance Tests are detailed in Specification 019113 Section 2.6 – Functional Performance Tests.
    b. Provide all appropriate equipment and materials as necessary to execute and complete all Functional Performance Tests. Comply with all requirements as outlined within Specification 019113 Section 2.8 – Test Equipment.
    c. Provide appropriate technicians for participation during system verification and functional performance testing. Technicians shall demonstrate system performance to Commissioning Agent including all modes of system operation (e.g. normal, abnormal, emergency, etc.)
    d. Verify all functional performance tests prior to requesting test witness by the Commissioning Agent, demonstrate all Functional Performance test tasks in the presence of the Commissioning Agent and assist the Commissioning Agent in all verification and functional performance tests.
    e. Participate in verification of the TAB report, which will consist of repeating any selected measurement contained in the TAB report where required by the Commissioning Agent for verification or diagnostic purposes. Typically, TAB Verification shall occur in conjunction with Functional Performance Testing.
    f. Cancellation or delays of any system tests or Functional Performance Testing upon the day of that particular scheduled test, due to lack of preparation or status of installation shall be considered a failed test due to the additional time required by the Commissioning Agent to witness electrical testing. These additional tests shall be treated in accordance with Specification 019113 Section 3.6-A.

7. Training Requirements:

    a. Comprehensive training of O&M personnel shall be performed by the Controls Contractor(s) and Equipment Manufacturer(s) prior to turnover of the systems to the Owner. Training shall include but not be limited to classroom instruction and hands-on instruction of the installed equipment and systems.
    b. The Training Schedule is to be coordinated and completed by the Controls Contractor(s). The Training Schedule is to be updated and maintained as construction progresses. The Training Schedule and all updates shall be coordinated with and approved of by the Owner.
    c. Contractor(s) responsible for the installation or provision of any piece of equipment or system shall attend, at minimum, the initial training session for that equipment or system.
    d. All Training Documentation shall be assembled and organized in a binder or set of binders. Coordinate with all other Contractor(s) to provide one complete bound Training Record. This requirement shall not be negated, unless other specific complete Project Training Record requirements, encompassing ALL project training documentation, is outlined elsewhere within the specifications.

8. Close-out Requirements:

    a. Remedy all deficiencies identified during commissioning. Provide all materials, equipment, labor, etc. to accomplish these remedies.
    b. Provide a complete set of Record Documents (As-Built Drawings and Specifications) to the Architect and/or Design Professional as required by the project specifications.
    c. Provide a complete set of O&M Manuals and Project Training Record to the Architect and/or Design Professional as required by the project specifications. Provide a complete copy of Equipment and System Warranties to the Architect and/or Design Professional as required by the project specifications.
    d. Provide a complete copy of Equipment and System Warranties to the Architect and/or Design Professional as required by the project specifications.

E. Automatic Controls and Building Automation System Contractor(s):

1. Comply with all requirements as outlined within Specification 230901 Section 1.5 Sub-Section D – Controls Contractor(s).

2. Review design for controllability with respect to selected equipment:

3. Verify proper hardware specification exists for functional performance required by specification and sequence of operation.

4. Verify proper safeties and interlocks are included in design.

5. Verify proper sizing of control valves and actuators based on design pressure drops. Verify control valve authority to control coil properly.

6. Verify proper sizing of control dampers. Verify damper authority to control air stream. Verify proper damper positioning for mixing to prevent stratification. Verify actuator vs. damper sections for smooth operation.

7. Verify proper selection of sensor ranges.

8. In addition to all other submittal requirements outlined with in Specifications 019113 and 230901, provide the following submittals to the Commissioning Agent:

    a. Hardware and software submittals.
    b. Control panel construction shop drawings.
    c. Narrative description of each control sequence for each piece of equipment controlled.
    d. Diagrams showing all control points, sensor locations, point names, actuators, controllers and, where necessary, points of access, superimposed on diagrams of the physical equipment.
    e. Logic diagrams showing the logic flow of the system.
    f. A list of all control points, including analog inputs, analog outputs, digital inputs, and digital outputs. Include the values of all parameters for each system point. Provide a separate list for each stand-alone control unit.

g. A complete control language program listing, including all software routines employed in operating the control system. Also provide a program write-up, organized in the same manner as the control software. This narrative shall describe the logic flow of the software and the functions of each routine and sub-routine. It should also explain individual math or logic operations that are not clear from reading the software listing.
h. Application software and project applications code manuals.
i. Operations and Maintenance Staff comments on the BAS Graphics Submittal. Include all Controls Contractor responses.

9. Verify proper installation and performance of controls / BAS hardware and software provided by others.

10. Issue a Statement of Calibration for each system which states that all system points and interfaces have been properly calibrated and adjusted.

11. Provide controls graphics submittals to the Commissioning Agent and to the Owner and Owner's Maintenance Personnel for approval. Do not proceed with controls graphics programming without integration of the Owner's Maintenance Personnel comments.

12. Provide thorough training to operating personnel on hardware operations and programming, and the application program for the system.

13. Demonstrate system performance to Commissioning Agent including all modes of system operation (e.g. normal, abnormal, emergency).

14. Provide control system technician for use during system verification and functional performance testing.

15. Provide system modifications as required.

16. Provide support and coordination with TAB contractor on all interfaces between their scopes of work. Provide all devices, such as portable operator's terminals, for TAB use in completing TAB procedures and TAB verification by the Commissioning Agent.

17. The Controls Contractor(s) shall provide trending as required to confirm, disconfirm or correct any deficiencies identified during Commissioning. The Commissioning Agent will provide the list of systems and points for trending.

F. Equipment Manufacturer(s):

1. Comply with all requirements as outlined within Specification 230901 Section 1.5 Sub-Section D – Controls Contractor(s).

2. Assist in scheduling of training sessions. Provide training of Owner's Maintenance Personnel with adequacy required for full comprehension of equipment and maintenance procedures.

3. Review installation for Equipment Manufacturer's specific requirements. Verify safeties, limits, relays and all other equipment specific settings are correct. Verify these settings optimize equipment performance and efficiencies.

4. Perform, approve and document all start-up services as outlined within the specifications for each piece of equipment, component and accessory. Perform all standard manufacturer services as outlined on manufacturer supplied forms. Additionally, perform all other requirements specifically called for within the project specifications, not otherwise performed in a manufacturer standard startup service. Provide additional documentation for these services on forms with manufacturer's letterhead.

5. Demonstrate performance of equipment as required within Functional Performance Tests.

1.6 DOCUMENTATION

A. The Commissioning Agent shall oversee and maintain the development of Commissioning Documentation. The Commissioning Documentation shall be kept in three ring binders, and organized by system and sub-system when practical. All pages shall be numbered, and a table of contents page(s) shall be provided. The Commissioning Documentation shall include the following which is to be maintained by the Contractor(s):

1. Start-Up and Check-Out Documentation: Organized and arranged with its associated Pre-Functional Checklist.

2. System and Component test: Organized and arranged with its associated Pre-Functional Checklist.

3. Pre-Functional Checklist: Organized and arranged as per provided by the Commissioning Agent. Typically these forms are organized by System and Sub-System and according to the order of standard specifications as outlined by American Institute of Architects (AIA.)

4. Functional Performance Tests: All tests performed by the installing contractors for internal checkout and for witness by the Commissioning Agent shall be kept by the Contractor(s), organized and arranged by System and Sub-System, and turned over to the Commissioning Agent for inclusion into the Final Commissioning Report.

5. Project Training Record: The Training Record shall be provided with a Table of Contents followed by the updated Training Schedule and finally followed by each Training Session Agenda and Record. The Training Session Agenda and Record shall be organized by System and Sub-System.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. The appropriate Contractor(s) shall furnish all special tools and equipment required during the commissioning process. A list of all tools and equipment to be used during commissioning shall be submitted to the Commissioning Agent for approval. The owner shall furnish necessary utilities for the commissioning process. Additional test equipment requirements are found in Specification 019113 Section 2.8 – Test Equipment.

2.2 TEST EQUIPMENT - PROPRIETARY

A. Proprietary test equipment and software required by any equipment manufacturer for programming and/or start-up, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist in the commissioning process as needed. Proprietary test equipment (and software) shall become the property of the owner upon completion of the commissioning process.

PART 3 - EXECUTION

3.1 GENERAL

A. A pre-construction meeting of all Commissioning Team members shall be held at a time and place designated by the owner. The purpose shall be to familiarize all parties with the commissioning process, and to ensure that the responsibilities of each party are clearly understood.

B. A Final Commissioning Plan shall be developed by the Commissioning Agent. The Controls Contractor(s) shall assist the Commissioning Agent in preparing the Commissioning Plan by providing all necessary information pertaining to the actual equipment and installation in a timely manner. If contractor initiated system changes have been made that alter the commissioning process, the Commissioning Agent shall notify the Owner.

C. The Commissioning Process shall follow the schedule and procedures set forth within the Final Commissioning Plan.

D. The Controls Contractor(s) shall complete all phases of work so the systems can be started, tested, balanced, and acceptance procedures undertaken. This includes the complete installation of all equipment, materials, pipe, duct, wire, insulation, controls, etc., per the contract documents and related directives, clarifications, and change orders.

E. The Controls Contractor(s) shall coordinate all Commissioning Activities into the project as required herein and as outlined within the Commissioning Plan. The Controls Contractor(s) shall complete all required Commissioning and Construction Activities correctly and on schedule.

3.2 PARTICIPATION IN ACCEPTANCE PROCEDURES

A. The Controls Contractor(s) shall provide skilled technicians to start-up and debug all systems within Division 23. These same technicians shall be made available to assist the Commissioning Agent in completing the commissioning program. Work schedules, time required for testing, etc., shall be requested by the Commissioning Agent and coordinated by the Controls Contractor(s). Controls Contractor(s) shall ensure that the qualified technician(s) are available and present during the agreed upon schedules and of sufficient duration to complete the necessary tests, adjustments, and/or problem resolutions.

B. System performance problems and discrepancies may require additional technician time, Commissioning Agent time, reconstruction of systems, and/or replacement of system components. The additional technician time shall be made available for subsequent commissioning periods, at no cost to the owner, until the required system performance is obtained.

C. The Commissioning Agent reserves the right to question the appropriateness and qualifications of the technicians relative to each item of equipment, system, and/or sub-system. Qualifications of technicians shall include expert knowledge relative to the specific equipment involved and willingness to work with the Commissioning Agent. The Controls Contractor(s) shall provide adequate documentation and tools to start-up and test the equipment, system, and/or sub-system.

3.3 DEFICIENCY RESOLUTION

A. In some systems, miss-adjustments, misapplied equipment, and/or deficient performance under varying loads will result in additional work being required to commission the systems. This work shall be completed under the direction of the Owner, with input from the contractor and equipment supplier. Whereas all members shall have input and the opportunity to discuss, debate, and work out problems, the Owner and/or Architect shall have final jurisdiction over any additional work done to achieve performance.

B. Corrective work shall be completed in a timely fashion to permit the completion of the commissioning process. Any and all schedule items affected by this work shall be reflected on the Commissioning and Overall Project Schedules.

3.4 ADDITIONAL COMMISSIONING

A. The Controls Contractor, and associated sub-contractors, shall include time for additional commissioning required as a result of failure of a pre-functional or a functional test. Incomplete or incorrect Pre-Functional Checklists reviewed by the Commissioning Agent shall require an additional inspection to verify the re-completed PFC is complete and accurate. Functional Performance Tests witnessed by the Commissioning Agent which fail, shall require retesting, again witnessed by the Commissioning Agent. These documents must be re-checked or re-witnessed in order for the system to be approved and accepted by the Commissioning Agent.

B. The Commissioning Agent will invoice the Owner for additional time required to witness any retesting due to failed PFC’s or FPT’s at a rate of $85/hour (including travel time), plus expenses, and the Owner will deduct this cost from the Construction Manager’s Application for Payment. The Construction Manager will then back charge the party responsible for the test’s failure. It is the Contractor’s responsibility to properly de-bug systems and verify successful system performance prior to inviting the Commissioning Agent to witness the test.

3.5 SEASONAL COMMISSIONING

A. Seasonal commissioning pertains to testing under full load conditions during peak heating and peak cooling seasons, as well as part load conditions in the spring and fall. Initial commissioning shall be done as soon as contract work is completed, regardless of season. Subsequent commissioning may be undertaken at any time thereafter to ascertain adequate performance during the different seasons.

B. Heating equipment shall be tested during winter design extremes. Cooling equipment shall be tested during summer design extremes with a fully occupied building. Each contractor and supplier shall be responsible to participate in the initial and the alternate peak season tests of the systems as required to demonstrate performance.

3.6 PRE-FUNCTIONAL CHECKLISTS AND FUNCTIONAL PERFORMANCE TESTS

A. The Commissioning Agent shall be responsible for preparing the Pre-Functional Checklist. The Controls Contractor(s) shall be responsible for completing their applicable sections. Detailed descriptions of Pre-Functional Checklists are outlined in Section 019113-2.4.

B. The Commissioning Agent shall be responsible for preparing the Functional Performance Tests. The Commissioning Agent and Contractor (s) shall schedule the tests and assemble the commissioning team members who shall be responsible for the tests. Participating contractors, manufacturers, suppliers, etc. shall include all costs to do the work involved in these tests in their proposals. Detailed descriptions of Functional Performance Tests are outlined in Section 019113-2.6.

C. Following is a list of tasks and supporting information that shall be required:

1. Mechanical Contractor(s) - provide the services of a technician(s) who is (are) familiar with the construction and operation of this system. Provide access to the contract plans, shop drawings, and equipment cut sheets of all installed equipment.

2. Controls Contractor - provide the services of a controls engineer who is familiar with the details of the project. Provide details of the control system, schematics, and a narrative description of control sequences of operation.

D. Documentation and Reporting Requirements:

1. Any contractors with responsibilities related to the equipment to be installed, i.e. Mechanical, electrical, TAB, controls, Construction Manager, shall be responsible for completing their related portion of the Pre-Functional Checklist and Functional Performance Test forms and shall sign off on its completion.

E. If deficiencies are identified during verification, the construction manager must be notified, and action taken to remedy the deficiency. The final tabulated checklist data sheets shall be reviewed by the Design Professional and the Commissioning Agent, to determine if verification is complete, and the operating system is functioning in accordance with the contract documents.

END OF SECTION 230901

SECTION 230993 - SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

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. This Section includes control sequences for HVAC systems, subsystems, and equipment.

B. Related Sections include the following:

1. Section 230900 "Instrumentation and Control for HVAC" for control equipment and devices and for submittal requirements.

1.3 DEFINITIONS

A. LEV: Linear Expansion Valve.

1.4 INDOOR FAN COIL UNIT SEQUENCE

A. On/Off Control: The indoor units can be commanded ON/OFF either by a schedule in the Central Controller, at the Remote Controller, or by the BMS. If all indoor units are off, the outdoor unit shall turn off. With the Night Setback Function/Mode, the system shall cycle on during unoccupied periods as needed to maintain unoccupied temperature set point.

B. Space Temperature Control: The indoor unit shall modulate its internal linear expansion valve (LEV) to maintain unit discharge air to maintain temperature set point via the indoor unit’s internal controls.

1. The set point is adjustable at the remote controller, central controller, or through a BMS interface. The temperature set point shall also be scheduled at the central controller.

C. Mode Control:

1. Auto Mode:

a. The indoor unit shall determine whether it should be in auto-heat mode or auto-cool mode based on space temperature relative to temperature set point. If the indoor unit is in auto heat mode, the indoor unit control board shall follow the heat

mode sequence. If the indoor unit is in auto cool mode, the indoor unit control board shall follow the cool mode sequence.

b. The indoor unit shall switch from auto heat to auto cool when the space temperature rises above set point and remains above the temperature set point plus the dead band for three minutes.

c. The indoor unit shall switch from auto cool to auto heat when the space temperature drops below set point and remains below the temperature set point minus the dead band for three minutes.

2. Heating Mode: The indoor unit shall modulate its linear expansion valve (LEV) to maintain temperature set point.

3. Cooling Mode: The indoor unit shall modulate its linear expansion valve (LEV) to maintain temperature set point.

D. Fan Control: Fan shall be controlled by the central controller. During occupied periods the unit fans shall be set to on and remain on. During unoccupied periods the fans shall cycle on as needed to maintain unoccupied temperature set point.

1.5 DEDICATED OUTDOOR AIR SYSTEM 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 (normally closed temperature switch, open at preset low temperature 35 deg F).
b. Output Device: Hard wired through motor starter; DDC system alarm.
c. Action: Allow start if duct temperature is above 35 deg F; signal alarm if fan fails to start as commanded.

2. Initiate: Occupied Time Schedule:

a. Input Device: DDC system time schedule.
b. Output Device: Binary output to motor starter.
c. Action: Energize fan(s).

3. Initiate: Unoccupied Time Schedule:

a. Input Device: DDC system demand.
b. Output Device: Binary output to motor starter.
c. Action: Energize fan(s).

4. 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.

5. Display: Remote through JACE interface.

B. Start and Stop Supply Fan:

1. Occupied Time Schedule:

a. Input Device: DDC system time schedule.
b. Output Device: Binary output.
c. Action: Enable control.

2. Display:

a. Supply-fan on-off indication.

C. Start and Stop Exhaust Fan:

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. Heat Wheel:

1. Enable: Freeze Protection:

a. Input Device: Duct-mounted averaging element thermostat, located before supply fan (normally closed temperature switch, open at preset low temperature 35 deg F).
b. Output Device: Hard wired through motor starter; DDC system alarm.
c. Action: Allow start if duct temperature is above 35 deg F; signal alarm if fan fails to start as commanded.

2. Initiate: Occupied Time Schedule:

a. Input Device: DDC system time schedule.
b. Output Device: Binary output to motor starter.
c. Action: Energize Heat Wheel.

3. Initiate: Unoccupied Time Schedule:

    a. Input Device: DDC system demand.
    b. Output Device: Binary output to motor starter.
    c. Action: Energize Heat Wheel.

4. Unoccupied Ventilation:

    a. Input Device: DDC system time schedule and output.
    b. Output Device: DDC system binary output to motor starter.
    c. Action: Energize wheel.
    d. Display: Heat Wheel on-off indication as BAS Display graphic:

E. DX Cooling/Heating Coil:

1. Occupied Time Schedule:

    a. Input Device: DDC system time schedule.
    b. Output Device: Binary output.
    c. Action: Enable control.

2. Discharge-Air Temperature:

    a. Input Device: Duct-mounted thermostat.
    b. Output Device: Normally closed modulating control valve.
    c. Action: Maintain supply-air temperature set point of 56 deg F.

3. Unoccupied Time Schedule:

    a. Input Device: DDC system time schedule.
    b. Output Device: Binary output.
    c. Action: Disable control.

4. Display:

    a. Fan-discharge air-temperature indication.
    b. Fan-discharge air-temperature set point.
    c. Cooling-coil air-temperature indication.
    d. Cooling-coil air-temperature set point.
    e. Cooling-coil control-valve position.

F. Coordination of Dedicated Outdoor Air System Unit Sequences: Ensure that preheat, mixed-air, and cooling-coil controls have common inputs and do not overlap in function.

G. Operator Station Display: Provide the following to remote operator workstation display terminal through Contractor-provided JACE panel to be located adjacent to IT patchboard:

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. Exhaust-fan on-off indication.
7. Heat Wheel on-off indication
8. Fan-discharge air-temperature indication.
9. Fan-discharge air-temperature set point.
10. Cooling/heating-coil air-temperature indication.
11. Cooling/heating-coil air-temperature set point.
12. Room temperature indication.
13. Room temperature set point.

1.6 TERMINAL UNIT OPERATING SEQUENCE

A. Cabinet Unit Heater, Electric (UH-1): Unit thermostat cycles fan and sequences stages of heating.

B. Baseboard Unit Heater, Electric (UH-2): Unit thermostat sequences stages of heating.

C. Exhaust Fan (EF-1): Continuous operation, energized from electrical disconnect switch.

1.7 VENTILATION SEQUENCES

A. Ventilation Damper: DDC system time schedule opens dampers.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230993

SECTION 232300 - REFRIGERANT PIPING

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. Refrigerant pipes and fittings.
2. Refrigerant piping valves and specialties.
3. Refrigerants.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of valve and refrigerant piping specialty.

1. Include pressure drop, based on manufacturer's test data, for the following:

a. Thermostatic expansion valves.
b. Solenoid valves.
c. Hot-gas bypass valves.
d. Filter dryers.
e. Strainers.
f. Pressure-regulating valves.

B. Shop Drawings:

1. Show piping size and 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.
2. Show interface and spatial relationships between piping and equipment.
3. Shop Drawing Scale: 1/4 inch equals 1 foot.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."

B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.6 PRODUCT STORAGE AND HANDLING

A. Store piping with end caps in place to ensure that piping interior and exterior are clean when installed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Line Test Pressure for Refrigerant R-410A:

1. Suction Lines for Air-Conditioning Applications: 300 psig.
2. Suction Lines for Heat-Pump Applications: 535 psig.
3. Hot-Gas and Liquid Lines: 535 psig.

2.2 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B 280, Type ACR.

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. Brazing Filler Metals: AWS A5.8/A5.8M.

E. 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. Working Pressure Rating: Factory test at minimum 500 psig.
5. Maximum Operating Temperature: 250 deg F.

2.3 VALVES AND SPECIALTIES

A. Diaphragm Packless Valves:

1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
3. Operator: Rising stem and hand wheel.
4. Seat: Nylon.
5. End Connections: Socket, union, or flanged.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 275 deg F.

B. Packed-Angle Valves:

1. Body and Bonnet: Forged brass or cast bronze.
2. Packing: Molded stem, back seating, and replaceable under pressure.
3. Operator: Rising stem.
4. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
5. Seal Cap: Forged-brass or valox hex cap.
6. End Connections: Socket, union, threaded, or flanged.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 275 deg F.

C. Check Valves:

1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
3. Piston: Removable polytetrafluoroethylene seat.
4. Closing Spring: Stainless steel.
5. End Connections: Socket, union, threaded, or flanged.
6. Maximum Opening Pressure: 0.50 psig.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 275 deg F.

D. 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.

E. Solenoid Valves: Comply with AHRI 760 and UL 429; listed and labeled by a National Recognized Testing Laboratory (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 ac coil.
6. Working Pressure Rating: 400 psig.
7. Maximum Operating Temperature: 240 deg F.

F. Thermostatic Expansion Valves: Comply with AHRI 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.

G. 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.

H. 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.

I. 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 parts per million (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.

J. Replaceable-Core Filter Dryers: Comply with AHRI 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 or charcoal.
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. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 240 deg F.

K. Receivers: Comply with AHRI 495.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

   a. Heldon Products; Henry Technologies.

2. Comply with UL 207; listed and labeled by an NRTL.

3. Body: Welded steel with corrosion-resistant coating.
4. Tappings: Inlet, outlet, liquid level indicator, and safety relief valve.
5. End Connections: Socket or threaded.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 275 deg F.

L. Liquid Accumulators: Comply with AHRI 495.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Emerson Climate Technologies.
   b. Heldon Products; Henry Technologies.
   c. Parker Hannifin Corp.

2. Body: Welded steel with corrosion-resistant coating.

3. End Connections: Socket or threaded.
4. Working Pressure Rating: 500 psig.
5. Maximum Operating Temperature: 275 deg F.

2.4 REFRIGERANTS

A. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Arkema Inc.
   b. DuPont Fluorochemicals Div.
   c. Genetron Refrigerants; Honeywell International Inc.
   d. Mexichem Fluor Inc.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANT R-410A

A. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.

B. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with Alloy HB soldered joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

A. Install diaphragm packless valves in suction and discharge lines of compressor.

B. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.

C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.

D. Except as otherwise indicated, install diaphragm packless valves on inlet and outlet side of filter dryers.

E. Install thermostatic expansion valves as close as possible to distributors on evaporators.

1. Install valve so diaphragm case is warmer than bulb.
2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

F. Install safety relief valves where required by 2010 ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.

G. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

H. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for the device being protected:

1. Solenoid valves.
2. Thermostatic expansion valves.
3. Compressor.

I. Install filter dryers in liquid line between compressor and thermostatic expansion valve.

3.3 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 on Shop Drawings.

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 Section 230900 "Instrumentation and Control for HVAC" and Section 230993 "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 Section 083100 "Access Doors and Panels" 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 piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

R. Identify refrigerant piping and valves according to Section 230553 "Identification for HVAC Piping and Equipment."

S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.4 PIPE 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 pipe and fittings before assembly.

C. 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.

3.5 HANGERS AND SUPPORTS

A. Comply with requirements for pipe hangers and supports specified in Section 230529 "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 (6 m) long.
2. Roller hangers and spring hangers for individual horizontal runs 20 feet (6 m) 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 diameters:

1. NPS 1/2: Maximum span, 60 inches; minimum rod, 1/4 inch.
2. NPS 5/8: Maximum span, 60 inches; minimum rod, 1/4 inch.
3. NPS 1: Maximum span, 72 inches; minimum rod, 1/4 inch.
4. NPS 1-1/4: Maximum span, 96 inches; minimum rod, 3/8 inch.
5. NPS 1-1/2: Maximum span, 96 inches; minimum rod, 3/8 inch.
6. NPS 2: Maximum span, 96 inches; minimum rod, 3/8 inch.

D. Support multifloor vertical runs at least at each floor.

3.6 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Comply with ASME B31.5, Chapter VI.
2. Test refrigerant piping, specialties, and receivers. 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 "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.

B. Prepare test and inspection reports.

3.7 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.

3.8 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 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. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealant and gaskets.
6. Hangers and supports.

B. Related Sections:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.

B. LEED Submittals:

1. Product Data for Prerequisite IEQ 1: Documentation indicating that duct systems comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."
2. Product Data for Prerequisite EA 2: Documentation indicating that duct systems comply with ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
3. Duct-Cleaning Test Report for Prerequisite IEQ 1: Documentation of work performed for compliance with ASHRAE 62.1, Section 7.2.4 - "Ventilation System Start-up."
4. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content.

C. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

D. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.

1.5 INFORMATIONAL SUBMITTALS

A. 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.

B. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. CertainTeed Corporation.
b. Johns Manville; a Berkshire Hathaway company.
c. Knauf Insulation.
d. Owens Corning.

2. Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

a. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II, Grade 1; and with NFPA 90A or NFPA 90B.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Aeroflex USA, Inc.
b. Armacell LLC.
c. Rubatex International, LLC.

2. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

3. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

a. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Natural-Fiber Duct Liner: 85 percent cotton, 10 percent borate, and 5 percent polybinding fibers, treated with a microbial growth inhibitor and complying with NFPA 90A or NFPA 90B.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Bonded Logic, Inc.
b. Reflectix Inc.

2. Maximum Thermal Conductivity: 0.24 Btu x in./h x sq. ft. x deg F at75 deg F mean temperature when tested according to ASTM C 518.
3. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to ASTM E 84; certified by an NRTL.

4. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

    a. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Insulation Pins and Washers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

E. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
7. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:

    a. Fan discharges.
    b. Intervals of lined duct preceding unlined duct.
    c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.

8. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.5 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

2.6 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 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

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 on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. 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.

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

A. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Outdoor, Supply-Air Ducts: Seal Class A.
3. Outdoor, Exhaust Ducts: Seal Class C.
4. Outdoor, Return-Air Ducts: Seal Class C.
5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
7. Unconditioned Space, Exhaust Ducts: Seal Class C.
8. Unconditioned Space, Return-Air Ducts: Seal Class B.
9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
11. Conditioned Space, Exhaust Ducts: Seal Class B.
12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 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.

3.5 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 233300 "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 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099100 "Painting."

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."

    a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

C. Duct system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.8 DUCT CLEANING

A. Clean new duct system(s) before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.9 START UP

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.10 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel.

B. Supply Ducts:

1. Ducts Connected to Fan Coil Units:

a. Pressure Class: Positive 2-inch wg.
b. Minimum SMACNA Seal Class: C.
c. SMACNA Leakage Class for Rectangular: 12.
d. SMACNA Leakage Class for Round and Flat Oval: 12.

2. Ducts Connected to DOAS:

a. Pressure Class: Positive 2-inch wg.
b. Minimum SMACNA Seal Class: C.
c. SMACNA Leakage Class for Rectangular: 12.
d. SMACNA Leakage Class for Round and Flat Oval: 12.

3. Ducts Connected to Equipment Not Listed Above:

a. Pressure Class: Positive 2-inch wg.
b. Minimum SMACNA Seal Class: C.
c. SMACNA Leakage Class for Rectangular: 12.
d. SMACNA Leakage Class for Round and Flat Oval: 12.

C. Return Ducts:

1. Ducts Connected to Fan Coil Units,:

a. Pressure Class: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: C.
c. SMACNA Leakage Class for Rectangular: 12.
d. SMACNA Leakage Class for Round and Flat Oval: 12.

2. Ducts Connected to Equipment Not Listed Above:

a. Pressure Class: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: C.
c. SMACNA Leakage Class for Rectangular: 12.
d. SMACNA Leakage Class for Round and Flat Oval: 12.

D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:

a. Pressure Class: Negative 2-inch wg.
b. Minimum SMACNA Seal Class: B if negative pressure, and B if positive pressure.
c. SMACNA Leakage Class for Rectangular: 12.

d. SMACNA Leakage Class for Round and Flat Oval: 12.

2. Ducts Connected to Equipment Not Listed Above:

a. Pressure Class: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: B if negative pressure, and B if positive pressure.
c. SMACNA Leakage Class for Rectangular: 12.
d. SMACNA Leakage Class for Round and Flat Oval: 12.

E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:

1. Ducts Connected to Equipment Not Listed Above:

a. Pressure Class: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: C.
c. SMACNA Leakage Class for Rectangular: 12.
d. SMACNA Leakage Class for Round and Flat Oval: 12.

F. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.

G. Liner:

1. Supply Air Ducts: Fibrous glass, Type I or Flexible elastomeric.
2. Return Air Ducts: Fibrous glass, Type I or Flexible elastomeric.
3. Exhaust Air Ducts: Fibrous glass, Type I.

H. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "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) Radius-to Diameter Ratio: 1.5.

b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

I. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."

a. Rectangular Main to Rectangular Branch: 45-degree entry.
b. Rectangular Main to Round Branch: Spin in.

END OF SECTION 233113

SECTION 233300 - AIR DUCT 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. Backdraft and pressure relief dampers.
2. Barometric relief dampers.
3. Manual volume dampers.
4. Control dampers.
5. Fire dampers.
6. Turning vanes.
7. Duct-mounted access doors.
8. Flexible connectors.
9. Flexible ducts.
10. Duct accessory hardware.

B. Related Requirements:

1. Section 283111 "Digital, Addressable Fire-Alarm System" for duct-mounted fire and smoke detectors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

B. LEED Submittals:

1. Product Data for Prerequisite IEQ 1: Documentation indicating that units comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."
2. Product Data for Prerequisite EA 2: Documentation indicating that duct insulation R-values comply with tables in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air Conditioning."

C. 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, smoke-damper, combination fire- and smoke-damper, ceiling, installations, including sleeves; and duct-mounted access doors and remote damper operators.
e. Duct security bars.
f. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.
2. Exposed-Surface Finish: Mill phosphatized.

B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and finish for exposed ducts.

C. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

D. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.

E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 BACKDRAFT AND PRESSURE RELIEF DAMPERS

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. Air Balance Inc.; a division of Mestek, Inc.
2. American Warming and Ventilating; a division of Mestek, Inc.
3. Cesco Products; a division of Mestek, Inc.
4. Greenheck Fan Corporation.
5. Lloyd Industries, Inc.
6. Nailor Industries Inc.
7. NCA Manufacturing, Inc.
8. Pottorff.
9. Ruskin Company.
10. Vent Products Company, Inc.

B. Description: Gravity balanced.

C. Maximum Air Velocity: 2000 fpm.

D. Maximum System Pressure: 2-inch wg.

E. Frame: Hat-shaped, 0.063-inch-thick, galvanized sheet steel, with welded corners or mechanically attached and mounting flange.

F. Blades: Multiple single-piece blades, maximum 6-inch width, 0.063-inch-thick, galvanized sheet steel with sealed edges.

G. Blade Action: Parallel.

H. Blade Axles:

1. Material: Plated steel.
2. Diameter: 0.20 inch minimum.

I. Tie Bars and Brackets: Galvanized steel.

J. Return Spring: Adjustable tension.

K. Bearings: Steel ball or synthetic pivot bushings.

L. Accessories:

1. Adjustment device to permit setting for varying differential static pressure.
2. Counterweights and spring-assist kits for vertical airflow installations.
3. Electric actuators.
4. Chain pulls.
5. Screen Mounting: Rear mounted.
6. Screen Material: Aluminum.
7. Screen Type: Insect.
8. 90-degree stops.

2.4 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Air Balance Inc.; a division of Mestek, Inc.
b. American Warming and Ventilating; a division of Mestek, Inc.
c. Flexmaster U.S.A., Inc.
d. McGill AirFlow LLC.
e. Nailor Industries Inc.
f. Pottorff.
g. Ruskin Company.
h. Trox USA Inc.
i. Vent Products Company, Inc.

2. Standard leakage rating.
3. Suitable for horizontal or vertical applications.
4. Frames:

a. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel.
b. Mitered and welded corners.
c. Flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:

a. Multiple or single blade.
b. Parallel- or opposed-blade design.
c. Stiffen damper blades for stability.
d. Galvanized-steel, 0.064 inch thick.

6. Blade Axles: Galvanized steel.

7. Bearings:

    a. Oil-impregnated bronze or Stainless-steel sleeve.
    b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

8. Tie Bars and Brackets: Galvanized steel.

B. Jackshaft:

1. Size: 0.5-inch diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

C. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch-thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.5 CONTROL DAMPERS

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. American Warming and Ventilating; a division of Mestek, Inc.
2. Arrow United Industries; a division of Mestek, Inc.
3. Cesco Products; a division of Mestek, Inc.
4. Greenheck Fan Corporation.
5. Lloyd Industries, Inc.
6. McGill AirFlow LLC.
7. Metal Form Manufacturing, Inc.
8. Nailor Industries Inc.
9. NCA Manufacturing, Inc.
10. Pottorff.
11. Ruskin Company.
12. Vent Products Company, Inc.
13. Young Regulator Company.

B. Low-leakage rating and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.

C. Frames:

1. Hat shaped.
2. 0.094-inch-thick, galvanized sheet steel.

D. Blades:

1. Multiple blade with maximum blade width of 8 inches.
2. Parallel-blade or opposed- design.
3. Galvanized-steel.
4. 0.064 inch thick single skin.
5. Blade Edging: Closed-cell neoprene or PVC.

E. Blade Axles: 1/2-inch-diameter; galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.

1. Operating Temperature Range: From minus 40 to plus 200 deg F.

F. Bearings:

1. Oil-impregnated bronze or Molded synthetic.
2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
3. Thrust bearings at each end of every blade.

2.6 FIRE DAMPERS

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. Air Balance Inc.; a division of Mestek, Inc.
2. Arrow United Industries; a division of Mestek, Inc.
3. Cesco Products; a division of Mestek, Inc.
4. Greenheck Fan Corporation.
5. Nailor Industries Inc.
6. NCA Manufacturing, Inc.
7. Pottorff.
8. Prefco; Perfect Air Control, Inc.
9. Ruskin Company.
10. Vent Products Company, Inc.
11. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Type: Dynamic; rated and labeled according to UL 555 by an NRTL.

C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.

D. Fire Rating: 1-1/2 hours.

E. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.

F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Minimum Thickness: 0.05 0.138 inch or 0.39 inch thick, as indicated, and of length to suit application.

2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

G. Mounting Orientation: Vertical or horizontal as indicated.

H. Blades: Roll-formed, interlocking, 0.024-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch-thick, galvanized-steel blade connectors.

I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

J. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

2.7 TURNING VANES

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. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Elgen Manufacturing.
4. METALAIRE, Inc.
5. SEMCO Incorporated.
6. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."

E. Vane Construction: Single wall.

2.8 DUCT-MOUNTED ACCESS DOORS

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. American Warming and Ventilating; a division of Mestek, Inc.
2. Cesco Products; a division of Mestek, Inc.
3. Ductmate Industries, Inc.
4. Elgen Manufacturing.

5. Flexmaster U.S.A., Inc.
6. Greenheck Fan Corporation.
7. McGill AirFlow LLC.
8. Nailor Industries Inc.
9. Pottorff.
10. Ventfabrics, Inc.
11. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."

1. Door:

   a. Double wall, rectangular.
   b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
   c. Vision panel.
   d. Hinges and Latches: 1-by-1-inchbutt or piano hinge and cam latches.
   e. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:

   a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
   b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
   c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
   d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

C. Pressure Relief Access Door:

1. Door and Frame Material: Galvanized sheet steel.
2. Door: Double wall with insulation fill with metal thickness applicable for duct pressure class.
3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
4. Doors close when pressures are within set-point range.
5. Hinge: Continuous piano.
6. Latches: Cam.
7. Seal: Neoprene or foam rubber.
8. Insulation Fill: 1-inch-thick, fibrous-glass or polystyrene-foam board.

2.9 DUCT ACCESS PANEL ASSEMBLIES

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. Ductmate Industries, Inc.

2. Flame Gard, Inc.
3. 3M.

B. Labeled according to UL 1978 by an NRTL.

C. Panel and Frame: Minimum thickness 0.0528-inch carbon steel.

D. Fasteners: Carbon steel. Panel fasteners shall not penetrate duct wall.

E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.

F. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.10 FLEXIBLE CONNECTORS

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. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Elgen Manufacturing.
4. Ventfabrics, Inc.
5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd.
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

2.11 FLEXIBLE DUCTS

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. Flexmaster U.S.A., Inc.
2. McGill AirFlow LLC.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.

1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.

3. Temperature Range: Minus 10 to plus 160 deg F.
4. Insulation R-value: Comply with ASHRAE/IESNA 90.1.

C. Flexible Duct Connectors:

1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.
2. Non-Clamp Connectors: Liquid adhesive plus tape.

2.12 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.

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 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. Upstream from duct filters.
3. At outdoor-air intakes and mixed-air plenums.
4. At drain pans and seals.
5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
6. 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.
7. At each change in direction and at maximum 50-foot spacing.
8. Upstream from turning vanes.
9. Control devices requiring inspection.
10. 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 Section 230553 "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 ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.

P. Connect flexible ducts to metal ducts with liquid adhesive plus tape.

Q. Install duct test holes where required for testing and balancing purposes.

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, smoke, and combination 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.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

SECTION 233423 - HVAC POWER VENTILATORS

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. In-line centrifugal fans.

1.3 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan-performance ratings on sea level.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Also include the following:

1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound-power ratings.
3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Material thickness and finishes, including color charts.
5. Dampers, including housings, linkages, and operators.
6. Roof curbs.
7. Fan speed controllers.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Roof framing and support members relative to duct penetrations.
2. Ceiling suspension assembly members.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.7 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. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

C. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

1.8 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate sizes and locations of concrete bases with actual equipment provided.

C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.1 IN-LINE CENTRIFUGAL FANS

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. Acme Engineering & Manufacturing Corporation.
2. American Coolair Corporation.
3. Ammerman; Millennium Equipment.
4. Breidert Air Products.
5. Carnes Company.
6. FloAire.
7. Greenheck Fan Corporation.
8. Hartzell Fan Incorporated.
9. JencoFan.
10. Loren Cook Company.
11. Madison Manufacturing.
12. PennBarry.
13. Quietaire Inc.

B. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.

C. Direct-Drive Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.

D. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.

E. Accessories:

1. Volume-Control Damper: Manually operated with quadrant lock, located in fan outlet.
2. Companion Flanges: For inlet and outlet duct connections.

2.2 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install power ventilators level and plumb.

B. Ceiling Units: Suspend units from structure; use steel wire or metal straps.

C. Support suspended units from structure using threaded steel rods and elastomeric hangers having a static deflection of 1 inch.

D. Install units with clearances for service and maintenance.

E. Label units according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

C. Replace fan and motor pulleys as required to achieve design airflow.

D. Lubricate bearings.

END OF SECTION 233423

SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

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. Rectangular and square ceiling diffusers.
2. Perforated diffusers.
3. Adjustable bar grille.
4. Fixed face grilles.
5. Linear bar grilles.

B. Related Sections:

1. Section 089100 "Louvers" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
2. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.3 ACTION 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, room location, quantity, model number, size, and accessories furnished.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

A. Rectangular and Square Ceiling Diffusers SD-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hart & Cooley Inc.
b. METALAIRE, Inc.
c. Nailor Industries Inc.
d. Price Industries.
e. Titus.

2. Material: Steel.
3. Finish: Baked enamel, white.
4. Face Size: 24 by 24 inches.
5. Duct Inlet: Round or Square. See plan for specifics.
6. Face Style: Plaque.
7. Mounting: Surface or T-bar. See plans for specifics.
8. Pattern: Fixed.

B. Perforated Diffuser RG-1, EG-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hart & Cooley Inc.
b. METALAIRE, Inc.
c. Nailor Industries Inc.
d. Price Industries.
e. Titus.

2. Material: Steel backpan and pattern controllers, with steel face.
3. Finish: Baked enamel, white.
4. Face Size: 24 by 24 inches.
5. Duct Inlet: Round or Square. See plan for specifics.
6. Face Style: Flush.
7. Mounting: Surface or T-bar. See plan for specifics.
8. Pattern Controller: None.

2.2 REGISTERS AND GRILLES

A. Adjustable Bar Grille SD-3:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hart & Cooley Inc.
b. METALAIRE, Inc.
c. Nailor Industries Inc.
d. Price Industries.
e. Titus.

2. Material: Steel.
3. Finish: Baked enamel, white.
4. Face Blade Arrangement: Horizontal spaced 3/4 inch apart.
5. Core Construction: Integral.

6. Rear-Blade Arrangement: Vertical spaced 3/4 inch apart.
7. Frame: 1-1/4 inches wide.

B. Fixed Face Grille RG-3:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Hart & Cooley Inc.
   b. Nailor Industries Inc.
   c. Price Industries.

2. Material: Steel.
3. Finish: Baked enamel, white.
4. Face Arrangement: ½" Blade spacing, 45 degree deflection.
5. Frame: 1-1/4 inches wide.
6. Mounting: Countersunk screw.

C. Linear Bar Grille SD-2:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Hart & Cooley Inc.
   b. Nailor Industries Inc.
   c. Price Industries.
   d. Titus.

2. Material: Aluminum.
3. Finish: Brushed aluminum with factory applied clear coat.
4. Face Arrangement: Pencil Proof Bar spacing, 7/16" 0 degree deflection core.
5. Distribution plenum.

   a. Internal insulation.

6. Frame: 1 inch wide.
7. Mounting: Concealed.

2.3 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 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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 Architect 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.

3.3 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 234100 - PARTICULATE AIR FILTRATION

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. Pleated panel filters.
2. Side-service housings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include dimensions; operating characteristics; required clearances and access; rated flow capacity, including initial and final pressure drop at rated airflow; efficiency and test method; fire classification; furnished specialties; and accessories for each model indicated.

B. LEED Submittals:

1. Product Data for Prerequisite IEQ 1: Documentation indicating that units comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."
2. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content.

C. Shop Drawings: For air filters. Include plans, elevations, sections, details, and attachments to other work.

1. Show filter rack assembly, dimensions, materials, and methods of assembly of components.
2. Include setting drawings, templates, and requirements for installing anchor bolts and anchorages.
3. Include diagram for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of filter and rack to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Provide one complete set(s) of filters for each filter bank. If system includes prefilters, provide only prefilters.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. ASHRAE Compliance:

1. Comply with applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality"; Section 5 - "Systems and Equipment"; and Section 7 - "Construction and Startup."
2. Comply with ASHRAE 52.2 for MERV for methods of testing and rating air-filter units.

B. Comply with NFPA 90A and NFPA 90B.

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.

2.2 PLEATED PANEL FILTERS

A. Description: Factory-fabricated, self-supported, extended-surface, pleated, panel-type, disposable air filters with holding frames.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. 3M.
b. Camfil Farr.
c. Flanders Corporation.
d. Koch Filter Corporation.

B. Media: Cotton and synthetic fibers coated with nonflammable adhesive.

1. Adhesive: As recommended by air-filter manufacturer and with a VOC content of 80 g/L or less.

2. Adhesive: As recommended by air-filter manufacturer and that complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
3. Media shall be coated with an antimicrobial agent.
4. Separators shall be bonded to the media to maintain pleat configuration.
5. Welded-wire grid shall be on downstream side to maintain pleat.
6. Media shall be bonded to frame to prevent air bypass.
7. Support members on upstream and downstream sides to maintain pleat spacing.

C. Filter-Media Frame: Cardboard frame with perforated metal retainer sealed or bonded to the media.

D. Mounting Frames: Welded galvanized steel, with gaskets and fasteners; suitable for bolting together into built-up filter banks.

1. MERV Rating: 8 at Fan Coil units and 13 for Outdoor air systems when tested according to ASHRAE 52.2.

2.3 SIDE-SERVICE HOUSINGS

A. Description: Factory-assembled by Fan Coil Unit manufacturer, side-service housings, constructed of galvanized steel, with flanges to connect to duct or casing system.

B. Prefilters: Integral tracks to accommodate 2-inch-deep, disposable filters.

C. Access Doors: Continuous gaskets on perimeter and positive-locking devices, and arranged so filter cartridges can be loaded from either access door.

D. Sealing: Incorporate positive-sealing gasket material on channels to seal top and bottom of filter cartridge frames and to prevent bypass of unfiltered air.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Position each filter unit with clearance for normal service and maintenance. Anchor filter holding frames to substrate.

B. Install filters in position to prevent passage of unfiltered air.

C. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing with new, clean filters.

D. Coordinate filter installations with duct and air-handling-unit installations.

3.2 CLEANING

A. After completing system installation and testing, adjusting, and balancing of air-handling and air-distribution systems, clean filter housings and install new filter media.

END OF SECTION 234100

SECTION 236200 - PACKAGED COMPRESSOR AND CONDENSER UNITS

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 packaged, refrigerant compressor and condenser units.

1.3 ACTION SUBMITTALS

A. Product Data: For each compressor and condenser unit. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include equipment dimensions, weights and structural loads, required clearances, method of field assembly, components, and location and size of each field connection.

B. LEED Submittals:

1. Product Data for Prerequisite EA 2: Documentation indicating that units comply with applicable requirements in ASHRAE/IESNA 90.1.
2. Product Data for Credit EA 4: Documentation indicating that compressor and condenser units and refrigerants comply.

C. Shop Drawings: For compressor and condenser units. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Structural members to which compressor and condenser units will be attached.
2. Liquid and vapor pipe sizes.
3. Refrigerant specialties.
4. Piping including connections, oil traps, and double risers.
5. Compressors.
6. Evaporators.

B. Field quality-control reports.

C. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For compressor and condenser units to include in emergency, operation, and maintenance manuals.

1.6 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. Fabricate and label refrigeration system according to ASHRAE 15, "Safety Standard for Refrigeration Systems."

C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6, "Heating, Ventilating, and Air-Conditioning."

1.7 COORDINATION

A. Coordinate sizes and locations of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-In-Place Concrete."

B. Coordinate location of piping and electrical rough-ins.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of compressor and condenser units that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Compressor failure.
    b. Condenser coil leak.

2. Warranty Period: Five years from date of Substantial Completion.
3. Warranty Period (Compressor Only): Five years from date of Substantial Completion.
4. Warranty Period (Components Other Than Compressor): Five years from date of Substantial Completion.
5. Warranty Period (Condenser Coil Only): Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 COMPRESSOR AND CONDENSER UNITS, AIR COOLED, 6 TO 120 TONS

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. Carrier Corporation; Commercial HVAC Systems.
2. Daikin.
3. Trane; a business of American Standard Companies.
4. YORK; a Johnson Controls company.
5. LG.
6. Mitisubishi Electric.

B. Description: Factory assembled and tested, air cooled; consisting of casing, compressors, condenser coils, condenser fans and motors, and unit controls.

C. Compressor: Hermetic scroll compressor designed for service with crankcase sight glass, crankcase heater, and backseating service access valves on suction and discharge ports.

1. Capacity Control: On-off compressor cycling.

D. Refrigerant: R-410A.

E. Condenser Coil: Seamless copper-tube, aluminum-fin coil, including subcooling circuit and backseating liquid-line service access valve. Factory pressure test coils, then dehydrate by drawing a vacuum and fill with a holding charge of nitrogen or refrigerant.

F. Condenser Fans: Propeller-type vertical discharge; either directly or belt driven. Include the following:

1. Permanently lubricated, ball-bearing motors.
2. Separate motor for each fan.
3. Dynamically and statically balanced fan assemblies.

G. Operating and safety controls include the following:

1. Manual-reset, high-pressure cutout switches.
2. Automatic-reset, low-pressure cutout switches.
3. Low-oil-pressure cutout switch.
4. Compressor-winding thermostat cutout switch.
5. Three-leg, compressor-overload protection.
6. Control transformer.
7. Magnetic contactors for compressor and condenser fan motors.
8. Timer to prevent excessive compressor cycling.
9. Low-Ambient Controller: Cycles condenser fan to permit operation down to 0 deg F.
10. Gage Panel: Package with refrigerant circuit suction and discharge gages.
11. Part-winding-start timing relay, circuit breakers, and contactors.

H. Unit Casings: Designed for outdoor installation with weather protection for components and controls and with removable panels for required access to compressors, controls, condenser fans, motors, and drives. Additional features include the following:

1. Steel, galvanized or zinc coated, for exposed casing surfaces; treated and finished with manufacturer's standard paint coating.
2. Perimeter base rail with forklift slots and lifting holes to facilitate rigging.
3. Gasketed control panel door.
4. Nonfused disconnect switch, factory mounted and wired, for single external electrical power connection.

2.2 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2.3 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate compressor and condenser units according to ARI 340/360.

B. Energy Efficiency: Equal to or greater than prescribed by ASHRAE/IESNA 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings," Section 6, "Heating, Ventilating, and Air-Conditioning."

C. Test and inspect shell and tube condensers according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

D. Testing Requirements: Factory test sound-power-level ratings according to ARI 370.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of compressor and condenser units.

B. Examine roughing-in for refrigerant piping systems to verify actual locations of piping connections before equipment installation.

C. Examine walls, floors, and roofs for suitable conditions where compressor and condenser units will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install units level and plumb, firmly anchored in locations indicated; maintain manufacturer's recommended clearances.

B. Install compressor and condenser units on concrete base. Concrete materials and installation requirements are specified in Section 033000 "Cast-In-Place Concrete."

C. Concrete Bases:

1. Install dowel rods to connect concrete base to concrete slab. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of the base.
2. For equipment supported on structural slab, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.
5. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

D. Maintain manufacturer's recommended clearances for service and maintenance.

E. Loose Components: Install electrical components, devices, and accessories that are not factory mounted.

3.3 CONNECTIONS

A. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

B. Connect precharged refrigerant tubing to unit's quick-connect fittings. Install tubing so it does not interfere with access to unit. Install furnished accessories.

C. Connect refrigerant piping to air-cooled compressor and condenser units; maintain required access to unit. Install furnished field-mounted accessories. Refrigerant piping and specialties are specified in Section 232300 "Refrigerant Piping."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test. Certify compliance with test parameters.
2. Leak Test: After installation, charge system with refrigerant and oil and test for leaks. Repair leaks, replace lost refrigerant and oil, and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor operation and unit operation, product capability, and compliance with requirements.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
5. Verify proper airflow over coils.

C. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.

D. Compressor and condenser units will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions and perform the following:

    a. Inspect for physical damage to unit casing.
    b. Verify that access doors move freely and are weathertight.
    c. Clean units and inspect for construction debris.
    d. Verify that all bolts and screws are tight.
    e. Adjust vibration isolation and flexible connections.
    f. Verify that controls are connected and operational.

B. Lubricate bearings on fan motors.

C. Verify that fan wheel is rotating in the correct direction and is not vibrating or binding.

D. Start unit according to manufacturer's written instructions and complete manufacturer's startup checklist.

E. Measure and record airflow and air temperature rise over coils.

F. Verify proper operation of condenser capacity control device.

G. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.

H. After startup and performance test, lubricate bearings.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain compressor and condenser units. One hour of onsite training to be provided.

END OF SECTION 236200

SECTION 236313 - AIR-COOLED REFRIGERANT CONDENSERS

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 packaged, air-cooled refrigerant condensers for outdoor installation.

1.3 ACTION SUBMITTALS

A. Product Data: For each air-cooled refrigerant condenser. Include rated capacities, operating characteristics, furnished specialties, and accessories. Include equipment dimensions, weights and structural loads, required clearances, method of field assembly, components, and location and size of each field connection.

B. LEED Submittals:

1. Product Data for Prerequisite EA 2: Documentation indicating that units comply with applicable requirements in ASHRAE/IESNA 90.1.
2. Product Data for Credit EA 4: Documentation indicating that air-cooled refrigerant condensers and refrigerants comply.

C. Shop Drawings: For air-cooled refrigerant condensers. 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.

D. Delegated-Design Submittal: For air-cooled refrigerant condensers 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. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Structural members to which air-cooled refrigerant condensers will be attached.
2. Liquid and vapor pipe sizes.
3. Refrigerant specialties.
4. Piping including connections, oil traps, and double risers.
5. Evaporators.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-cooled refrigerant condensers to include in emergency, operation, and maintenance manuals.

1.6 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. Fabricate and label refrigeration system according to ASHRAE 15, "Safety Standard for Refrigeration Systems."

C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-in-Place Concrete."

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 077200 "Roof Accessories."

C. Coordinate location of refrigerant piping and electrical rough-ins.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carrier Corporation; Commercial HVAC Systems.
2. Mitsubishi
3. Coolenheat Inc.
4. Daiken
5. Engineered Air.
6. Heatcraft Refrigeration Products LLC.
7. Trane; a business of American Standard Companies.
8. USA Coil & Air.
9. YORK; a Johnson Controls company.

2.2 MANUFACTURED UNITS

A. Description: Factory assembled and tested; consisting of casing, condenser coils, condenser fans and motors, and unit controls.

B. Refrigerant: R-410A.

C. Condenser Coil: Factory tested at 425 psig.

1. Tube: 3/8-inch-diameter seamless copper.
2. Coil Fin: Aluminum.
3. Coating: Powder-baked enamel
4. Circuit: To match compressors with liquid subcooling coil.

D. Condenser Fans and Drives: Propeller fans with aluminum or galvanized-steel fan blades, for vertical air discharge; directly driven with permanently lubricated ball-bearing motors with integral current- and thermal-overload protection.

1. Weather-proof motors with rain shield and shaft slinger.
2. Extend grease lines to outside of casing.

E. Condenser Fans and Drives: Forward-curved centrifugal fans for vertical air discharge.

1. Fan on steel shaft with self-aligning ball bearings.
2. V-belt drive with minimum of two belts; variable pitch drive pulley.
3. Motor mounted on adjustable slide base.

F. Operating and Safety Controls: Include condenser fan motor thermal and overload cutouts; 115-V control transformer, if required; magnetic contactors for condenser fan motors and a nonfused factory-mounted and -wired disconnect switch for single external electrical power connection.

1. Fan Cycling Control: Ambient thermostats.

G. Casings: Galvanized or zinc-coated steel treated and finished with manufacturer's standard paint coating designed for outdoor installation with weather protection for components and controls, and with the following:

1. Removable panels for access to controls, condenser fans, motors, and drives.
2. Stainless-steel fan guards.

3. Lifting eyes.
4. Removable legs, 36 inches high.

2.3 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

1. Enclosure Type: Totally enclosed, fan cooled.
2. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
3. Mount unit-mounted disconnect switches on exterior of unit.

2.4 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate air-cooled refrigerant condensers according to ARI 460.

B. Testing Requirements: Factory test sound-power-level ratings according to ARI 270.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of air-cooled refrigerant condensers.

B. Examine roughing-in for refrigerant piping systems to verify actual locations of piping connections before equipment installation.

C. Examine walls, floors, and roofs for suitable conditions where air-cooled condensers will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install units level and plumb, firmly anchored in locations indicated; maintain manufacturer's recommended clearances.

B. Equipment Mounting: Install air-cooled condenser refrigerant condensers on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases specified in Section 033000 "Cast-in-Place Concrete."

C. Equipment Mounting: Install air-cooled condenser refrigerant condensers on cast-in-place concrete equipment base(s) using elastomeric pads. Comply with requirements for equipment bases specified in Section 033000 "Cast-in-Place Concrete."

1. Minimum Deflection: 1 inch.

D. Maintain manufacturer's recommended clearances for service and maintenance.

E. Loose Components: Install electrical components, devices, and accessories that are not factory mounted.

3.3 CONNECTIONS

A. Install piping adjacent to machine to allow service and maintenance.

B. Refrigerant Piping: Connect piping to unit with pressure relief, service valve, filter-dryer, and moisture indicator on each refrigerant-circuit liquid line. Refrigerant piping and specialties are specified in Section 232300 "Refrigerant Piping."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Perform electrical test and visual and mechanical inspection.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Complete manufacturer's starting checklist.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
5. Verify proper airflow over coils.

C. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.

D. Air-cooled refrigerant condensers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions and perform the following:

    a. Inspect for physical damage to unit casing.
    b. Verify that access doors move freely and are weathertight.
    c. Clean units and inspect for construction debris.
    d. Verify that all bolts and screws are tight.
    e. Adjust vibration isolation and flexible connections.
    f. Verify that controls are connected and operational.

2. Lubricate bearings on fan motors.
3. Verify that fan wheel is rotating in the correct direction and is not vibrating or binding.
4. Adjust fan belts to proper alignment and tension.
5. Start unit according to manufacturer's written instructions and complete manufacturer's startup checklist.
6. Measure and record airflow and air temperature rise over coils.
7. Verify proper operation of capacity control device.
8. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.
9. After startup and performance test, lubricate bearings.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-cooled refrigerant condensers. One hour of onsite training to be provided.

END OF SECTION 236313

SECTION 237433 - DEDICATED OUTDOOR-AIR UNITS

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 factory-packaged units capable of supplying up to 100 percent outdoor air and providing cooling and heating.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rated capacities, operating characteristics, and furnished specialties and accessories.

B. LEED Submittals:

1. Product Data for Prerequisite EA 2: Documentation indicating that units comply with applicable requirements in ASHRAE/IESNA 90.1.
2. Product Data for Prerequisite EA 3: Documentation indicating that refrigerants comply.
3. Product Data for Credit EA 4: Documentation indicating that equipment and refrigerants comply.
4. Product Data for Prerequisite IEQ 1: Documentation indicating that units comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."
5. Product Data for Credit IEQ 1: Documentation indicating that units are equipped with a direct outdoor airflow-measuring device capable of measuring the minimum outdoor airflow with accuracy within 15 percent of the design minimum airflow rate, as defined by ASHRAE 62.1.
6. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
7. Product Data for Credit IEQ 5: Documentation indicating that units include MERV 13 filters rated according to ASHRAE 52.2.

C. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Prepare the following by or under the supervision of a qualified professional engineer:

    a. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Roof penetration details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Required roof penetrations for ducts, pipes, and electrical raceways, including size and location of each penetration.

B. Startup service reports.

C. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For units to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fan Belts: One set for each belt-driven fan.
2. Filters: One set for each unit.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to replace components of units that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Compressors: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

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. AAON.
2. Addison.
3. Desert Aire.
4. Engineered Air.
5. LCSystems.
6. Munters Corporation, Dehumidification Division; Des Champs Products.
7. Thomas & Betts Corporation; Reznor HVAC Division.
8. Thybar Corporation.

2.2 PERFORMANCE REQUIREMENTS

A. General Fabrication Requirements: Comply with requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Start-up."

B. Cabinet Thermal Performance:

1. Maximum Overall U-Value: Comply with requirements in ASHRAE/IESNA 90.1.
2. Include effects of metal-to-metal contact and thermal bridges in the calculations.

C. Cabinet Surface Condensation:

1. Cabinet shall have additional insulation and vapor seals if required to prevent condensation on the interior and exterior of the cabinet.
2. Portions of cabinet located downstream from the cooling coil shall have a thermal break at each thermal bridge between the exterior and interior casing to prevent condensation from occurring on the interior and exterior surfaces. The thermal break shall not compromise the structural integrity of the cabinet.

D. Maximum Cabinet Leakage: 1 percent of the total supply-air flow at a pressure rating equal to the fan shut-off pressure.

E. Cabinet Deflection Performance:

1. Walls and roof deflection shall be within 1/200 of the span at the design working pressure equal to the fan shut-off pressure. Deflection limits shall be measured at any point on the surface.
2. Floor deflections shall be within 1/240 of the span considering the worst-case condition caused by the following:

a. Service personnel.
b. Internal components.
c. Design working pressure defined for the walls and roof.

F. Electrical components, devices, and accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 CABINET

A. Construction: Single or double wall.

B. Exterior Casing Material: Galvanized steel with paint finish or stainless steel.

C. Interior Casing Material: Galvanized or stainless steel.

D. Lifting and Handling Provisions: Factory-installed shipping skids and lifting lugs.

E. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.

1. Service Doors: Hinged access doors with gaskets. Material and construction of doors shall match material and construction of cabinet in which doors are installed.

F. Roof: Standing seam or membrane; sloped to drain water.

G. Floor: metal surface, Insulation shall be below metal surface.

H. Cabinet Insulation:

1. Type: Fibrous-glass duct lining complying with ASTM C 1071, Type II or flexible elastomeric insulation complying with ASTM C 534, Type II, sheet materials.
2. Thickness: 1 inch.
3. Insulation Adhesive: Comply with ASTM C 916, Type I.
4. Mechanical Fasteners: Suitable for adhesive, mechanical, or welding attachment to casing without damaging liner and without causing air leakage when applied as recommended by manufacturer.

I. Condensate Drain Pans:

1. Shape: Rectangular, with 1 percent slope in at least two planes to direct water toward drain connection.
2. Size: Large enough to collect condensate from cooling coils including coil piping connections, coil headers, and return bends.

    a. Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
    b. Depth: A minimum of 2 inches deep.

3. Configuration: Single wall.
4. Material: Galvanized-steel sheet with asphaltic waterproofing compound coating on pan top surface or Stainless-steel sheet.
5. Drain Connection:

    a. Located on one end of pan, at lowest point of pan.
    b. Terminated with threaded nipple.
    c. Minimum Connection Size: NPS 1.

6. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

J. Surfaces in Contact with Airstream: Comply with requirements in ASHRAE 62.1 for resistance to mold and erosion.

2.4 SUPPLY FAN

A. Forward-Curved Fan Type: Centrifugal; statically and dynamically balanced.

1. Fan Wheel Material: Galvanized steel, mounted on solid-steel shaft.
2. Bearings: Self-aligning, permanently lubricated ball bearings.

B. Service Factor for Belt Drive Applications: V-belt drive with matching fan pulley and adjustable motor sheaves and belt assembly with minimum 1.4 service factor.

C. Motors:

1. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

D. Mounting: Fan wheel, motor, and drives shall be mounted to fan casing with elastomeric isolators.

2.5 HEAT RECOVERY DEVICE

A. Heat Wheel

2.6 COOLING COILS

A. Capacity Ratings: Comply with ASHRAE 33 and ARI 410.

B. Coil Casing Material: Manufacturer's standard material.

C. Tube Material: Copper.

D. Tube Header Material: Manufacturer's standard material.

E. Fin Material: Aluminum.

F. Fin and Tube Joints: Mechanical bond.

G. Leak Test: Coils shall be leak tested with air underwater.

H. Refrigerant Coil Capacity Reduction: Circuit coils for face row or interleaved control.

I. Refrigerant Coil Suction and Distributor Header Materials: Seamless copper tube with brazed joints.

2.7 REFRIGERATION SYSTEM

A. Comply with requirements in ASHRAE 15, "Safety Standard for Refrigeration Systems."

B. Refrigerant Charge: Factory charged with refrigerant and filled with oil.

C. Compressors: Scroll compressors with integral vibration isolators, internal overcurrent and overtemperature protection, internal pressure relief, and crankcase heater.

D. Refrigerant: R-410A.

1. Classified as Safety Group A1 according to ASHRAE 34.
2. Provide unit with operating charge of refrigerant.

E. Refrigeration System Specialties:

1. High-pressure switch.
2. Low-pressure switch.
3. Thermostat for coil freeze-up protection during low ambient temperature operation or loss of air.
4. Brass service valves installed in discharge and liquid lines.

F. Refrigerant condenser coils:

1. Capacity Ratings: Complying with ASHRAE 33 and ARI 410.
2. Tube Material: Copper.
3. Fin Material: Aluminum.
4. Fin and Tube Joint: Mechanical bond.
5. Leak Test: Coils shall be leak tested with air underwater.

G. Condenser Fan Assembly:

1. Fans: Direct-drive propeller type with statically and dynamically balanced fan blades.
2. Fan Motors:

a. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

H. Safety Controls:

1. Compressor motor and condenser coil fan motor low ambient lockout.
2. Overcurrent protection for compressor motor.

2.8 ELECTRIC-RESISTANCE HEATING COIL

A. UL Compliance: Comply with requirements in UL 1995, "Heating and Cooling Equipment."

B. Electric-Resistance Heating Elements:

1. Coiled Resistance Wire: 80 percent nickel and 20 percent chromium.
2. Heating Capacity: Low density 35 W per sq. in., factory wired for single-point wiring connection; with time delay for element staging and overcurrent- and overheat-protection devices.

3. Safety Controls:

    a. Blower-motor interlock, air-pressure switch.
    b. Quiet mercury contactors.
    c. Time delay between steps.
    d. Integral, nonfused power disconnect switch.

2.9 FILTERS

A. Cleanable Filters: 2-inch-thick, cleanable metal mesh.

B. Disposable Panel Filters:

1. Comply with NFPA 90A.
2. Minimum Merv: 13, according to ASHRAE 52.2.

C. Mounting Frames:

1. Panel filters arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or from access plenum.
2. Extended surface filters arranged for flat orientation, removable from access plenum.
3. Galvanized or stainless steel with gaskets and fasteners, suitable for bolting together into built-up filter banks.

2.10 ELECTRICAL POWER CONNECTIONS

A. General Electrical Power Connection Requirements: Factory-installed and -wired switches, motor controllers, transformers, and other necessary electrical devices shall provide a single-point field power connection to unit.

B. Wiring: Numbered and color-coded to match wiring diagram.

C. Wiring Location: Install factory wiring outside an enclosure in a raceway.

D. Factory Wiring: Branch power circuit to each motor and to controls with one of the following disconnecting means:

1. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.
2. NEMA KS 1, heavy-duty, nonfusible switch.
3. UL 489, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.

E. Factory-Mounted, Overcurrent-Protection Service: For each motor.

F. Controls: Factory wire unit-mounted controls where indicated.

G. Control Relays: Auxiliary and adjustable time-delay relays.

2.11 CONTROLS

A. Control Wiring: Factory wire connection for controls' power supply.

B. Control Devices: Sensors, transmitters, relays, switches, detectors, operators, actuators, and valves shall be manufacturer's standard items to accomplish indicated control functions.

C. Unit-Mounted Status Panel:

1. Cooling/Off/Heating Controls: Control operational mode.
2. Damper Position: Indicate position of outdoor-air dampers in terms of percentage of outdoor air.
3. Status Lights:

    a. Filter dirty.
    b. Fan operating.
    c. Cooling operating.
    d. Heating operating.
    e. Smoke alarm.
    f. General alarm.

4. Digital Numeric Display:

    a. Outdoor airflow.
    b. Supply airflow.
    c. Outdoor dry-bulb temperature.
    d. Outdoor dew point temperature.
    e. Space temperature.
    f. Supply temperature.
    g. Space relative humidity.
    h. Space carbon dioxide level.

D. Control Dampers:

1. Damper Location: Factory installed inside unit for ease of blade axle and bushing service.
2. Damper Leakage: Comply with requirements in AMCA 500-D. Leakage shall not exceed 6.5 cfm per sq. ft. at a static-pressure differential of 4.0 inches water column when a torque of 5 inch pounds per sq. ft. is applied to the damper jackshaft.
3. Damper Rating: Rated for close-off pressure equal to the fan shutoff pressure.
4. Damper Label: Bear the AMCA seal for both air leakage and performance.
5. Blade Configuration: Unless otherwise indicated, use parallel blade configuration for two-position control and equipment isolation service and use modulating control when mixing two airstreams. For other applications, use an opposed-blade configuration.
6. Damper Frame Material: galvanized steel or stainless steel.
7. Blade Type: Single-thickness metal reinforced with multiple V-grooves or hollow-shaped airfoil.
8. Blade Material: Extruded aluminum galvanized steel or stainless steel.
9. Maximum Blade Width: 6 inches.
10. Maximum Blade Length: 48 inches.

11. Blade Seals: Replaceable, continuous perimeter vinyl seals and jambs with stainless-steel compression-type seals.
12. Bearings: Thrust bearings for vertical blade axles.
13. Airflow Measurement:

    a. Monitoring System: Complete and functioning system of airflow monitoring as an integral part of the damper assembly where indicated.
    b. Remote Monitoring Signal: 0-10 volt or 4-20 mA scaled signal.
    c. Accuracy of flow measurement: Within 10 percent of the actual flow rate between the range of the scheduled minimum and maximum airflow. For units with a large range between minimum and maximum airflow, configure the damper sections and flow measurement assembly as necessary to comply with accuracy.
    d. Straightening Device: Integral to the flow measurement assembly if required to achieve the specified accuracy as installed.
    e. flow measuring device: Suitable for operation in untreated and unfiltered outdoor air. If necessary, include temperature and altitude compensation and correction to maintain the accuracy.

E. Damper Operators:

1. Factory-installed electric operator for each damper assembly with one operator for each damper assembly mounted to the damper frame.
2. Operator capable of shutoff against fan pressure and able to operate the damper with sufficient reserve power to achieve smooth modulating action and proper speed of response at the velocity and pressure conditions to which the damper is subjected.
3. Maximum Operating Time: Open or close damper 90 degrees in 90 seconds.
4. Adjustable Stops: For both maximum and minimum positions.
5. Position Indicator and Graduated Scale: Factory installed on each actuator with words "OPEN" and "CLOSED," or similar identification, at travel limits.
6. Spring-return operator to fail-safe; either closed or open as required by application.
7. Operator Type: Direct coupled, designed for minimum 60,000 full-stroke cycles at rated torque.
8. Position feedback Signal: For remote monitoring of damper position.
9. Coupling: V-bolt and V-shaped, toothed cradle.
10. Circuitry: Electronic overload or digital rotation-sensing circuitry.

F. Refrigeration System Controls:

1. Unit-mounted enthalpy controller shall lock out refrigerant system when outdoor-air enthalpy is less than 28 Btu/lb of dry air or outdoor-air temperature is less than 60 deg F.

G. Electric-Resistance Heat Controls:

1. Factory-mounted sensor in unit discharge with sensor adjustment located in control panel to control electric coil to maintain temperature.

H. Integral Smoke Alarm: Smoke detector installed in exhaust air.

I. DDC Temperature Control: Standalone control module for link between unit controls and DDC temperature-control system. Control module shall be compatible with control system specified in Section 230900 "Instrumentation and Control for HVAC." Links shall include the following:

1. Start/stop interface relay, and relay to notify DDC temperature-control system alarm condition.
2. Hardware interface or additional sensors for the following:

a. Room temperature.
b. Discharge-air temperature.
c. Refrigeration system operating.
d. Constant and variable motor loads.
e. Cooling load.
f. Economizer cycles.
g. Air-distribution static pressure and ventilation-air volumes.

J. BAS Interface: Factory-installed hardware and software to enable the BAS to monitor, control, and display unit status and alarms.

1. Hardwired Points:

a. Monitoring: On-off status, common trouble alarm.
b. Control: On-off operation, supply temperature set-point adjustment.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for piping, ducts, and electrical systems to verify actual locations of connections before equipment installation.

C. Examine roof curbs and equipment supports for suitable conditions where units will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's rigging and installation instructions for unloading units and moving to final locations.

B. Equipment Mounting: Install floor or on-grade mounted units on cast-in-place concrete equipment bases. Comply with requirements for equipment bases specified in Section 033000 "Cast-in-Place Concrete."

1. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install on 4-inch- high concrete base.

C. Install separate devices furnished by manufacturer and not factory installed.

D. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

E. Install drain pipes from unit drain pans to storm drain.

1. Drain Piping: Drawn-temper copper water tubing complying with ASTM B 88, Type L, with soldered joints.
2. Drain Piping: Schedule 40 PVC pipe complying with ASTM D 1785, with solvent-welded fittings.

    a. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
    b. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Pipe Size: Same size as condensate drain pan connection.

3.3 CONNECTIONS

A. Duct Connections:

1. Comply with requirements in Section 233113 "Metal Ducts."
2. Drawings indicate the general arrangement of ducts.
3. Connect ducts to units with flexible duct connectors. Comply with requirements for flexible duct connectors in Section 233300 "Air Duct Accessories."

B. Electrical Connections: Comply with requirements for power wiring, switches, and motor controls in electrical Sections.

1. Install electrical devices furnished by unit manufacturer but not factory mounted.

3.4 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

2. Inspect units for visible damage to refrigerant compressor, condenser and evaporator coils, and fans.
3. Start refrigeration system when outdoor-air temperature is within normal operating limits and measure and record the following:

    a. Cooling coil leaving-air, dry- and wet-bulb temperatures.
    b. Cooling coil entering-air, dry- and wet-bulb temperatures.
    c. Condenser coil entering-air dry-bulb temperature.
    d. Condenser coil leaving-air dry-bulb temperature.

4. Simulate maximum cooling demand and inspect the following:

    a. Compressor refrigerant suction and hot-gas pressures.
    b. Short-circuiting of air through outside coil or from outside coil to outdoor-air intake.

5. Inspect casing insulation for integrity, moisture content, and adhesion.
6. Verify that clearances have been provided for servicing.
7. Verify that controls are connected and operable.
8. Verify that filters are installed.
9. Clean coils and inspect for construction debris.
10. Verify bearing lubrication.
11. Clean fans and inspect fan-wheel rotation for movement in correct direction without vibration and binding.
12. Adjust fan belts to proper alignment and tension.
13. Start unit.
14. Inspect and record performance of interlocks and protective devices including response to smoke detectors by fan controls and fire alarm.
15. Operate unit for run-in period.
16. Calibrate controls.
17. Adjust and inspect high-temperature limits.
18. Verify operational sequence of controls.
19. Measure and record the following airflows. Plot fan volumes on fan curve.

    a. Supply-air volume.
    b. Exhaust-air flow.

B. After startup, change filters, verify bearing lubrication, and adjust belt tension.

C. Remove and replace components that do not properly operate and repeat startup procedures as specified above.

D. Prepare written report of the results of startup services.

3.5 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units. Two hours of onsite training to be provided.

END OF SECTION 237433

SECTION 238219 - FAN COIL UNITS

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. This Section includes fan-coil units and accessories.

1.3 DEFINITIONS

A. BAS: Building automation system.

1.4 ACTION SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. LEED Submittals:

1. Product Data for Credit EA 4: Documentation indicating that equipment and refrigerants comply.
2. Product Data for Prerequisite IEQ 1: Documentation indicating that units comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."

C. 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.

D. Warranty: Special warranty specified in this Section.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fan-coil units to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Maintenance schedules and repair part lists for motors, coils, integral controls, and filters.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fan-Coil-Unit Filters: Furnish 1 spare filters for each filter installed.

1.7 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. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.8 COORDINATION

A. Coordinate layout and installation of fan-coil units and suspension system components with other construction that penetrates or is supported by ceilings, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of condensing units that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Compressor failure.
b. Condenser coil leak.

2. Warranty Period: Five years from date of Substantial Completion.
3. Warranty Period (Compressor Only): Five years from date of Substantial Completion.
4. Warranty Period (Condenser Coil Only): Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In the Fan-Coil-Unit 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 fan-coil unit 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.

2.2 FAN-COIL UNITS

A. Basis-of-Design Product: Mitisibushi, City-Multi or designation or a comparable product by one of the following:

B. Available Manufacturers:

1. Daikin Industries, Ltd.
2. Carrier Corporation.
3. Trane.
4. LG Electronics U.S.A., Inc.

C. Description: Factory-packaged and -tested units rated according to ARI 440, ASHRAE 33, and UL 1995.

D. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

E. Main and Auxiliary Drain Pans: Plastic or Insulated galvanized steel with plastic liner. Fabricate pans and drain connections to comply with ASHRAE 62.1.

F. Chassis: Galvanized steel where exposed to moisture. Floor-mounting units shall have leveling screws.

G. Cabinet: Steel with baked-enamel finish in manufacturer's standard paint color.

H. Fan and Motor Board:

1. Fan: Forward curved, double width, centrifugal; directly connected to motor. Thermoplastic or painted-steel wheels, and aluminum, painted-steel, or galvanized-steel fan scrolls.
2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."
3. Wiring Termination: Connect motor to chassis wiring with plug connection.

I. Control devices and operational sequences are specified in Section 230900 "Instrumentation and Control for HVAC" and Section 230993 "Sequence and Operations for HVAC Controls."

J. Basic Unit Controls:

1. Control voltage transformer.
2. Wall-mounting thermostat with the following features:

    a. Heat-cool-off switch.
    b. Fan on-auto switch.
    c. Fan-speed switch.
    d. Automatic changeover.
    e. Adjustable deadband.
    f. Concealed set point.
    g. Exposed indication.
    h. Degree F indication.

3. Unoccupied-period-override push button.
4. Data entry and access port.

    a. Input data includes room temperature, and humidity set points and occupied and unoccupied periods.
    b. Output data includes room temperature and humidity, supply-air temperature, entering-water temperature, operating mode, and status.

K. DDC Terminal Controller:

1. Scheduled Operation: Occupied and unoccupied periods on seven-day clock with a minimum of four programmable periods per day.
2. Unit Supply-Air Fan Operation:

    a. Occupied Periods: Fan runs continuously.
    b. Unoccupied Periods: Fan cycles to maintain room setback temperature.

3. Controller shall have volatile-memory backup.

L. BAS Interface Requirements:

1. Interface relay for scheduled operation.
2. Interface relay to provide indication of fault at the central workstation.
3. Provide BACnet or LonWorks interface for central BAS workstation for the following functions:

    a. Adjust set points.
    b. Fan-coil-unit start, stop, and operating status.
    c. Data inquiry, including supply- and room-air temperature and humidity.
    d. Occupied and unoccupied schedules.

M. Electrical Connection: Factory wire motors and controls for a single electrical connection.

2.3 DUCTED FAN-COIL UNITS

A. Basis-of-Design Product: Mitisibushi, City-Multi or a comparable product by one of the following:

1. Daikin Industries, Ltd.
2. Carrier Corporation.
3. Trane.
4. LG Electronics U.S.A., Inc.

B. Description: Factory-packaged and -tested units rated according to ARI 440, ASHRAE 33, and UL 1995.

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

D. Drain Pans: Galvanized steel. Fabricate pans and drain connections to comply with ASHRAE 62.1.

E. Chassis: Galvanized steel where exposed to moisture, with baked-enamel finish and removable access panels.

F. Cabinets: Steel with baked-enamel finish in manufacturer's standard paint color.

G. Filters: Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.

1. Pleated Cotton-Polyester Media: 8 MERV.

H. Indoor Refrigerant Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, and brazed joints at fittings. Comply with ARI 210/240, and leak test to minimum 450 psig for a minimum 300-psig working pressure. Include thermal expansion valve.

I. Direct-Driven Fans: Forward curved, centrifugal; with permanently lubricated, multispeed motor resiliently mounted in the fan inlet. Aluminum or painted-steel wheels, and painted-steel or galvanized-steel fan scrolls.

1. Motors: Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

J. Remote condensing units are specified in Section 236200 "Packaged Compressor and Condenser Units."

K. Basic Unit Controls:

1. Control voltage transformer.
2. Wall-mounting thermostat with the following features.

a. Heat-cool-off switch.
b. Fan on-auto switch.

c. Fan-speed switch.
d. Automatic changeover.
e. Adjustable deadband.
f. Concealed set point.
g. Exposed indication.
h. Degree F indication.

3. Unoccupied-period-override push button.
4. Data entry and access port.

a. Input data includes room temperature, and humidity set points and occupied and unoccupied periods.
b. Output data includes room temperature and humidity, supply-air temperature, entering-water temperature, operating mode, and status.

L. DDC Terminal Controller:

1. Scheduled Operation: Occupied and unoccupied periods on seven-day clock with a minimum of four programmable periods per day.
2. Unoccupied Period Override Operation: Two hours.
3. Unit Supply-Air Fan Operation:

a. Occupied Periods: Fan runs continuously.
b. Unoccupied Periods: Fan cycles to maintain room setback temperature.

4. Refrigerant-Coil Operation:

a. Occupied Periods: Start compressor to maintain room temperature or humidistat set point.
b. Unoccupied Periods: Stop compressor cooling and cycle compressor for heating to maintain setback temperature.

M. BAS Interface Requirements:

1. Interface relay for scheduled operation.
2. Interface relay to provide indication of fault at the central workstation.
3. Provide BACnet or LonWorks interface for central BAS workstation for the following functions:

a. Adjust set points.
b. Fan-coil-unit start, stop, and operating status.
c. Data inquiry including supply- and room-air temperature and humidity.
d. Occupied and unoccupied schedules.

N. Electrical Connection: Factory wire motors and controls for a single electrical connection.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive fan-coil units for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for piping and electrical connections to verify actual locations before fan-coil-unit installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install fan-coil units level and plumb.

B. Install fan-coil units to comply with NFPA 90A.

C. Suspend fan-coil units from structure with elastomeric hangers.

D. Verify locations of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 60 inches above finished floor.

E. Install new filters in each fan-coil unit within two weeks after Substantial Completion.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:

1. Install piping adjacent to machine to allow service and maintenance.
2. Connect piping to fan-coil-unit factory hydronic piping package. Install piping package if shipped loose.
3. Connect condensate drain to indirect waste.

    a. Install condensate trap of adequate depth to seal against the pressure of fan. Install cleanouts in piping at changes of direction.

B. Connect supply and return ducts to fan-coil units with flexible duct connectors specified in Section 233300 "Air Duct Accessories." Comply with safety requirements in UL 1995 for duct connections.

C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect 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 motor rotation and unit operation.
2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fan-coil units. One hour of onsite training to be provided. Refer to Section 019113 "General Commissioning Requirements."

END OF SECTION 238219

SECTION 238239 - UNIT HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Wall and ceiling heaters with propeller fans and electric-resistance heating coils.

1.3 DEFINITIONS

A. BAS: Building automation system.

B. CWP: Cold working pressure.

C. PTFE: Polytetrafluoroethylene plastic.

D. TFE: Tetrafluoroethylene plastic.

1.4 ACTION SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated.

B. LEED Submittals:

1. Product Data for Prerequisite IEQ 1: Documentation indicating that units comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."

C. 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. Plans, elevations, sections, and details.
2. Location and size of each field connection.
3. Equipment schedules to include rated capacities, operating characteristics, furnished specialties, and accessories.
4. Location and arrangement of integral controls.
5. Wiring Diagrams: Power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For cabinet unit heaters to include in emergency, operation, and maintenance manuals.

1.6 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. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

PART 2 - PRODUCTS

2.1 WALL AND CEILING HEATERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:

1. Berko Electric Heating; a division of Marley Engineered Products.
2. Chromalox, Inc.; a division of Emerson Electric Company.
3. Indeeco.
4. Markel Products; a division of TPI Corporation.
5. Marley Electric Heating; a division of Marley Engineered Products.
6. Ouellet Canada Inc.
7. QMark Electric Heating; a division of Marley Engineered Products.
8. Trane.
9. Reznor.
10. Modine.

B. Description: An assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.

C. Cabinet:

1. Front Panel: Stamped-steel louver, with removable panels fastened with tamperproof fasteners.
2. Finish: Baked enamel over baked-on primer with manufacturer's standard color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.
3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

D. Surface-Mounting Cabinet Enclosure: Steel with finish to match cabinet.

E. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high temperature protection.

F. Fan: Aluminum propeller directly connected to motor.

1. Motor: Permanently lubricated. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

G. Controls: Unit-mounted thermostat.

H. Electrical Connection: Factory wire motors and controls for a single field connection.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for electrical connections to verify actual locations before unit heater installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install cabinet unit heaters to comply with NFPA 90A.

B. Install propeller unit heaters level and plumb.

C. Suspend cabinet unit heaters from structure with elastomeric hangers.

D. Suspend propeller unit heaters from structure with all-thread hanger rods and. Hanger rods and attachments to structure are specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

E. Install new filters in each fan-coil unit within two weeks of Substantial Completion.

3.3 CONNECTIONS

A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. 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 motor rotation and unit operation.
2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

B. Remove and replace malfunctioning units and retest as specified above.

3.5 ADJUSTING

A. Adjust initial temperature set points.

END OF SECTION 238239

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

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. Copper building wire rated 600 V or less.
2. Connectors, splices, and terminations rated 600 V and less.

B. Related Requirements:

1. Section 271519 "Data Communications Horizontal Cabling" for cabling used for voice and data circuits.
2. Section 280513 “Conductors and Cables for Electronic Safety and Security” for conductors and cabling used for security circuits.

1.3 DEFINITIONS

A. RoHS: Restriction of Hazardous Substances.

B. VFC: Variable-frequency controller.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For each conductor and cable indicating lead content.
2. Product Data: For recycled content, indicating post-consumer and pre-consumer recycled content and cost.
3. Product Data: For solvents and adhesives, indicating VOC content.
4. Laboratory Test Reports: For solvents and adhesives, indicating compliance with requirements for low-emitting materials.

C. Product Schedule: Indicate type, use, location, and termination locations.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cerro Wire LLC.
2. Encore Wire Corporation.
3. General Cable Technologies Corporation.
4. Southwire Company.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

E. Conductor Insulation:

1. Type TC-ER: Comply with NEMA WC 70/ICEA S-95-658 and UL 1277.
2. Type THHN and Type THWN-2: Comply with UL 83.
3. Type XHHW-2: Comply with UL 44.

F. Shield:

1. Type TC-ER: Cable designed for use with VFCs, with oversized crosslinked polyethylene insulation, spiral-wrapped foil plus 85 percent coverage braided shields and insulated full-size ground wire, and sunlight- and oil-resistant outer PVC jacket.

2.2 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. 3M Electrical Products.
2. Hubbell Power Systems, Inc.
3. Ideal Industries, Inc.
4. ILSCO.
5. O-Z/Gedney; a brand of Emerson Industrial Automation.
6. Thomas & Betts Corporation; A Member of the ABB Group.

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.

C. VFC Output Circuits Cable: Extra-flexible stranded for all sizes.

D. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN/THWN-2, single conductors in raceway or Type XHHW-2, single conductors in raceway.

B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway Type XHHW-2, single conductors in raceway.

E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.

F. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

G. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

H. VFC Output Circuits: Type TC-ER cable with braided shield.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

G. Complete cable tray systems installation according to Section 270536 "Cable Tray for Communication Systems" prior to installing conductors and cables.

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078400 "Firestopping."

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform 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 of the following visual and electrical tests:

    a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
    b. Test bolted connections for high resistance using one of the following:

        1) A low-resistance ohmmeter.
        2) Calibrated torque wrench.
        3) Thermographic survey.

    c. Inspect compression-applied connectors for correct cable match and indentation.
    d. Inspect for correct identification.
    e. Inspect cable jacket and condition.
    f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
    g. Continuity test on each conductor and cable.
    h. Uniform resistance of parallel conductors.

3. Initial Infrared Scanning: After Substantial Completion, but before Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.

    a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
    b. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

B. Cables will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports to record the following:

1. Procedures used.
2. Results that comply with requirements.
3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

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 grounding and bonding systems and equipment.

1.3 ACTION SUBMITTALS

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

B. Sustainable Design Submittals:

1. Product Data: For each conductor and cable indicating lead content.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans showing dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:

1. Test wells.
2. Ground rods.
3. Ground rings.
4. Grounding arrangements and connections for separately derived systems.

B. Qualification Data: For testing agency and testing agency's field supervisor.

C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

    a. Plans showing as-built, dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:

        1) Test wells.
        2) Ground rods.
        3) Ground rings.
        4) Grounding arrangements and connections for separately derived systems.

    b. Instructions for periodic testing and inspection of grounding features at test wells, ground rings, and grounding connections for separately derived systems based on NETA MTS and NFPA 70B Insert reference.

        1) Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
        2) Include recommended testing intervals.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Certified by NETA.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

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

B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Burndy; Part of Hubbell Electrical Systems.
2. ERICO International Corporation.
3. Harger Lightning & Grounding.
4. ILSCO.
5. O-Z/Gedney; a brand of Emerson Industrial Automation.
6. Thomas & Betts Corporation; A Member of the ABB Group.

2.3 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

D. Lead Content: Less than 300 parts per million.

2.4 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

C. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression or exothermic-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.

E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.

F. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.

G. Conduit Hubs: Mechanical type, terminal with threaded hub.

H. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt or socket set screw.

I. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.

J. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.

K. Tower Ground Clamps: Mechanical type, copper or copper alloy, terminal two-piece clamp.

L. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.

M. Water Pipe Clamps:

1. Mechanical type, two pieces with stainless-steel bolts.

a. Material: Tin-plated aluminum.
b. Listed for direct burial.

2. U-bolt type with malleable-iron clamp and copper ground connector.

N. Lead Content: Less than 300 parts per million.

2.5 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet.

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 bare tinned copper conductor, 4/0 AWG minimum.

1. Bury at least 24 inches below grade.

C. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.

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 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING SEPARATELY DERIVED SYSTEMS

A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.

3.4 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.

C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from the foundation.

3.5 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.
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.

C. 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.

D. 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.

E. 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.

F. Metallic Fences: Comply with requirements of IEEE C2.

1. Grounding Conductor: Bare, tinned copper, not less than No. 8 AWG.
2. Gates: Shall be bonded to the grounding conductor with a flexible bonding jumper.
3. Barbed Wire: Strands shall be bonded to the grounding conductor.

3.6 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 Section 260543 "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches deep, with cover.

1. 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 bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

E. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

F. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each ground rod, extending around the perimeter of building.

1. Install tinned-copper conductor not less than 4/0 AWG for ground ring and for taps to building steel.
2. Bury ground ring not less than 24 inches from building's foundation.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.

    a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    b. Perform tests by fall-of-potential method according to IEEE 81.

4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

C. Grounding system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
2. Substations and Pad-Mounted Equipment: 5 ohms.
3. Manhole Grounds: 10 ohms.

F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

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. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:

a. Hangers.
b. Steel slotted support systems.
c. Trapeze hangers.
d. Clamps.
e. Turnbuckles.
f. Sockets.
g. Eye nuts.
h. Saddles.
i. Brackets.

2. Include rated capacities and furnished specialties and accessories.

B. Shop Drawings: For fabrication and installation details for electrical hangers and support systems.

1. Trapeze hangers. Include product data for components.
2. Steel slotted-channel systems.
3. Equipment supports.
4. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

C. Delegated-Design Submittal: For hangers and supports for electrical systems.

1. Include design calculations and details of trapeze hangers.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.
2. Structural members to which hangers and supports will be attached.
3. Size and location of initial access modules for acoustical tile.
4. Items penetrating finished ceiling, including the following:

a. Lighting fixtures.
b. Air outlets and inlets.
c. Speakers.
d. Sprinklers.
e. Access panels.
f. Projectors.
g. All other electrical, communications, security, and fire alarm components.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M.
2. AWS D1.2/D1.2M.

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; a part of Atkore International.
b. B-line, an Eaton business.
c. ERICO International Corporation.
d. GS Metals Corp.
e. G-Strut.

f. Thomas & Betts Corporation; A Member of the ABB Group.
g. Unistrut; Part of Atkore International.

2. Material: Galvanized steel, Plain steel, or Stainless Steel, Type 304 as applicable for installation.
3. Channel Width: 1-5/8 inches.
4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
5. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
6. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
7. Channel Dimensions: Selected for applicable load criteria.

B. 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.

C. 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 made of malleable iron.

D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.

E. 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; Illinois Tool Works, Inc.
3) MKT Fastening, LLC.
4) Simpson Strong-Tie Co., Inc.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) B-line, an Eaton business.
2) Empire Tool and Manufacturing Co., Inc.
3) Hilti, Inc.

4) ITW Ramset/Red Head; Illinois Tool Works, Inc.
5) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: Stainless-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 Section 055000 "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 unless requirements in this Section are stricter.

B. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

C. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMTs, IMCs, and RMCs as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

D. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted 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 single-bolt conduit clamps.

E. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.

B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

C. 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: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts, Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69, or Spring-tension clamps.
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.

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 055000 "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 Section 033000 "Cast-in-Place Concrete."

C. Anchor equipment to concrete base as follows:

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 Section 099100 Painting for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

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. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetal wireways and auxiliary gutters.
5. Surface raceways.
6. Boxes, enclosures, and cabinets.

B. Related Requirements:

1. Section 260543 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.
2. Section 270533 "Conduits and Back Boxes for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems and electronic safety and security.

1.3 DEFINITIONS

A. GRC: Galvanized rigid steel conduit.

B. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
3. All electrical, communications, and electronic safety and security equipment.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. AFC Cable Systems, Inc.
2. Allied Tube & Conduit.
3. Anamet Electrical, Inc.
4. Electri-Flex Company.
5. O-Z/Gedney.
6. Picoma Industries.
7. Republic Conduit.
8. Robroy Industries.
9. Southwire Company.
10. Thomas & Betts Corporation.
11. Western Tube and Conduit Corporation.
12. Wheatland Tube Company.

B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. GRC: Comply with ANSI C80.1 and UL 6.

D. IMC: Comply with ANSI C80.6 and UL 1242.

E. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch, minimum.

F. EMT: Comply with ANSI C80.3 and UL 797.

G. FMC: Comply with UL 1; zinc-coated steel.

H. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

I. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
2. Fittings for EMT:
    a. Material: Steel.
    b. Type: Compression.
3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

J. Joint Compound for IMC or GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. AFC Cable Systems, Inc.
2. Anamet Electrical, Inc.
3. Arnco Corporation.
4. CANTEX Inc.
5. CertainTeed Corporation.
6. Condux International, Inc.
7. Electri-Flex Company.
8. Kraloy.
9. Lamson & Sessions; Carlon Electrical Products.
10. Niedax-Kleinhuis USA, Inc.
11. RACO; Hubbell.
12. Thomas & Betts Corporation.

B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

D. Rigid HDPE: Comply with UL 651A.

E. Continuous HDPE: Comply with UL 651B.

F. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D 3485.

G. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-Line, Inc.
2. Hoffman.
3. Mono-Systems, Inc.
4. Square D.
5. Austin Electrical Enclosures.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1, Type 3R, Type 4, or Type 12, unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Hinged type or Flanged-and-gasketed type unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.4 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Allied Moulded Products, Inc.
2. Hoffman.
3. Lamson & Sessions; Carlon Electrical Products.
4. Niedax-Kleinhuis USA, Inc.

B. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.

D. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.

E. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.

2.5 SURFACE RACEWAYS

A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect or Prime coated, ready for field painting. Finish shall be coordinated at time of submittal.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Mono-Systems, Inc.
    b. Panduit Corp.
    c. Wiremold / Legrand.

2.6 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Adalet.
2. Cooper Technologies Company; Cooper Crouse-Hinds.
3. EGS/Appleton Electric.
4. Erickson Electrical Equipment Company.
5. FSR Inc.
6. Hoffman.
7. Hubbell Incorporated.
8. Kraloy.
9. Milbank Manufacturing Co.
10. Mono-Systems, Inc.
11. O-Z/Gedney.
12. RACO; Hubbell.
13. Robroy Industries.
14. Spring City Electrical Manufacturing Company.
15. Stahlin Non-Metallic Enclosures.
16. Thomas & Betts Corporation.
17. Wiremold / Legrand.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

E. Metal Floor Boxes:

1. Material: Cast metal or sheet metal.
2. Type: Fully adjustable.
3. Shape: Rectangular.
4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

F. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb. shall be listed and marked for the maximum allowable weight.

G. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb.

1. Listing and Labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.

J. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

K. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.

L. Gangable boxes are prohibited.

M. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1, Type 3R, Type 4, or Type 12 as required, with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

N. Cabinets:

1. NEMA 250, Type 1, Type 3R, or Type 12 as required, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC.
2. Concealed Conduit, Aboveground: GRC.
3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried or concrete encased, as indicated.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R or Type 4, as indicated.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:

    a. Loading dock.
    b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    c. Mechanical rooms.
    d. Gymnasiums.
    e. Canopies.

4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations, or where specifically indicated.
6. Damp or Wet Locations: GRC.
7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

C. Minimum Raceway Size: 3/4-inch trade size (interior) and 1-inch trade size (exterior) unless specifically noted otherwise.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
3. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Install surface raceways only where indicated on Drawings.

F. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

E. Arrange stub-ups so curved portions of bends are not visible above finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run. Support within 12 inches of changes in direction.

G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

H. Support conduit within 12 inches of enclosures to which attached.

I. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
3. Arrange raceways to keep a minimum of 2 inches of concrete cover in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
5. Change from RNC to GRC before rising above floor.

J. Stub-ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for raceways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

L. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

M. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

N. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

O. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

P. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

Q. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

R. Surface Raceways:

1. Install surface raceway with a minimum 2-inch radius control at bend points.
2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

S. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

T. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Where otherwise required by NFPA 70.

U. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

V. Expansion-Joint Fittings:

1. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.

2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:

    a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
    b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
    c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
    d. Attics: 135 deg F temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

W. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC in damp or wet locations not subject to severe physical damage.

X. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

Y. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

Z. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

AA. Locate boxes so that cover or plate will not span different building finishes.

BB. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

CC. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

DD. Set metal floor boxes level and flush with finished floor surface.

3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.4 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078400 "Firestopping."

3.5 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

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. Direct-buried conduit, ducts, and duct accessories.
2. Concrete-encased conduit, ducts, and duct accessories.
3. Handholes and boxes.
4. Manholes.

1.3 DEFINITIONS

A. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include duct-bank materials, including separators and miscellaneous components.
2. Include ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
3. Include accessories for manholes, handholes, boxes, and other utility structures.
4. Include warning tape.
5. Include warning planks.

B. Shop Drawings:

1. Precast or Factory-Fabricated Underground Utility Structures:

a. Include plans, elevations, sections, details, attachments to other work, and accessories.
b. Include duct entry provisions, including locations and duct sizes.
c. Include reinforcement details.
d. Include frame and cover design and manhole frame support rings.
e. Include Ladder details.
f. Include grounding details.

g. Include dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
h. Include joint details.

2. Factory-Fabricated Handholes and Boxes Other Than Precast Concrete:

a. Include dimensioned plans, sections, and elevations, and fabrication and installation details.
b. Include duct entry provisions, including locations and duct sizes.
c. Include cover design.
d. Include grounding details.
e. Include dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

1.5 INFORMATIONAL SUBMITTALS

A. Duct-Bank Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures.

1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.
2. Drawings shall be signed and sealed by a qualified professional engineer.

B. Product Certificates: For concrete and steel used in precast concrete handholes, as required by ASTM C 858.

C. Qualification Data: For professional engineer and testing agency responsible for testing nonconcrete handholes and boxes.

D. Source quality-control reports.

E. Field quality-control reports.

1.6 MAINTENANCE MATERIALS SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

B. Furnish cable-support stanchions, arms, and associated fasteners in quantities equal to 5 percent of quantity of each item installed.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

1.8 FIELD CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions, and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Owner's written permission.

B. Ground Water: Assume ground-water level is at grade level unless a lower water table is noted on Drawings.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR DUCTS AND RACEWAYS

A. Comply with ANSI C2.

2.2 CONDUIT

A. Rigid Steel Conduit: Galvanized. Comply with ANSI C80.1.

B. RNC: NEMA TC 2, Type EPC-40-PVC and Type EPC-80-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

2.3 NONMETALLIC DUCTS AND DUCT ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ARNCO Corp.
2. Beck Manufacturing.
3. CANTEX INC.
4. CertainTeed Corporation.
5. Condux International, Inc.
6. Crown Line Plastics.
7. ElecSys, Inc.
8. Electri-Flex Company.
9. Endot Industries Inc.
10. IPEX USA LLC.
11. Lamson & Sessions.
12. National Pipe & Plastics.
13. Opti-Com Manufacturing Network, Inc (OMNI).
14. Spiraduct/AFC Cable Systems, Inc.

B. Underground Plastic Utilities Duct: NEMA TC 2, UL 651, ASTM F 512, Type EPC-80 and Type EPC-40, with matching fittings complying with NEMA TC 3 by same manufacturer as the duct.

C. Duct Accessories:

1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and size of ducts with which used, and selected to provide minimum duct spacing indicated while supporting ducts during concreting or backfilling.
2. Warning Tape: Underground-line warning tape specified in Section 260553 "Identification for Electrical Systems."
3. Concrete Warning Planks: Nominal 12 by 24 by 3 inches in size, manufactured from 6000-psi concrete.

    a. Color: Red dye added to concrete during batching.
    b. Mark each plank with "ELECTRIC" in 2-inch- high, 3/8-inch- deep letters.

2.4 PRECAST CONCRETE HANDHOLES AND BOXES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Christy Concrete Products.
2. Elmhurst-Chicago Stone Co.
3. Oldcastle Precast, Inc.
4. Rinker Group, Ltd.
5. Riverton Concrete Products.
6. Utility Concrete Products, LLC.
7. Utility Vault Co.
8. Wausau Tile Inc.

B. Comply with ASTM C 858 for design and manufacturing processes.

C. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or box.

1. Frame and Cover: Weatherproof cast-iron frame, with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
2. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
3. Cover Legend: Molded lettering, As indicated for each service.
4. Configuration: Units shall be designed for flush burial and have integral closed bottom unless otherwise indicated.
5. Extensions and Slabs: Designed to mate with bottom of enclosure. Same material as enclosure.

    a. Extension shall provide increased depth of 12 inches.
    b. Slab: Same dimensions as bottom of enclosure, and arranged to provide closure.

6. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.
7. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks, plus an additional 12 inches vertically and horizontally to accommodate alignment variations.

    a. Windows shall be located no less than 6 inches from interior surfaces of walls, floors, or frames and covers of handholes, but close enough to corners to facilitate racking of cables on walls.
    b. Window opening shall have cast-in-place, welded-wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
    c. Window openings shall be framed with at least two additional No. 3 steel reinforcing bars in concrete around each opening.

8. Duct Entrances in Handhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.

    a. Type and size shall match fittings to duct or conduit to be terminated.
    b. Fittings shall align with elevations of approaching ducts and be located near interior corners of handholes to facilitate racking of cable.

9. Handholes 12 inches wide by 24 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.5 HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. General Requirements for Handholes and Boxes: Comply with SCTE 77. Comply with tier requirements in "Underground Enclosure Application" Article.

1. Color: Gray or Green.
2. Configuration: Units shall be designed for flush burial and have open bottom unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, as indicated for each service.
6. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.
7. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
8. Handholes 12 inches wide by 24 inches long and larger shall have factory-installed inserts for cable racks and pulling-in irons.

B. Polymer Concrete Handholes and Boxes with Polymer Concrete Cover: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Armorcast Products Company.
    b. Carson Industries LLC.
    c. NewBasis.
    d. Quazite: Hubbell Power Systems, Inc.

2.6 SOURCE QUALITY CONTROL

A. Test and inspect precast concrete utility structures according to ASTM C 1037.

B. Nonconcrete Handhole and Pull-Box Prototype Test: Test prototypes of manholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Tests of materials shall be performed by an independent testing agency.
2. Testing machine pressure gages shall have current calibration certification, complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate layout and installation of ducts, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field. Notify Architect if there is a conflict between areas of excavation and existing structures or archaeological sites to remain.

B. Coordinate elevations of ducts and duct-bank entrances into handholes, and boxes with final locations and profiles of ducts and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct runs drain to handholes, and as approved by Architect.

C. Clear and grub vegetation to be removed, and protect vegetation to remain. Remove and stockpile topsoil for reapplication.

3.2 UNDERGROUND DUCT APPLICATION

A. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank unless otherwise indicated.

B. Ducts for Electrical Branch Circuits: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank unless otherwise indicated.

C. Underground Ducts Crossing Paved Paths, Walks and Driveways, Roadways, and Railroads: RNC, NEMA Type EPC-40-PVC, encased in reinforced concrete.

3.3 UNDERGROUND ENCLOSURE APPLICATION

A. Handholes and Boxes for 600 V and Less:

1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. AASHTO HB 17, H-20 structural load rating.
2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Precast concrete, AASHTO HB 17, H-20 structural load rating.
3. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Precast concrete, AASHTO HB 17, H-10 structural load rating.
4. Units Subject to Light-Duty Pedestrian Traffic Only: Polymer concrete units, SCTE 77, Tier 8, structurally tested according to SCTE 77 with 3000-lbf vertical loading.
5. Cover design load shall not exceed the design load of the handhole or box.

3.4 EARTHWORK

A. Excavation and Backfill: Comply with Section 312000 "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restore surface features at areas disturbed by excavation, and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Section 329200 "Turf and Grasses" and Section 329000 "Planting."

D. Cut and patch existing pavement in the path of underground ducts and utility structures according to the "Cutting and Patching" Article in Section 017329 "Execution."

3.5 DUCT INSTALLATION

A. Install ducts according to NEMA TCB 2.

B. Slope: Pitch ducts a minimum slope of 1:300 down toward handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes (if required), to drain in both directions.

C. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches, both horizontally and vertically, at other locations unless otherwise indicated.

D. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.

E. Installation Adjacent to High-Temperature Steam Lines: Where duct banks are installed parallel to underground steam lines, perform calculations showing the duct bank will not be subject to environmental temperatures above 40 deg C. Where environmental temperatures are calculated to rise above 40 deg C, and anywhere the duct bank crosses above an underground steam line, install insulation blankets listed for direct burial to isolate the duct bank from the steam line.

F. Duct Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches o.c. for 5-inch ducts, and vary proportionately for other duct sizes.

1. Begin change from regular spacing to end-bell spacing 10 feet from the end bell without reducing duct line slope and without forming a trap in the line.
2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole. Install an expansion fitting near the center of all straight line direct-buried duct banks with calculated expansion of more than 3/4 inch.
3. Grout end bells into structure walls from both sides to provide watertight entrances.

G. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 10 feet outside the building wall, without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

H. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.

I. Pulling Cord: Install 100-lbf- test nylon cord in empty ducts.

J. Concrete-Encased Ducts: Support ducts on duct separators.

1. Excavate trench bottom to provide firm and uniform support for duct bank. Prepare trench bottoms as specified in Section 312000 "Earth Moving" for pipes less than 6 inches in nominal diameter.
2. Width: Excavate trench 12 inches wider than duct bank on each side.
3. Depth: Install top of duct bank at least 24 inches below finished grade in areas not subject to deliberate traffic, and at least 30 inches below finished grade in deliberate traffic paths for vehicles unless otherwise indicated.
4. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
5. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than five spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
6. Minimum Space between Ducts: 3 inches between ducts and exterior envelope wall, 2 inches between ducts for like services, and 4 inches between power and signal ducts.

7. Elbows: Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment, at building entrances through floor, and at changes of direction in duct run.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
    b. Stub-Ups to Equipment: For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of base. Install insulated grounding bushings on terminations at equipment.

8. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
9. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
10. Concrete Cover: Install a minimum of 3 inches of concrete cover at top and bottom, and a minimum of 2 inches on each side of duct bank.
11. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.

    a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.
    b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing-rod dowels extending a minimum of 18 inches into concrete on both sides of joint near corners of envelope.

12. Pouring Concrete: Comply with requirements in "Placing Concrete" Article in Section 033000 "Cast-in-Place Concrete." Place concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.

K. Direct-Buried Duct Banks:

1. Excavate trench bottom to provide firm and uniform support for duct bank. Comply with requirements in Section 312000 "Earth Moving" for preparation of trench bottoms for pipes less than 6 inches in nominal diameter.
2. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
3. Space separators close enough to prevent sagging and deforming of ducts, with not less than five spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6 inches between tiers.
4. Depth: Install top of duct bank at least 36 inches below finished grade unless otherwise indicated.
5. Set elevation of bottom of duct bank below frost line.

6. Install ducts with a minimum of 3 inches between ducts for like services and 6 inches between power and signal ducts.
7. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment, at building entrances through floor, and at changes of direction in duct run.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
    b. For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

8. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand place backfill to 4 inches over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction. Comply with requirements in Section 312000 "Earth Moving" for installation of backfill materials.

    a. Place minimum 6 inches of engineered fill above concrete encasement of duct bank.

L. Warning Planks: Bury warning planks approximately 12 inches above direct-buried ducts and duct banks, placing them 24 inches o.c. Align planks along the width and along the centerline of duct bank. Provide an additional plank for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional planks 12 inches apart, horizontally.

M. Warning Tape: Bury warning tape approximately 12 inches above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches of centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.

3.6 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES

A. Cast-in-Place Manhole Installation:

1. Finish interior surfaces with a smooth-troweled finish.
2. Windows for Future Duct Connections: Form and pour concrete knockout panels 1-1/2 to 2 inches thick, arranged as indicated.
3. Comply with requirements in Section 033000 "Cast-in-Place Concrete" for cast-in-place concrete, formwork, and reinforcement.

B. Precast Concrete Handhole and Manhole Installation:

1. Comply with ASTM C 891 unless otherwise indicated.
2. Install units level and plumb and with orientation and depth coordinated with connecting ducts, to minimize bends and deflections required for proper entrances.

3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevations:

1. Manhole Roof: Install with rooftop at least 15 inches below finished grade.
2. Manhole Frame: In paved areas and trafficways, set frames flush with finished grade. Set other manhole frames 1 inch above finished grade.
3. Install handholes with bottom below frost line.
4. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch above finished grade.
5. Where indicated, cast handhole cover frame integrally with handhole structure.

D. Hardware: Install removable hardware, including pulling eyes, cable stanchions, and cable arms, and insulators, as required for installation and support of cables and conductors and as indicated.

E. Fixed Manhole Ladders: Arrange to provide for safe entry with maximum clearance from cables and other items in manholes.

F. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inches for manholes and 2 inches for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

3.7 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting ducts, to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of ducts, and seal joint between box and extension as recommended by manufacturer.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas and trafficways, set cover flush with finished grade. Set covers of other handholes 1 inch above finished grade.

D. Install handholes and boxes with bottom below frost line.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.

F. Field cut openings for ducts and conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

G. For enclosures installed in asphalt paving and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on compacted earth.

1. Concrete: 3000 psi, 28-day strength, complying with Section 033000 "Cast-in-Place Concrete," with a troweled finish.
2. Dimensions: 10 inches wide by 12 inches deep or as required.

3.8 GROUNDING

A. Ground underground ducts and utility structures according to Section 260526 "Grounding and Bonding for Electrical Systems."

3.9 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:

1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide a minimum 6-inch- long mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
3. Test manhole and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 260526 "Grounding and Bonding for Electrical Systems."

B. Correct deficiencies and retest as specified above to demonstrate compliance.

3.10 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

B. Clean internal surfaces of manholes, including sump. Remove foreign material.

END OF SECTION 260543

SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

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. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

B. Related Requirements:

1. Section 078400 "Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. Sleeves for Rectangular Openings:

1. Material: Galvanized sheet steel.
2. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Advance Products & Systems, Inc.
b. CALPICO, Inc.
c. Metraflex Company (The).
d. Pipeline Seal and Insulator, Inc.
e. Proco Products, Inc.
f. OZ Gedney.
g. EGS/Appleton.
h. 3M.

2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Stainless steel.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Presealed Systems.
b. O-Z Gedney.
c. EGS/Appleton.
d. 3M.

2.4 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.

4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. 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.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 260544

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

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. Color and legend requirements for raceways, conductors, and warning labels and signs.
2. Labels.
3. Bands and tubes.
4. Tapes and stencils.
5. Tags.
6. Signs.
7. Cable ties.
8. Paint for identification.
9. Fasteners for labels and signs.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.

B. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

C. Delegated-Design Submittal: For arc-flash hazard study.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with ASME A13.1 and IEEE C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Comply with NFPA 70E and Section 260574 "Overcurrent Protective Device Arc-Flash Study" requirements for arc-flash warning labels.

F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Circuits at 600 V or Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage.

B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder, and branch-circuit conductors.

1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
2. Colors for 208/120-V Circuits:

a. Phase A: Black.
b. Phase B: Red.
c. Phase C: Blue.

3. Color for Neutral: White.
4. Color for Equipment Grounds: Green.

C. Warning Label Colors:

1. Identify system voltage with black letters on an orange background.

D. Warning labels and signs shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."
3. Arc Flash Labels as required per 260574 – Overcurrent Protective Device Arc-Flash Study.

2.3 LABELS

A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.
b. Champion America.
c. emedco.
d. Grafoplast Wire Markers.
e. HellermannTyton.
f. LEM Products Inc.
g. Marking Services, Inc.
h. Seton Identification Products.

2. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
3. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

B. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3-mil- thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.
b. Brother International Corporation.
c. emedco.
d. HellermannTyton.
e. Ideal Industries, Inc.

2. Minimum Nominal Size:

a. 1-1/2 by 6 inches for raceway and conductors.
b. 3-1/2 by 5 inches for equipment.
c. As required by authorities having jurisdiction.

2.4 BANDS AND TUBES

A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches long, with diameters sized to suit diameters and that stay in place by gripping action.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.

b. HellermannTyton.
c. Marking Services, Inc.
d. Panduit Corp.

2.5 TAPES AND STENCILS

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Carlton Industries, LP.
b. Champion America.
c. HellermannTyton.
d. Ideal Industries, Inc.
e. Marking Services, Inc.
f. Panduit Corp.

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.
b. Carlton Industries, LP.
c. emedco.
d. Marking Services, Inc.
e. 3M.

C. Tape and Stencil: 4-inch- wide black stripes on 10-inch centers placed diagonally over orange background and is 12 inches wide. Stop stripes at legends.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. HellermannTyton.
b. LEM Products Inc.
c. Marking Services, Inc.
d. Seton Identification Products.

D. Floor Marking Tape: 2-inch- wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Carlton Industries, LP.
b. Seton Identification Products.

E. Underground-Line Warning Tape:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Brady Corporation.
   b. Ideal Industries, Inc.
   c. LEM Products Inc.
   d. Marking Services, Inc.
   e. Reef Industries, Inc.
   f. Seton Identification Products.

2. Tape:

   a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
   b. Printing on tape shall be permanent and shall not be damaged by burial operations.
   c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.

3. Color and Printing:

   a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
   b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".
   c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".

4. Tag: “ELECTRICAL LINE, HIGH VOLTAGE”

   a. Pigmented polyolefin, bright colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
   b. Width: 3 inches.
   c. Thickness: 4 mils.
   d. Weight: 18.5 lb/1000 sq. ft.
   e. Tensile according to ASTM D 882: 30 lbf and 2500 psi.

5. Tag: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE":

   a. Multilayer laminate, consisting of high-density polyethylene scrim coated with pigmented polyolefin; bright colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
   b. Width: 3 inches.
   c. Thickness: 12 mils.
   d. Weight: 36.1 lb/1000 sq. ft.
   e. Tensile according to ASTM D 882: 400 lbf and 11,500 psi.

6. Tag: ELECTRICAL LINE, HIGH VOLTAGE:

    a. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core; bright colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
    b. Width: 3 inches.
    c. Overall Thickness: 5 mils.
    d. Foil Core Thickness: 0.35 mil.
    e. Weight: 28 lb/1000 sq. ft.
    f. Tensile according to ASTM D 882: 70 lbf and 4600 psi.

7. Tag: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE":

    a. Reinforced, detectable three-layer laminate, consisting of a printed pigmented woven scrim, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core; bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
    b. Width: 3 inches.
    c. Overall Thickness: 8 mils.
    d. Foil Core Thickness: 0.35 mil.
    e. Weight: 34 lb/1000 sq. ft.
    f. Tensile according to ASTM D 882: 300 lbf and 12,500 psi.

2.6 SIGNS

A. Laminated Acrylic or Melamine Plastic Signs:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Brady Corporation.
    b. Carlton Industries, LP.
    c. emedco.
    d. Marking Services, Inc.

2. Engraved legend.

3. Thickness:

    a. For signs up to 20 sq. in., minimum 1/16 inch.
    b. For signs larger than 20 sq. in., 1/8 inch thick.
    c. Engraved legend with black letters on white face.
    d. Punched or drilled for mechanical fasteners with 1/4-inch grommets in corners for mounting.
    e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.7 CABLE TIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. HellermannTyton.
2. Ideal Industries, Inc.
3. Marking Services, Inc.
4. Panduit Corp.

B. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 Deg F according to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black, except where used for color-coding.

C. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 Deg F according to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black.

D. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 Deg F according to ASTM D 638: 7000 psi.
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F.
5. Color: Black.

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of each item before installing identification products.

D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.

1. Secure tight to surface of conductor, cable, or raceway.

H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

I. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer.

J. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.

K. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:

1. "POWER."
2. "EMERGENCY EGRESS LIGHTING".
3. “FIRE ALARM”.

4. “COMMUNICATIONS”.
5. “SECURITY”.

L. Vinyl Wraparound Labels:

1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.

M. Self-Adhesive Labels:

1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.

N. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.

O. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.

1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.

P. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.

Q. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.

R. Underground Line Warning Tape:

1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
2. Install underground-line warning tape for cables in raceways.

S. Laminated Acrylic or Melamine Plastic Signs:

1. Attach signs with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high sign; where two lines of text are required, use labels 2 inches high, etc.

T. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.3 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

C. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows: See requirements listed previously.

D. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use vinyl wraparound labels and self-adhesive vinyl tape to identify the phase.

1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

E. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with the conductor or cable designation, origin, and destination.

F. Control-Circuit Conductor Termination Identification: For identification at terminations, provide self-adhesive labels with the conductor designation.

G. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.

H. Auxiliary Electrical Systems Conductor Identification: Self-adhesive vinyl tape that is uniform and consistent with system used by manufacturer for factory-installed connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

I. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.

J. Workspace Indication: Apply floor marking tape to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

K. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.

L. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels.

1. Apply to exterior of door, cover, or other access.
2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:

    a. Power-transfer switches.
    b. Controls with external control power connections.

M. Arc Flash Warning Labeling: Self-adhesive labels.

N. Operating Instruction Signs: Self-adhesive labels.

O. Emergency Operating Instruction Signs: Self-adhesive labels with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer.

P. Equipment Identification Labels:

1. Indoor Equipment: Laminated acrylic or melamine plastic sign.
2. Outdoor Equipment: Laminated acrylic or melamine sign.
3. Equipment to Be Labeled:

    a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of an engraved, laminated acrylic or melamine label.
    b. Enclosures and electrical cabinets.
    c. Access doors and panels for concealed electrical items.
    d. Transformers: Label that includes tag designation indicated on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
    e. Emergency system boxes and enclosures.
    f. Enclosed switches.
    g. Enclosed circuit breakers.
    h. Enclosed controllers.
    i. Variable-speed controllers.
    j. Push-button stations.
    k. Power-transfer equipment.
    l. Contactors.
    m. Remote-controlled switches, dimmer modules, and control devices.
    n. Battery-inverter units.
    o. Monitoring and control equipment.
    p. UPS equipment.

END OF SECTION 260553

SECTION 260572 - OVERCURRENT PROTECTIVE DEVICE SHORT-CIRCUIT STUDY

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 a computer-based, fault-current study to determine the minimum interrupting capacity of circuit protective devices.

1.3 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

D. SCCR: Short-circuit current rating.

E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.4 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Other Action Submittals: Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form.

1. Short-circuit study input data, including completed computer program input data sheets.
2. Short-circuit study and equipment evaluation report; signed, dated, and sealed by a qualified professional engineer.

a. Submit study report for action *prior* to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.
b. Revised single-line diagram, reflecting field investigation results and results of short-circuit study.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Short-Circuit Study Software Developer, Short-Circuit Study Specialist, and Field Adjusting Agency.

B. Product Certificates: For short-circuit study software, certifying compliance with IEEE 399.

1.6 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Short-Circuit Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

C. Short-Circuit Study Specialist Qualifications: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE

A. Software Developers: Subject to compliance with requirements, provide software by the following:

1. SKM Systems Analysis, Inc.

B. Comply with IEEE 399 and IEEE 551.

C. Analytical features of fault-current-study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output.

2.2 SHORT-CIRCUIT STUDY REPORT CONTENTS

A. Executive summary.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of the computer printout.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Cable size and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center, and panelboard designations.

D. Comments and recommendations for system improvements, where needed.

E. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short-circuit ratings.
2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.
3. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
4. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
5. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

F. Short-Circuit Study Input Data: All short circuit sources and system impedances.

G. Short-Circuit Study Output:

1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

   a. Voltage.
   b. Calculated fault-current magnitude and angle.
   c. Fault-point X/R ratio.
   d. Equivalent impedance.

2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

   a. Voltage.
   b. Calculated symmetrical fault-current magnitude and angle.
   c. Fault-point X/R ratio.
   d. Calculated asymmetrical fault currents:

      1) Based on fault-point X/R ratio.
      2) Based on calculated symmetrical value multiplied by 1.6.
      3) Based on calculated symmetrical value multiplied by 2.7.

3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

   a. Voltage.
   b. Calculated symmetrical fault-current magnitude and angle.
   c. Fault-point X/R ratio.
   d. No AC Decrement (NACD) ratio.
   e. Equivalent impedance.
   f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
   g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Obtain all data necessary for the conduct of the study.

1. Verify completeness of data supplied on the one-line diagram. Call any discrepancies to the attention of Architect.
2. For equipment provided that is Work of this Project, use characteristics submitted under the provisions of action submittals and information submittals for this Project.

B. Gather and tabulate the following input data to support the short-circuit study. Comply with recommendations in IEEE 551 as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in

charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.

1. Product Data for Project's overcurrent protective devices involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Obtain electrical power utility impedance at the service.
3. Power sources and ties.
4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
5. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
6. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
7. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
8. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
9. Motor horsepower and NEMA MG 1 code letter designation.
10. Cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

3.2 SHORT-CIRCUIT STUDY

A. Perform study following the general study procedures contained in IEEE 399.

B. Calculate short-circuit currents according to IEEE 551.

C. Base study on the device characteristics supplied by device manufacturer.

D. The extent of the electrical power system to be studied is indicated on Drawings.

E. Begin short-circuit current analysis at the service, extending down to the system overcurrent protective devices as follows:

1. To normal system low-voltage load buses where fault current is 10 kA or less.

F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

G. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.

1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.

H. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each of the following:

1. Electric utility's supply termination point.
2. Low-voltage main distribution panel.
3. Control panels.
4. Standby generators and automatic/manual transfer switches.
5. Branch circuit panelboards.
6. Disconnect switches.

3.3 ADJUSTING

A. Make minor modifications to equipment as required to accomplish compliance with short-circuit study.

3.4 DEMONSTRATION

A. Train Owner's operating and maintenance personnel in the use of study results.

END OF SECTION 260572

SECTION 260573 - OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

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 computer-based, overcurrent protective device coordination studies to determine overcurrent protective devices and to determine overcurrent protective device settings for selective tripping.

1. Study results shall be used to determine coordination of series-rated devices.

1.3 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

D. SCCR: Short-circuit current rating.

E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.4 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Other Action Submittals: Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form.

1. Coordination-study input data, including completed computer program input data sheets.
2. Study and equipment evaluation reports.

3. Overcurrent protective device coordination study report; signed, dated, and sealed by a qualified professional engineer.

    a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Coordination Study Software Developer, Coordination Study Specialist, and Field Adjusting Agency.

B. Product Certificates: For overcurrent protective device coordination study software, certifying compliance with IEEE 399.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For the overcurrent protective devices to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

    a. The following parts from the Protective Device Coordination Study Report:

        1) One-line diagram.
        2) Protective device coordination study.
        3) Time-current coordination curves.

    b. Power system data.

1.7 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Coordination Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

C. Coordination Study Specialist Qualifications: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Software Developers: Subject to compliance with requirements, provide software by the following:

1. SKM Systems Analysis, Inc.

B. Comply with IEEE 242 and IEEE 399.

C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

1. Optional Features:

a. Arcing faults.
b. Simultaneous faults.
c. Explicit negative sequence.
d. Mutual coupling in zero sequence.

2.2 PROTECTIVE DEVICE COORDINATION STUDY REPORT CONTENTS

A. Executive summary.

B. Study descriptions, purpose, basis and scope. Include case descriptions, definition of terms and guide for interpretation of the computer printout.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.

2. Cable size and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center, and panelboard designations.

D. Study Input Data: As described in "Power System Data" Article.

E. Short-Circuit Study Output: As specified in "Short-Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260572 "Overcurrent Protective Device Short-Circuit Study."

F. Protective Device Coordination Study:

1. Report recommended settings of protective devices, ready to be applied in the field. Use manufacturer's data sheets for recording the recommended setting of overcurrent protective devices when available.

    a. Phase and Ground Relays:

        1) Device tag.
        2) Relay current transformer ratio and tap, time dial, and instantaneous pickup value.
        3) Recommendations on improved relaying systems, if applicable.

    b. Circuit Breakers:

        1) Adjustable pickups and time delays (long time, short time, ground).
        2) Adjustable time-current characteristic.
        3) Adjustable instantaneous pickup.
        4) Recommendations on improved trip systems, if applicable.

    c. Fuses: Show current rating, voltage, and class.

G. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:

1. Device tag and title, one-line diagram with legend identifying the portion of the system covered.
2. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
3. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
4. Plot the following listed characteristic curves, as applicable:

    a. Power utility's overcurrent protective device.
    b. Medium-voltage equipment overcurrent relays.
    c. Medium- and low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.

d. Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.
e. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
f. Cables and conductors damage curves.
g. Ground-fault protective devices.
h. Motor-starting characteristics and motor damage points.
i. Generator short-circuit decrement curve and generator damage point.
j. The largest feeder circuit breaker in each motor-control center and panelboard.

5. Series rating on equipment allows the application of two series interrupting devices for a condition where the available fault current is greater than the interrupting rating of the downstream equipment. Both devices share in the interruption of the fault and selectivity is sacrificed at high fault levels. Maintain selectivity for tripping currents caused by overloads.
6. Provide adequate time margins between device characteristics such that selective operation is achieved.
7. Comments and recommendations for system improvements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.

1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.2 PROTECTIVE DEVICE COORDINATION STUDY

A. Comply with IEEE 242 for calculating short-circuit currents and determining coordination time intervals.

B. Comply with IEEE 399 for general study procedures.

C. The study shall be based on the device characteristics supplied by device manufacturer.

D. The extent of the electrical power system to be studied is indicated on Drawings.

E. Begin analysis at the service, extending down to the system overcurrent protective devices as follows:

1. To normal system low-voltage load buses where fault current is 10 kA or less.

F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

G. Transformer Primary Overcurrent Protective Devices:

1. Device shall not operate in response to the following:

a. Inrush current when first energized.
b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.

2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

H. Motor Protection:

1. Select protection for low-voltage motors according to IEEE 242 and NFPA 70.
2. Select protection for motors served at voltages more than 600 V according to IEEE 620.

I. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and protection recommendations in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

J. Generator Protection: Select protection according to manufacturer's written recommendations and to IEEE 242.

K. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.

1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.

L. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and single line-to-ground fault at each of the following:

1. Electric utility's supply termination point.
2. Main Distribution Panel
3. Standby generators and manual/automatic transfer switches.
4. Branch circuit panelboards.

M. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short-circuit ratings.
2. Adequacy of switchgear, motor-control centers, and panelboard bus bars to withstand short-circuit stresses.
3. Any application of series-rated devices shall be recertified, complying with requirements in NFPA 70.

3.3 LOAD-FLOW AND VOLTAGE-DROP STUDY

A. Perform a load-flow and voltage-drop study to determine the steady-state loading profile of the system. Analyze power system performance two times as follows:

1. Determine load-flow and voltage drop based on full-load currents obtained in "Power System Data" Article.
2. Determine load-flow and voltage drop based on 80 percent of the design capacity of the load buses.
3. Prepare the load-flow and voltage-drop analysis and report to show power system components that are overloaded, or might become overloaded; show bus voltages that are less than as prescribed by NFPA 70.

3.4 MOTOR-STARTING STUDY

A. Perform a motor-starting study to analyze the transient effect of the system's voltage profile during motor starting. Calculate significant motor-starting voltage profiles and analyze the effects of the motor starting on the power system stability.

B. Prepare the motor-starting study report, noting light flicker for limits proposed by IEEE 141, and voltage sags so as not to affect the operation of other utilization equipment on the system supplying the motor.

3.5 POWER SYSTEM DATA

A. Obtain all data necessary for the conduct of the overcurrent protective device study.

1. Verify completeness of data supplied in the one-line diagram on Drawings. Call discrepancies to the attention of Architect.
2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
3. For existing equipment, whether or not relocated obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers. The qualifications of technicians and engineers shall be qualified as defined by NFPA 70E.

B. Gather and tabulate the following input data to support coordination study. The list below is a guide. Comply with recommendations in IEEE 551 for the amount of detail required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.

1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Electrical power utility impedance at the service.
3. Power sources and ties.
4. Short-circuit current at each system bus, three phase and line-to-ground.
5. Full-load current of all loads.
6. Voltage level at each bus.
7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
8. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
12. Maximum demands from service meters.
13. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
14. Motor horsepower and NEMA MG 1 code letter designation.
15. Low-voltage cable sizes, lengths, number, conductor material, and conduit material (magnetic or nonmagnetic).
16. Medium-voltage cable sizes, lengths, conductor material, and cable construction and metallic shield performance parameters.
17. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:

    a. Special load considerations, including starting inrush currents and frequent starting and stopping.
    b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
    c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
    d. Generator thermal-damage curve.
    e. Ratings, types, and settings of utility company's overcurrent protective devices.
    f. Special overcurrent protective device settings or types stipulated by utility company.
    g. Time-current-characteristic curves of devices indicated to be coordinated.

h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
j. Panelboards, switchboards, motor-control center ampacity, and SCCR in amperes rms symmetrical.
k. Identify series-rated interrupting devices for a condition where the available fault current is greater than the interrupting rating of the downstream equipment. Obtain device data details to allow verification that series application of these devices complies with NFPA 70 and UL 489 requirements.

3.6 FIELD ADJUSTING

A. Adjust relay and protective device settings according to the recommended settings provided by the coordination study. Field adjustments shall be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

B. Make minor modifications to equipment as required to accomplish compliance with short-circuit and protective device coordination studies.

C. Testing and adjusting shall be by a full-time employee of the Field Adjusting Agency, who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters. Perform NETA tests and inspections for all adjustable overcurrent protective devices.

3.7 DEMONSTRATION

A. Engage the Coordination Study Specialist to train Owner's maintenance personnel in the following:

1. Acquaint personnel in the fundamentals of operating the power system in normal and emergency modes.
2. Hand-out and explain the objectives of the coordination study, study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpreting the time-current coordination curves.
3. Adjust, operate, and maintain overcurrent protective device settings.

END OF SECTION 260573

SECTION 260574 - OVERCURRENT PROTECTIVE DEVICE ARC-FLASH STUDY

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 a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

1.3 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

D. SCCR: Short-circuit current rating.

E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.4 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Study Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals shall be in digital form.

1. Arc-flash study input data, including completed computer program input data sheets.
2. Arc-flash study report; signed, dated, and sealed by a qualified professional engineer.

a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Arc-Flash Study Software Developer, Arc-Flash Study Specialist, and Field Adjusting Agency.

B. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

1. Maintenance procedures according to requirements in NFPA 70E shall be provided in the equipment manuals.
2. Operation and Maintenance Procedures: In addition to items specified in Section 017823 "Operation and Maintenance Data," provide maintenance procedures for use by Owner's personnel that comply with requirements in NFPA 70E.

1.7 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Arc-Flash Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

C. Arc-Flash Study Specialist Qualifications: Professional engineer in charge of performing the study, analyzing the arc flash, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. SKM Systems Analysis, Inc.

B. Comply with IEEE 1584 and NFPA 70E.

C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

2.2 ARC-FLASH STUDY REPORT CONTENT

A. Executive summary.

B. Study descriptions, purpose, basis and scope.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Cable size and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center and panelboard designations.

D. Study Input Data: As described in "Power System Data" Article.

E. Short-Circuit Study Output: As specified in "Short Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260572 "Overcurrent Protective Device Short-Circuit Study."

F. Protective Device Coordination Study Report Contents: As specified in "Protective Device Coordination Study Report Contents" Article in Section 260573 "Overcurrent Protective Device Coordination Study."

G. Arc-Flash Study Output:

1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

a. Voltage.
b. Calculated symmetrical fault-current magnitude and angle.
c. Fault-point X/R ratio.
d. No AC Decrement (NACD) ratio.
e. Equivalent impedance.

f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

H. Incident Energy and Flash Protection Boundary Calculations:

1. Arcing fault magnitude.
2. Protective device clearing time.
3. Duration of arc.
4. Arc-flash boundary.
5. Working distance.
6. Incident energy.
7. Hazard risk category.
8. Recommendations for arc-flash energy reduction.

I. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of the computer printout.

2.3 ARC-FLASH WARNING LABELS

A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for self-adhesive equipment labels. Produce a 3.5-by-5-inch self-adhesive equipment label for each work location included in the analysis.

B. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:

1. Location designation.
2. Nominal voltage.
3. Flash protection boundary.
4. Hazard risk category.
5. Incident energy.
6. Working distance.
7. Engineering report number, revision number, and issue date.

C. Labels shall be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

3.2 ARC-FLASH HAZARD ANALYSIS

A. Comply with NFPA 70E and its Annex D for hazard analysis study.

B. Preparatory Studies:

1. Protective Device Coordination Study Report Contents: As specified in "Protective Device Coordination Study Report Contents" Article in Section 260573 "Overcurrent Protective Device Coordination Study."

C. Calculate maximum and minimum contributions of fault-current size.

1. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume no motor load.
2. The maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.

D. Calculate the arc-flash protection boundary and incident energy at locations in the electrical distribution system where personnel could perform work on energized parts.

E. Include medium- and low-voltage equipment locations, except equipment rated 240-V ac or less fed from transformers less than 125 kVA.

F. Safe working distances shall be specified for calculated fault locations based on the calculated arc-flash boundary, considering incident energy of 1.2 cal/sq.cm.

G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:

1. Fault contribution from induction motors should not be considered beyond three to five cycles.
2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g., contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).

H. Arc-flash computation shall include both line and load side of a circuit breaker as follows:

1. When the circuit breaker is in a separate enclosure.
2. When the line terminals of the circuit breaker are separate from the work location.

I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.3 POWER SYSTEM DATA

A. Obtain all data necessary for the conduct of the arc-flash hazard analysis.

1. Verify completeness of data supplied on the one-line diagram on Drawings and under "Preparatory Studies" Paragraph in "Arc-Flash Hazard Analysis" Article. Call discrepancies to the attention of Architect.
2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers.

B. Electrical Survey Data: Gather and tabulate the following input data to support study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.

1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Obtain electrical power utility impedance at the service.
3. Power sources and ties.
4. Short-circuit current at each system bus, three phase and line-to-ground.
5. Full-load current of all loads.
6. Voltage level at each bus.
7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in per cent, and phase shift.
8. For reactors, provide manufacturer and model designation, voltage rating and impedance.
9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
12. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
13. Motor horsepower and NEMA MG 1 code letter designation.
14. Low-voltage cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
15. Medium-voltage cable sizes, lengths, conductor material, and cable construction and metallic shield performance parameters.

3.4 LABELING

A. Apply one arc-flash label for 600-V ac, 480-V ac, and applicable 208-V ac panelboards and disconnects and for each of the following locations:

1. Motor-control center.
2. Low-voltage switchboard.
3. Switchgear.
4. Medium-voltage switch.
5. Control panel.

3.5 APPLICATION OF WARNING LABELS

A. Install the arc-fault warning labels under the direct supervision and control of the Arc-Flash Study Specialist.

3.6 DEMONSTRATION

A. Engage the Arc-Flash Study Specialist to train Owner's maintenance personnel in the potential arc-flash hazards associated with working on energized equipment and the significance of the arc-flash warning labels.

END OF SECTION 260574

SECTION 260800 – COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 019113 – Commissioning General Requirements.

C. Section 220800 – Commissioning of Plumbing Systems.

D. Section 230800 – Commissioning of Mechanical Systems.

E. Section 230901 – Commissioning of Integrated Automation Systems.

F. Commissioning Plan.

1.2 DESCRIPTION OF WORK

A. The purpose of this section is to specify the Division 26 responsibilities and participation in the commissioning process. All contractors responsible for Division 26 installation or other activities shall have commissioning responsibilities described herein.

B. Work under this contract shall conform to requirements of Division 01, General Requirements, Conditions of the Contract, and Supplementary Conditions. This specification covers Commissioning of Electrical Systems, which are a part of this project.

C. Commissioning shall be a team effort to ensure that all electrical equipment and systems have been completely and properly installed and function together correctly to meet the design intent. Additionally, system performance parameters shall be monitored and documented for fine tuning of control sequences and operational procedures. Commissioning shall coordinate and document equipment installation, equipment start-up, controls calibration, testing and balancing, and verification and performance testing.

D. The Commissioning Team is defined in Specification 019113 Section 1.3 – Definitions. The electrical trades represented on the Commissioning Team shall include but not be limited to; electrical, lighting, fire alarm, telecommunications, security, and third party electrical testing agencies. The lead person for each trade who will actually perform or supervise the work is to be designated as the representative to the Commissioning Team. Responsibility for various steps of the commissioning process shall be divided among the members of the Commissioning Team, as described in this section.

E. Electrical Contractor(s) are responsible for electrical system installation, start-up, testing, preparation of O&M manuals, and operator training as defined in various Division 26 specification sections. Electrical Contractor(s) are responsible for coordination, observation, and verification of commissioning as defined in this section and Section 019113. Neither Section 019113 - Commissioning General Requirements nor Section 260800 – Commissioning of Electrical Systems shall relieve the Electrical Contractor(s) from their obligations to complete all portions of work in a satisfactory and fully operational manner. Furthermore, Section 260800 – Commissioning of Electrical Systems shall not relieve the Electrical Contractor(s) from any obligations set forth within Section 019113 – Commissioning General Requirements.

1.3 DEFINITIONS

A. Electrical Contractor(s): The term Electrical Contractor(s) utilized herein refers to any and all subcontracting companies or venders whom are responsible for the construction or other provisions regarding any of the systems which are being commissioned, as outlined in Specification 019113 Section 1.5 – Systems to be Included in Commissioning, and are defined within Division 26 of the specifications. Subcontracting parties outside of the scope of the systems being commissioned or outside of the scope of Division 26 are not included.

B. Equipment Manufacturer(s): The term Equipment Manufacturer(s) utilized herein refers to any and all subcontracting companies whom are responsible for the provision of equipment or components which are being commissioned, as outlined in Specification 019113 Section 1.5 – Systems to be Included in Commissioning, and are defined within Division 26 of the specifications. Equipment Manufacturer(s) shall refer to the direct representative of the maker and/or distributor of the equipment or component being provided. This may include either the actual equipment manufacturer or the supplier thereof, under the provisions that the supplier has a thorough knowledge of the equipment or component and is recognized by the actual equipment manufacturer as being a proper representative.

1.4 SCOPE OF WORK

A. The Electrical Contractor(s) shall be required to Commission all equipment, components and accessories of each of the commissioned systems as outlined within Specification 019113 Section 1.5 – Systems to be Included in Commissioning. In order to accomplish a complete commissioning process, the Electrical Contractor(s) shall be required to fulfill all requirements set forth within Specification 260800 Section 1.5 – Roles and Responsibilities. Additionally, the Electrical Contractor(s) shall be required to fulfill all requirements set forth within Specification 019113.

B. Through the Commissioning Process, the Electrical Contractor(s) shall accomplish thorough documentation, organized scheduling and coordination, detailed installation verification, and detailed system functional verification. For this, the Electrical Contractor(s) must cooperate and coordinate with the Commissioning Agent.

1.5 ROLES AND RESPONSIBILITIES

A. In addition to the Commissioning Agent, Owner and System Design Professional(s), the Commissioning Team is comprised of a minimum of one individual to represent each contracting company or vender whom is responsible for the construction or other provisions regarding any of the systems which are being commissioned, as outlined in Specification 019113 Section 1.5 – Systems to be Included in Commissioning, and are defined within Division 26 of the specifications. See Specification 019113 Section 1.3 – Definitions for the definition of the Commissioning Team.

B. Contracting companies providing members shall include but not be limited to; electrical contractor, lighting contractor, telecommunications contractor, security system contractor, fire alarm contractor, and third party electrical test agencies whose responsibilities are defined herein.

C. In addition to all roles and responsibilities defined herein, all Electrical Contractor(s) shall be required to fulfill all requirements described within Specification 019113 Section 1.4 – Roles and Responsibilities.

D. Electrical Contractor(s):

1. General Requirements:

a. Include all cost to complete commissioning requirements for electrical systems in the contract price. Contractor costs shall be reflected within the Schedule of Values as specified within Specification 019113 Section 2.2 – Schedule of Values.
b. Ensure cooperation and participation of specialty Contractors and Sub-Contractors.
c. Ensure participation of major Equipment Manufacturers in appropriate start-up, testing and training activities.
d. Attend Commissioning Meetings for construction phase coordination as scheduled by the Commissioning Agent. Additionally, attend the Commissioning Kick-Off Meeting as scheduled by the Commissioning Agent.

2. Commissioning Schedule:

a. Prepare a Preliminary Schedule for electrical systems and equipment, including component installation, start-up and checkout, and system start-up. Integrate commissioning activities into this Preliminary Schedule including Pre-Functional Checklists and Functional Performance Tests.
b. Update the Preliminary Schedule and submit a Final Schedule which shall reflect all items within the Preliminary Schedule and shall also include but not be limited to: inspections, O&M manual submission, training sessions, feeder testing, ground system testing, equipment and component NETA testing, Coordination Study completion and implementation, equipment energizing, and task completion. All Contractor(s) shall integrate schedule activities into one complete Final Schedule which shall be reflected within the Construction Manager's/General Contractor's overall project schedule. The Final Schedule shall be continuously updated throughout the Construction Phase.

3. Submittal Requirements:

    a. Comply with all Submittal requirements as outlined within Specification 019113 Section 2.3 – Submittals.
    b. Comply with all requirements as outlined within Specification 019113 Section 2.5 – Start-Up and Test Reports.
    c. Provide the following documentation to the Commissioning Agent for the purpose of construction updates:

        1) General construction progress and status reports
        2) Updated Architect, Owner, System Design Professional, and Contractor deficiency logs
        3) Minutes from all construction and coordination meetings not otherwise conducted by the Commissioning Agent
        4) Pre Start-Up and Start-Up procedures
        5) Value Engineering Proposals and a list of all accepted VE items
        6) Coordination Studies, Manufacture Inspection Reports, Authority Having Jurisdiction Inspection Reports, etc.
        7) Construction document changes resulting from electrical Requests for Information

4. Pre-Functional Requirements:

    a. Detailed installation verification shall be performed on all installed equipment and systems to ensure that the installations conform to the contract documents, local and applicable codes, and standard practice. This shall be accomplished through the completion of Pre-Functional Checklists. The creation, distribution, completion and maintenance of Pre-Functional Checklists are detailed in Specification 019113 Section 2.4 – Pre-Functional Checklists.
    b. Complete Pre-Functional Checklists on all electrical equipment and system components installed or provided by the Electrical Contractors(s).
    c. Provide written notification to the Commissioning Agent for each system listed in Specification 019113 Section 1.5 – Systems To Be Included In Commissioning, that the system installation is complete in its entirety and that the system is fully operational, online, and ready for Functional Performance Testing.

5. Equipment and System Start-Up:

    a. Perform all initial check-out and start-up procedures as outlined within the specifications and as per the Equipment Manufacturer's recommendations. Provide full documentation of all start-up and check-out procedures and results. Documentations is to be submitted to the Commissioning Agent in conjunction with the associated Pre-Functional Checklist.

b. Perform all feeder tests, ground system tests, infrared scanning and any other system component test required by the specifications requiring a 3rd party test agency. Provide full documentation of all tests procedures and results. Documentation is to be submitted to the Commissioning Agent in conjunction with the associated Pre-Functional Checklist. Some tests and inspections may be required to be witnessed and documented by the Commissioning Agent. For these tests and inspections, follow the procedures outlined in this Specification, Section 1.5-D-6 – Functional Performance Test Requirements.
c. Perform all Testing requirements for electrical components. Submit copies of the Testing Report to all interested and reviewing parties as required by the specifications and to the Commissioning Agent. Also, submit a copy of the preliminary Testing documentation including the Testing Plan, Forms and Report format to the Commissioning Agent for review and approval.

6. Functional Performance Test Requirements:

a. Detailed testing shall be performed on all installed equipment and systems to ensure that operation and performance conform to contract documents, local and applicable codes, and standard practice. This shall be accomplished through the completion of Functional Performance Tests. The creation, distribution and completion of Functional Performance Tests are detailed in Specification 019113 Section 2.6 – Functional Performance Tests.
b. Provide all appropriate equipment and materials as necessary to execute and complete all Functional Performance Tests. Comply with all requirements as outlined within Specification 019113 Section 2.8 – Test Equipment.
c. Provide appropriate technicians for participation during system verification and functional performance testing. Technicians shall demonstrate equipment as-installed condition and system performance to Commissioning Agent including all modes of system operation (e.g. normal, abnormal, emergency, etc.)
d. Verify all functional performance tests prior to requesting test witness by the Commissioning Agent. Demonstrate all Functional Performance test tasks in the presence of the Commissioning Agent and assist the Commissioning Agent in all verification and functional performance tests. Equipment and component conditioning tests, such as resistance tests, overpotential test, turns-ratio tests, etc.) are not required to be performed prior to requesting test witness by the Commissioning Agent.
e. Participate in verification of the TAB report, which will consist of repeating any selected measurement contained in the TAB report where required by the Commissioning Agent for verification or diagnostic purposes. Typically, TAB Verification shall occur in conjunction with Functional Performance Testing. Electrical TAB requirements will include but not be limited to measuring and recording all electrical motor data; voltage, current, frequency, rotations per minute, power consumption, etc.
f. Cancellation or delays of any electrical tests or Functional Performance Testing upon the day of that particular scheduled test, due to lack of preparation or status of installation shall be considered a failed test due to the additional time required by the Commissioning Agent to witness electrical testing. These additional tests shall be treated in accordance with Specification 019113 Section 3.6-A.

7. Training Requirements:

    a. Comprehensive training of O&M personnel shall be performed by the Electrical Contractor(s) and Equipment Manufacturer(s) prior to turnover of the systems to the Owner. Training shall include but not be limited to classroom instruction and hands-on instruction of the installed equipment and systems.
    b. The Training Schedule is to be coordinated and completed by the Electrical Contractor(s). The Training Schedule is to be updated and maintained as construction progresses. The Training Schedule and all updates shall be coordinated with and approved of by the Owner.
    c. Contractor(s) responsible for the installation or provision of any piece of equipment or system shall attend, at minimum, the initial training session for that equipment or system.
    d. All Training Documentation shall be assembled and organized in a binder or set of binders. Coordinate with all other Contractor(s) to provide one complete bound Training Record. This requirement shall not be negated, unless other specific complete Project Training Record requirements, encompassing ALL project training documentation, is outlined elsewhere within the specifications.

8. Close-Out Requirements:

    a. Remedy all deficiencies identified during commissioning. Provide all materials, equipment, labor, etc. to accomplish these remedies.
    b. Provide a complete set of Record Documents (As-Built Drawings and Specifications) to the Architect and/or Design Professional as required by the project specifications.
    c. Provide a complete set of O&M Manuals and Project Training Record to the Architect and/or Design Professional as required by the project specifications.
    d. Provide a complete copy of Equipment and System Warranties to the Architect and/or Design Professional as required by the project specifications.

E. Equipment Manufacturer(s):

1. Comply with all requirements as outlined within Specification 260800 Section 1.5 Sub-Section D – Electrical Contractor(s).

2. Assist in scheduling of training sessions. Provide training of Owner’s Maintenance Personnel with adequacy required for full comprehension of equipment and maintenance procedures.

3. Review installation for manufacturer’s specific requirements. Verify safeties, limits, relays and all other equipment specific settings are correct. Verify these settings optimize equipment performance and efficiencies.

4. Perform, approve and document all start-up services as outlined within the specifications for each piece of equipment, component and accessory. Perform all standard manufacturer services as outlined on manufacturer supplied forms. Additionally, perform all other requirements specifically called for within the project specifications, not otherwise performed in a manufacturer standard startup service. Provide additional documentation for these services on forms with manufacturer’s letterhead.

5. Demonstrate performance of equipment as required within Functional Performance Tests.

F. Third Party Electrical Test Agencies:

1. Comply with all requirements as outlined within Specification 260800 Section 1.5 Sub-Section D – Electrical Contractor(s).

2. Certified Third Party Test Agency shall perform all electrical tests as required by the specifications and as outlined within the Functional Performance Test procedures.

3. Testing Agency shall provide all equipment, components and accessories required for testing.

4. Functional Performance Tests for all power equipment, components and accessories shall follow NETA Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems. Electrical Contractor(s) shall notify the Commissioning Agent prior to any testing being performed by the Certified Third Party Test Agency with a minimum of two weeks (14 days) notice.

5. Testing Agency shall notify the Commissioning Team of all deficiencies and un-safe conditions existing within these systems. If predominant un-safe conditions exist it shall be the responsibility of the Third Party Testing Agency to terminate testing to be continued at a later date.

1.6 DOCUMENTATION

A. The Commissioning Agent shall oversee and maintain the development of commissioning documentation. The commissioning documentation shall be kept in three ring binders, and organized by system and sub-system when practical. All pages shall be numbered, and a table of contents page(s) shall be provided. The commissioning documentation shall include, but not be limited to, the following:

1. Start-Up and Check-Out Documentation: Organized and arranged with its associated Pre-Functional Checklist.

2. System and Component tests (i.e. Feeder Test Reports, Ground System Reports, etc.): Organized and arranged with its associated Pre-Functional Checklist.

3. Pre-Functional Checklist: Organized and arranged as per provided by the Commissioning Agent. Typically these forms are organized by System and Sub-System and according to the order of standard specifications as outlined by American Institute of Architects (AIA.)

4. Functional Performance Tests: All tests performed by the installing contractors for internal checkout and for witness by the Commissioning Agent shall be kept by the Contractor(s), organized and arranged by System and Sub-System, and turned over to the Commissioning Agent for inclusion into the Final Commissioning Report.

5. Project Training Record: The Training Record shall be provided with a Table of Contents followed by the updated Training Schedule and finally followed by each Training Session Agenda and Record. The Training Session Agenda and Record shall be organized by System and Sub-System.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. The appropriate Contractor(s) shall furnish all special tools and equipment required during the commissioning process. A list of all tools and equipment to be used during commissioning shall be submitted to the Commissioning Agent for approval. The owner shall furnish necessary utilities for the commissioning process. Additional test equipment requirements are found in Specification 019113 Section 2.8 – Test Equipment.

2.2 TEST EQUIPMENT - PROPRIETARY

A. Proprietary test equipment and software required by any equipment manufacturer for programming and/or start-up, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist in the commissioning process as needed. Proprietary test equipment (and software) shall become the property of the owner upon completion of the commissioning process.

PART 3 - EXECUTION

3.1 GENERAL

A. A pre-construction meeting of all Commissioning Team members shall be held at a time and place designated by the owner. The purpose shall be to familiarize all parties with the commissioning process, and to ensure that the responsibilities of each party are clearly understood.

B. A Final Commissioning Plan shall be developed by the Commissioning Agent. The Electrical Contractor(s) shall assist the Commissioning Agent in preparing the Commissioning Plan by providing all necessary information pertaining to the actual equipment and installation in a timely manner. If contractor initiated system changes have been made that alter the commissioning process, the Commissioning Agent shall notify the Owner.

C. The Commissioning Process shall follow the schedule and procedures set forth within the Final Commissioning Plan.

D. The Electrical Contractor(s) shall complete all phases of work so the systems can be started, tested, balanced, and acceptance procedures undertaken. This includes the complete installation of all equipment, materials, feeders, wire, insulation, controls, etc., per the contract documents and related directives, clarifications, and change orders.

E. The Electrical Contractor(s) shall coordinate all Commissioning Activities into the project as required herein and as outlined within the Commissioning Plan. The Electrical Contractor(s) shall complete all required Commissioning and Construction Activities correctly and on schedule.

3.2 PARTICIPATION IN ACCEPTANCE PROCEDURES

A. The Electrical Contractor(s) shall provide skilled technicians to start-up and debug all systems within Division 26. These same technicians shall be made available to assist the Commissioning Agent in completing the commissioning program. Work schedules, time required for testing, etc., shall be requested by the Commissioning Agent and coordinated by the Electrical Contractor(s). Electrical Contractor(s) shall ensure that the qualified technician(s) are available and present during the agreed upon schedules and of sufficient duration to complete the necessary tests, adjustments, and/or problem resolutions.

B. System performance problems and discrepancies may require additional technician time, Commissioning Agent time, reconstruction of systems, and/or replacement of system components. The additional technician time shall be made available for subsequent commissioning periods, at no cost to the owner, until the required system performance is obtained.

C. The Commissioning Agent reserves the right to question the appropriateness and qualifications of the technicians relative to each item of equipment, system, and/or sub-system. Qualifications of technicians shall include expert knowledge relative to the specific equipment involved and willingness to work with the Commissioning Agent. The Electrical Contractor(s) shall provide adequate documentation and tools to start-up and test the equipment, system, and/or sub-system.

3.3 DEFICIENCY RESOLUTION

A. In some systems, miss-adjustments, misapplied equipment, and/or deficient performance under varying loads will result in additional work being required to commission the systems. This work shall be completed under the direction of the Owner, with input from the contractor and equipment supplier. Whereas all members shall have input and the opportunity to discuss, debate, and work out problems, the Owner and/or Architect shall have final jurisdiction over any additional work done to achieve performance.

B. Corrective work shall be completed in a timely fashion to permit the completion of the commissioning process. Any and all schedule items affected by this work shall be reflected on the Commissioning and Overall Project Schedules.

3.4 ADDITIONAL COMMISSIONING

A. The Electrical Contractor, and associated sub-contractors, shall include time for additional commissioning required as a result of failure of a pre-functional or a functional test. Incomplete or incorrect Pre-Functional Checklists reviewed by the Commissioning Agent shall require an additional inspection to verify the re-completed PFC is complete and accurate. Functional Performance Tests witnessed by the Commissioning Agent which fail, shall require retesting, again witnessed by the Commissioning Agent. These documents must be re-checked or re-witnessed in order for the system to be approved and accepted by the Commissioning Agent.

B. The Commissioning Agent will invoice the Owner for additional time required to witness any retesting due to failed PFC’s or FPT’s and the Owner may deduct this cost at his discretion from the Construction Manager’s Application for Payment. It is the Electrical Contractor’s responsibility to properly de-bug systems and verify successful system performance prior to inviting the Commissioning Agent to witness the test.

3.5 SEASONAL COMMISSIONING

A. Seasonal commissioning pertains to testing under full load conditions during peak heating and peak cooling seasons, as well as part load conditions in the spring and fall. Initial commissioning shall be done as soon as contract work is completed, regardless of season. Subsequent commissioning may be undertaken at any time thereafter to ascertain adequate performance during the different seasons.

3.6 PRE-FUNCTIONAL CHECKLISTS AND FUNCTIONAL PERFORMANCE TESTS

A. The Commissioning Agent shall be responsible for preparing the Pre-Functional Checklist. The Electrical Contractor(s) shall be responsible for completing their applicable sections. Detailed descriptions of Pre-Functional Checklists are outlined in Section 019113-2.4.

B. The Commissioning Agent shall be responsible for preparing the Functional Performance Tests. The Commissioning Agent and Contractor (s) shall schedule the tests and assemble the commissioning team members who shall be responsible for the tests. Participating contractors, manufacturers, suppliers, etc. shall include all costs to do the work involved in these tests in their proposals. Detailed descriptions of Functional Performance Tests are outlined in Section 019113-2.6.

C. Following is a list of tasks and supporting information that shall be required:

1. Electrical contractor - provide a foreman electrician familiar with the electrical interlocks, interfaces with emergency power supply, and interfaces with alarm and life-safety systems. Provide access to the contract plans, and all as-built schematics of sub-systems, interfaces, and interlocks.

D. Documentation and Reporting Requirements:

1. Any contractors with responsibilities related to the equipment to be installed, i.e. mechanical, electrical, TAB, controls, Construction Manager or General Contractor, shall be responsible for completing their related portion of the Pre-Functional Checklist and Functional Performance Test forms and shall sign off on its completion.

2. If deficiencies are identified during verification, the construction manager must be notified, and action taken to remedy the deficiency. The final tabulated checklist data sheets shall be reviewed by the Design Professional and the Commissioning Agent, to determine if verification is complete, and the operating system is functioning in accordance with the contract documents.

END OF SECTION 260800

SECTION 260913 - ELECTRICAL POWER MONITORING AND CONTROL

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. Scope: Furnish and install an Energy and Power Management System (EPMS) as detailed on the Drawings and as herein specified. The system is defined to include data and analytics functionality in the broad categories of (a) energy performance optimization, (b) power reliability and availability, and (c) sustainability metrics. Features like real-time monitoring, alarming and event management, energy, power, and sustainability data analytics and visualization will facilitate the following functions at a high level:

1. Analyze energy usage and uncover savings opportunities.
2. Meet and exceed energy efficiency and sustainability standards and certifications.
3. Measure return on investment of energy capital projects.
4. Allocate and bill energy costs accurately to processes, tenants, cost centers, and departments.
5. Decrease the frequency and duration of unplanned outages.
6. Improve workplace safety by minimizing exposure to electrical hazards.
7. Provide accurate and automated documentation for regulatory compliance.
8. Improve the effectiveness of equipment maintenance activities.
9. Manage multiple power generation sources effectively.
10. Increase the return on electrical distribution assets.
11. Measure and achieve sustainability targets.

B. The work specified in this Section includes but shall not be limited to the following:

1. Hardware—such as metering devices for monitoring, protection, and control; device communication interface hardware; servers; mobile or workstation devices; and ancillary equipment.
2. Software—such as on premise installed software and cloud based software-as-a-service (SaaS) applications.
3. Services, support, and training.

C. The EPMS shall use Ethernet as the high-speed backbone network for device communications.

D. The high-speed network shall allow direct access to data provided by the power monitoring devices for implementing automatic control.

E. Data and analytics provided by the EPMS system for centralized display, analysis, logging, alarming, event recording, and other EPMS operations shall be accessible from a computer workstation with supported operating system and interface software.

F. The EPMS shall be manufactured by Schneider Electric or approved equal.

1.3 REFERENCES

A. General: The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only. The edition or revision of the referenced publications shall be the latest date as of the date of the Contract Documents, unless otherwise specified.

B. All metering devices shall be UL 508 listed, CSA approved, and have CE marking.

C. The system shall comply with the applicable portions of NEMA standards. In addition, the control unit shall comply with FCC emission standards specified in Part 15, Sub-Part J for Class A application.

D. The Energy and Power Management System and components shall comply with codes and standards as applicable.

1.4 SUBMITTALS

A. Product Data: EPMS product catalog sheets and technical data sheets specifying physical data and electrical performance, electrical characteristics, and connection requirements of each device shall be supplied under the EPMS scope of work.

B. Drawings, Documentation, Operation and Maintenance (O&M) Manuals:

1. EPMS drawings shall show all relevant field monitoring devices and networking components. Drawings shall identify network connections and protocols. Drawings shall identify device room locations and recommended installation notations. Specific locations and mounting details are subject to the discretion and responsibilities of the installation contractor.
2. Sequence of operation (for control applications such as automatic transfer schemes, load control, etc.), layout drawings, as-built wiring diagrams, bill of material, spare parts list, and component catalog information shall be included in a final documentation package that will be delivered to the owner prior to training.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer shall be a firm engaged in providing EPMS systems, and shall be able to prove an installed base of such systems successfully operating in at least one hundred customer sites for a minimum of five years.

B. The EPMS vendor shall bear full responsibility to ensure that the EPMS system performs as specified.

C. The EPMS solution shall be fully tested in a test-bed environment with hardware devices representative of a large scale functional power distribution system (including both physical and simulated devices) such as advanced power quality meters, low voltage main meters, low voltage feeder meters, circuit breaker trip units, transformer monitoring units, protective relays, branch circuit power meters, etc. Documented test results including system response times, network performance, and recommended network architectures shall be published and provided upon request.

D. No products shall violate patents filed in any country.

PART 2 - PRODUCTS

2.1 METERING—MV MAINS—STANDARD

A. The metering device used to monitor medium voltage mains for network management, energy cost allocation, power quality analysis, asset management, operational efficiency, and compliance reporting, shall have at minimum the following features:

1. Voltage and current inputs—three (3) phase inputs; direct connect to circuits up to 600 VAC, eliminating the need for voltage (potential) transformers; five (5) amperes (A) nominal current inputs.
2. Supported measured and calculated metering parameters—four-quadrant metering, full range of three (3) phase voltage, current, power and energy measurements, percentage unbalance, power factor (true and displacement per phase and three (3) phase) demand (minimum/maximum, present demand interval, running average demand, and predicted demand), total harmonic distortion (THD), individual current and voltage harmonics readings.
3. High accuracy standards—meets stringent IEC and ANSI measurement accuracy standards such as IEC 62053-22 Class 0.2S, ANSI C12.20 0.2 Class 10 and 20.
4. High-visibility display with the following characteristics:

    a. User programmable to display up to four (4) quantities per screen.
    b. Capable of displaying graphical metering data such as phasor diagrams, watt-hour disk simulator, spectral components etc.
    c. Capable of displaying harmonics content (THD, K-factor, crest-factor) in histogram format.

5. I/O: integrated or expandable with the following characteristics:

    a. Minimum four (4) digital inputs and four (4) digital outputs for equipment status/position monitoring and equipment control/interface.
    b. Minimum four (4) analog inputs (4-20 mA).
    c. Pulse output relay operation for kWh/kVARh total/imported/exported.

6. Communications Capability—multi-port serial and Ethernet communications with at least two Modbus serial ports and one Ethernet port with Ethernet-to-serial RS-485 gateway.

7. On-board logging:

    a. Non-volatile time stamps with on-board logging of I/O conditions, minimum/maximum values, energy and demand, maintenance data, alarms, and any measured parameters; trending and short-term forecasting of energy and demand.
    b. Ability to record any parameter in the meter and trigger multiple such recordings in continuous succession (triggered manually or through internal event conditions, including periodic timers or set-point activity).
    c. Continuous recording of intervals from 100 years down to one-half (½) cycle.
    d. Number of records (depth) and overflow conditions (stop-when-full or circular) shall be programmable.

8. On-board web server can be used for:

    a. Access to real-time values and basic power quality information using standard web browser.
    b. Basic meter configuration.

9. Alarming capabilities:

    a. Set-point driven alarming capability.
    b. Generate an email notification upon an alarm condition.
    c. Millisecond resolution timestamp on alarm entries.
    d. Support consecutive high-speed triggers for alarms and waveform recording, triggering on a cycle-by-cycle basis with no “dead” time between events (i.e. no need for a re-arming delay time between events).
    e. Operate relays or initiate data logging captures on alarm conditions.
    f. Control any number of digital output relays in an AND or an OR configuration, using pulse mode or latch mode operation, for control and alarm purposes.
    g. Combine any logical combination of available set-point conditions to control an internal or external function/event.

10. Time-stamped event log (1 millisecond (ms.) resolution) with the following characteristics:

    a. Support at least 500 events, programmable up to a maximum of 20000 events.
    b. For each event, record date and time, cause and effect, and priority.
    c. Record all events relating to set-point activity, relay operation and self-diagnostics.
    d. Capable of synchronizing time stamps between devices on the same serial communications network to within 100 ms.
    e. Minimum event recording response time is one-half (½) cycle (8.3ms 60Hz, 10ms 50Hz) for high-speed events and one (1) second for other events.
    f. Programmable set-point events.

11. Power quality analysis and compliance monitoring:

    a. Without separate software, have the following capabilities:

        1) Display statistical indicators of power quality on the front display.

2) Compare power quality parameters (present, predicted, average, or calculated values) with an absolute or relative set point, and alert (via e-mail or pager), or enable control (via a local interface to power quality (PQ) mitigation equipment/control systems through relays and analog or digital outputs) when set-point is exceeded.
3) Support EN50160 reporting for compliance monitoring.

b. Third party laboratory tested to the power quality standards—IEC 61000-4-30 Class 'A' 2nd edition, IEC 61000-4-15 – Flicker.
c. Low pass anti-aliasing signal filters to meet the requirements of IEC 61000-4-7:2002.

12. Fault recording and waveform capture:

a. Simultaneously capture voltage and current channels for sub-cycle disturbance, transients, as well as multi-cycle sags, swells and outages in quick succession, without dead time between recordings.
b. 512 samples per cycle waveform recording, minimum 33/40 μs transient capture (60/50 Hz).
c. Configurable to provide COMTRADE waveforms for all captures.

13. Disturbance detection:

a. High-speed sag/swell detection of voltage disturbances on a cycle-by-cycle basis, providing duration of the disturbance, the minimum, maximum, and average value of the voltage for each phase during the disturbance.
b. Detect disturbances less than one cycle in duration.
c. Determine the location of a disturbance more quickly and accurately by determining the direction of the disturbance relative to the meter. Capture analysis results in the event log, along with a timestamp and confidence level indicating level of certainty.

14. Programmability:

a. Capable of deriving values for combinations of measured or calculated parameters, using arithmetic, trigonometric, logic, thermocouple linearization, and temperature conversion functions.
b. Capable (through a graphical flexible programming language) of creating programmable modules with metered and input data, through arithmetic and logic operations (such as minimum, maximum, set point, digital input, digital output, etc.) that can be arbitrarily linked together to create application functionality.

2.2 METERING—LV MAINS—STANDARD

A. The metering device used to monitor the low voltage mains for network management, energy cost allocation, power quality analysis, asset management, operational efficiency, and compliance reporting, shall have at minimum the following features:

1. High-visibility color graphical display.

2. Direct connect to circuits up to 600 VAC, eliminating the need for voltage (potential) transformers; five (5) amperes (A) nominal current inputs.
3. Supported monitoring parameters—full range of three (3) phase voltage, current, power and energy measurements, total harmonic distortion (THD), individual current and voltage harmonics readings, waveform capture, voltage and current disturbances (dip/swell) detection, ability to determine the location of a disturbance (upstream/downstream).
4. COMTRADE—up to 255 COMTRADE disturbance capture files available via FTP and providing client notification of new captures through IEC 61850 (RDRE logical node).
5. Power Quality compliance—without using separate software, determine statistical indicators of power quality that include but are not limited to voltage dips and swells, harmonics, and frequency in accordance with EN 50160 power quality standard and provide an indication of pass/fail in a web interface.
6. User customization—capable of deriving values for any combination of measured or calculated parameters using arithmetic, trigonometric, and logic functions through graphical, flexible object oriented, programmable modules. Modules can be linked together in an arbitrary manner to create functionality such as totalization, efficiency measurements, control functions, load shedding, demand response, power factor correction, and compliance monitoring.
7. Communications capability—multi-port Ethernet and serial communications with at least two Ethernet ports and one RS485 serial port. Functionality through Ethernet connectivity includes e-mail on alarm, e-mail interval energy data, on-board web server, SNMP network management, NTP time synchronization, Ethernet-to-serial RS-485 gateway, Modbus, DNP3, and IEC 61850.
8. On-board logging—non-volatile time stamped on-board logging of input/output (I/O) conditions, min/max values, energy and demand, maintenance data, alarms, and any measured parameters; trending and short-term forecasting of energy and demand; custom alarming with time stamping; trigger alarms on at least 50 definable power or I/O conditions; use of Boolean logic to combine alarms.
9. I/O—at least three (3) digital inputs and one (1) digital output for equipment status/position monitoring and equipment control or interfacing with millisecond timestamp.
10. Expandable I/O—the ability to add optional I/O of at least 24 digital inputs and 16 relay outputs, 16 analog inputs and eight (8) analog outputs, or combinations of digital and analog I/O in the field.

2.3 METERING—LV FEEDERS—STANDARD

A. The metering device used to monitor the medium voltage mains for network management, energy cost allocation, power quality analysis, asset management, operational efficiency, and compliance reporting, shall have at minimum the following features:

1. High-visibility color graphical display.
2. Direct connect to circuits up to 600 VAC, eliminating the need for voltage (potential) transformers; 5 A nominal current inputs.
3. Supported monitoring parameters—full range of 3-phase voltage, current, power and energy measurements, total harmonic distortion (THD), individual current and voltage harmonics readings, waveform capture, voltage and current disturbances (dip/swell) detection, ability to determine the location of a disturbance (upstream/downstream).

4. COMTRADE—up to 255 COMTRADE disturbance capture files available via FTP and providing client notification of new captures through IEC 61850 (RDRE logical node).
5. Power Quality compliance—without using separate software, determine statistical indicators of power quality that include, but are not limited to, voltage dips and swells, harmonics, and frequency in accordance with EN 50160 power quality standard and provide an indication of pass/fail in a web interface.
6. User customization—capable of deriving values for any combination of measured or calculated parameters using arithmetic, trigonometric, and logic functions through graphical, flexible object oriented, programmable modules. Modules can be linked together in an arbitrary manner to create functionality such as totalization, efficiency measurements, control functions, load shedding, demand response, power factor correction, and compliance monitoring.
7. Communications capability—multi-port Ethernet and serial communications with at least two Ethernet ports and one RS485 serial port. Functionality through Ethernet connectivity includes e-mail on alarm, e-mail interval energy data, on-board web server, SNMP network management, NTP time synchronization, Ethernet-to-serial RS-485 gateway, Modbus, DNP3, and IEC 61850.
8. On-board logging—non-volatile time stamped on-board logging of I/O conditions, min/max values, energy and demand, maintenance data, alarms, and any measured parameters; trending and short-term forecasting of energy and demand; custom alarming with time stamping; trigger alarms on at least 50 definable power or I/O conditions; use of Boolean logic to combine alarms.
9. I/O—at least three (3) digital inputs and one (1) digital output for equipment status/position monitoring and equipment control or interfacing with millisecond timestamp.
10. Expandable I/O—the ability to add optional I/O of at least 24 digital inputs and 16 relay outputs, 16 analog inputs and eight (8) analog outputs, or combinations of digital and analog I/O in the field.

2.4 SUB METERING—INDIVIDUAL CIRCUITS—STANDARD

A. The metering device used to monitor circuits for purposes of network management, energy cost management, energy allocation, and operational efficiency shall have the following minimum features:

1. Connections and form factor - direct connect to circuits up to 600 VAC, eliminating the need for voltage (potential) transformers; five (5) amperes (A) nominal current inputs. Removable connectors for voltage inputs, control power, communications, inputs and outputs; easily mountable in the pre-made cutout without tools; form factor shall be ¼ DIN with 92 X 92 cut-out and 96 x 96 panel mount integrated display.
2. Supported monitoring parameters—full range of 3-phase voltage, current, power and energy measurements, power factor, frequency, total harmonic distortion (THD), individual power harmonics (up to 63rd order).
3. Accuracy standards - use four-quadrant metering and sample current/voltage simultaneously without gaps with 64 samples per cycle (zero-blind); comply with ANSI C12.20 class 0.2 and IEC 61557-12 class 0.2 for revenue meters.

4. Display - Backlit dot-matrix LCD display, anti-glare and scratch resistant with a minimum of 128 x128 pixels, capable of displaying four values in one screen simultaneously; a summary screen to allow the user to view a snapshot of the system; support either integrated or remote display.
5. Support four (4) digital inputs for Demand Synch Pulse, Time Synch Input, and Conditional Energy Control; have two (2) digital outputs that operate either by user command sent over communication link, or in response to a user defined alarm or event.
6. Communications - serial RS-485 Modbus and Ethernet Modbus TCP; provide two Ethernet ports to allow wiring from meter to meter as a daisy-chain; be capable of serve data over the Ethernet network accessible through a standard web browser; the monitor shall contain default pages from the factory.
7. Onboard data logging capabilities - to log data, alarms and events; logged information will include data logs, minimum/maximum log files of selected parameter values, and alarm logs for each user defined alarm or event log; support the following on-board nonvolatile memory—14 parameters every 15 minutes for 90 days.
8. Alarming capabilities - support 29 set-point driven alarms, four (4) digital alarms, (4) unary alarms, 10 Boolean alarms and five (5) custom alarms; user definable alarm events; set-point driven alarms shall be available for voltage/current parameters, input status, and end of interval status.
9. Firmware-upgradeable to enhance functionality through the Ethernet or serial communication connection and shall allow upgrades of individual meters or groups.
10. Integrated gateway functionality, enabling the capability to connect via Ethernet to downstream, serially connected devices.
11. Designed accordingly to eco-design complying with ISO 14062, especially MCCB materials shall be halogen free type; designed for easy disassembly and recycling at end of life, and comply with environmental directives ROHS and WEEE.

2.5 METERING—UTILITY REVENUE

A. The revenue grade metering device used to monitor incoming utility medium voltage mains for grid revenue, substation automation, network management, energy cost allocation, power quality analysis, asset management, operational efficiency, and compliance reporting, shall have at minimum the following features:

1. Form factor—ANSI socket 9S, 29S, 35S and 36S; user-selectable 9S, 29S, and 36S; FT-21 switchboard/draw-out style.
2. Voltage and current inputs—three (3) phase inputs; Direct connect to circuits up to 600 VAC, eliminating the need for voltage (potential) transformers; five (5) amperes (A) nominal current inputs; equipped with two spring-loaded socket grounding tabs to ensure reliable electrical contact; optional mechanical bonding ground.
3. Supported measured and calculated metering parameters—four-quadrant metering, full range of three-phase voltage, current, power and energy measurements, percentage unbalance, power factor (true and displacement per phase and three-phase) demand (minimum/maximum, present demand interval, running average demand, and predicted demand), total harmonic distortion (THD), individual current, and voltage harmonics readings.

4. High accuracy standards—meet in a single device over the Class 2/10/20 current classes in a single device (over all environmental conditions and influence factors outlined in the standard and its referenced standards).

    a. Less than half the measurement error of ANSI C12.20 class 0.2 accuracy over the Class 2/10/20 current classes.
    b. Less than half the measurement error of IEC62053-22 class 0,2S accuracy from 0.010A-20A in a single device.
    c. Less than twenty times the measurement error of IEC62053-23 class 2 accuracy from 0.010A-20A in a single device.
    d. Support up to eight (8) points of magnitude and phase correction for each voltage and current measurement input.
    e. Overvoltage/overcurrent protection—capable of meeting all accuracy specifications after withstanding 500A for one (1) second or 2500 VAC RMS for one (1) minute (with internal protection disabled).

5. High-visibility display with the following characteristics:

    a. User programmable to display up to four (4) quantities per screen.
    b. Capable of displaying graphical metering data such as phasor diagrams, watt-hour disk simulator, spectral components etc.
    c. Capable of displaying harmonics content (THD, K-factor, crest-factor) in histogram format.

6. I/O—integrated or expandable with the following characteristics:

    a. Minimum four (4) digital inputs and four (4) digital outputs for equipment status/position monitoring and equipment control or interfacing.
    b. Minimum four (4) analog inputs (4-20 mA).
    c. Pulse output relay operation for kWh/kVARh total/imported/exported.

7. Communications Capability.

    a. Ethernet, RS485/232 serial, ANSI 12.18 compliant optical port.
    b. Protocol support: DNP3.0(Ethernet/serial); Modbus slave/mastering (Ethernet/serial); SMTP/SNTP(Ethernet); MV90(Ethernet/serial); XML(TCP); IEC61850(TCP).
    c. IRIG-B port to allow GPS time synchronization to +/-1ms accuracy from GPS source.
    d. Automatically e-mail alarm notifications, scheduled system status updates and data logs on an event-driven or scheduled basis.

8. On-board logging.

    a. Non-volatile time stamps with on-board logging of I/O conditions, minimum/maximum values, energy and demand, maintenance data, alarms, and any measured parameters; trending and short-term forecasting of energy and demand.
    b. Ability to record any parameter in the meter and trigger multiple such recordings in continuous succession (triggered manually or through internal event conditions, including periodic timers or set-point activity).

c. Continuous recording of intervals from 100 years down to ½ cycle.
d. Number of records (depth) and overflow conditions (stop-when-full or circular) shall be programmable.

9. On-board web server that can be used for:

a. Access to real-time values and basic power quality data through a web browser.
b. Basic meter configuration.

10. Alarming capabilities:

a. Set-point driven alarming capability.
b. Generate an email notification upon an alarm condition.
c. Millisecond resolution timestamp on alarm entries
d. Support consecutive high-speed alarm conditions for alarms and waveform recording, triggering on a cycle-by-cycle basis with no "dead" time between events (i.e., no need for a re-arming delay time between events).
e. Operate relays or initiate data logging captures on alarm conditions.
f. Control any number of digital output relays in an AND or an OR configuration using pulse mode or latch mode operation for control and alarm purposes.
g. Combine any logical combination of any number of available set-point conditions to control an internal or external function or event.

11. Time-stamped event log (one (1) millisecond resolution) with the following characteristics:

a. Support at least 500 events, programmable up to a maximum of 20000 events.
b. For each event, record date and time, cause and effect, and priority.
c. Record all events relating to set-point activity, relay operation, and self-diagnostics.
d. Capable of synchronizing time stamps between devices on the same serial communications network, to within 100 milliseconds.
e. Minimum event recording response time is ½ cycle (8.3ms 60Hz, 10ms 50Hz) for high-speed events and one (1) second for other events.
f. Programmable set-point events.

12. Power quality analysis and compliance monitoring.

a. Without separate software, have the following capabilities:

1) Display statistical indicators of power quality on the front display.
2) Compare power quality parameters (present, predicted, average, or calculated values) with an absolute or relative set point. When set-point is exceeded, alert via e-mail or pager, or enable control via a local interface to PQ mitigation equipment or control systems through relays and analog or digital outputs.
3) Support EN50160 reporting for compliance monitoring.

b. Third party Laboratory tested to the power quality standards IEC 61000-4-30 Class 'A' 2nd edition, IEC 61000-4-15, and Flicker.

c. Low pass anti-aliasing signal filters to meet the requirements of IEC 61000-4-7:2002.

13. Fault recording and waveform capture.

a. Simultaneously capture voltage and current channels for sub-cycle disturbance, transients, as well as multi-cycle sags, swells and outages in quick succession, without dead time between recordings.
b. 1024 samples per cycle waveform recording, minimum 17/20 μs transient capture (60/50 Hz).
c. Configurable to provide COMTRADE waveforms for all captures.

14. Disturbance detection.

a. High-speed sag/swell detection of voltage disturbances on a cycle-by-cycle basis, providing duration of the disturbance, the minimum, maximum, and average value of the voltage for each phase during the disturbance.
b. Detect disturbances less than one cycle in duration.
c. Determine the location of a disturbance more quickly and accurately by determining the direction of the disturbance relative to the meter. Capture analysis results in the event log, along with a timestamp and confidence level indicating level of certainty.

15. Programmability.

a. Capable of deriving values for any combination of measured or calculated parameter using arithmetic, trigonometric, logic, thermocouple linearization, and temperature conversion functions,
b. Capable (through a graphical flexible programming language) of creating programmable modules with metered and input data through arithmetic and logic operations (such as minimum, maximum, set point, digital input, digital output, etc.) that can be arbitrarily linked together to create application functionality.

16. System Integration—capable of integrating with custom reporting, spreadsheet, database and other applications with XML compatible data.

2.6 METERING—TRANSFER SWITCHES—STANDARD

A. The metering device used to monitor transfer switches for purposes of automated generator test documentation such as Emergency Power Supply System (EPSS) Test Automation, shall have at minimum the following features:

1. High-visibility display.
2. Direct connect to circuits up to 600 VAC, eliminating the need for voltage (potential) transformers; five (5) amperes (A) nominal current inputs.
3. Supported monitoring parameters—full range of 3-phase voltage, current, power and energy measurements, total harmonic distortion (THD), individual current and voltage harmonics readings, waveform capture, and voltage and current disturbance (sag/swell) detection.

4. Communications capability—multi-port serial and Ethernet communications with at least two Modbus serial ports and one (1) Ethernet port. The Ethernet port offers e-mail on alarm, web server, and an Ethernet-to-serial RS-485 gateway.
5. On-board logging—non-volatile time stamped on-board logging of I/O conditions, minimum/maximum values, energy and demand, maintenance data, alarms, and any measured parameters; trending and short-term forecasting of energy and demand; custom alarming with time stamping; trigger alarms on at least 50 definable power or I/O conditions; use of Boolean logic to combine alarms.
6. I/O—at least four (4) digital inputs and four (4) digital outputs for equipment status/position monitoring, and equipment control or interfacing.

2.7 METERING—GENERATORS—STANDARD

A. The metering device used to monitor generators for purposes of automated generator test documentation, Emergency Power Supply System (EPSS) Test Automation, shall have at minimum the following features:

1. High-visibility display.
2. Direct connect to circuits up to 600 VAC, eliminating the need for voltage (potential) transformers; five (5) amperes (A) nominal current inputs.
3. Supported monitoring parameters—full range of 3-phase voltage, current, power and energy measurements, total harmonic distortion (THD), individual current and voltage harmonics readings, waveform capture, and voltage and current disturbance (sag/swell) detection.
4. Communications Capability—multi-port serial and Ethernet communications with at least two Modbus serial ports and one (1) Ethernet port. The Ethernet port offers e-mail on alarm, web server and an Ethernet-to-serial RS-485 gateway.
5. On-board logging—non-volatile time stamped on-board logging of I/O conditions, minimum/maximum values, energy and demand, maintenance data, alarms, and any measured parameters; trending and short-term forecasting of energy and demand; custom alarming with time stamping; trigger alarms on at least 50 definable power or I/O conditions; use of Boolean logic to combine alarms.
6. I/O—at least four (4) digital inputs and four (4) digital outputs for equipment status/position monitoring and equipment control or interfacing, four (4) analog inputs (4-20 mA) to monitor engine parameters such as oil pressure, coolant temperature, etc.
7. High accuracy standards—meet stringent IEC and ANSI measurement accuracy standards such as IEC 62053-22 Class 0.2S, ANSI C12.20 0.2 Class 10 and 20.
8. Digital fault recording—simultaneously capture voltage and current channels for sub-cycle disturbance, transients, as well as multi-cycle sags, swells and outages; 512 samples per cycle waveform recording, 40/33 µs transient capture (50/60 Hz).
9. Power quality analysis and compliance monitoring—a choice of THD metering, individual current and voltage harmonics readings, waveform capture, and voltage and current disturbance (sag/swell) detection.
10. Disturbance direction detection—determines the location of a disturbance more quickly and accurately by determining the direction of the disturbance relative to the meter. Analysis results are captured in the event log, along with a timestamp and confidence level indicating level of certainty.

11. Integration of fuel parameters—communications with the fuel monitoring system shall provide integration of parameters such as fuel level, water content, run time remaining with fuel on hand, etc. Communications shall be direct or through a protocol converter.
12. Battery Health Monitoring—the system shall be capable of capturing the voltage of the engine start battery during engine starting with a minimum sampling rate of one sample per millisecond for purposes of signature analysis.

2.8 METERING—ENCLOSURES

A. Any metering enclosed cabinets supplied shall meet the following specifications:

1. Minimum UL type 1 listed steel enclosure with factory-supplied knockouts.
2. Lockable and provide for the application of a security seal.
3. Available options for NEMA Type 1 and Type 3R applications.
4. Single set of incoming terminals for connecting the voltage metering leads.
5. Control power and voltage sensing power separated for distribution to each meter from main set of incoming terminals.
6. External control power transformers not required for any power systems up to, and including, 480 volts.
7. Standard wiring harnesses for control power and voltage sensing to connect each meter internally. The harness may daisy chain the voltage connections from meter to meter on each row of meters. Finger safe terminals to terminate the meter end of the wiring harness.
8. Common daisy chain wiring for communications wiring, with a single loop for all meters connected to the circuit and each end terminated in a common location. Communication wiring installed such that interference from the power wiring is minimized.
9. Shorting terminal blocks for connecting the current transformer leads from the field to all ordered meters. Factory installed wiring harness shall be provided to connect the CT circuit from the shorting block to the meter.
10. Capability to field-install meters without cutting or splicing the voltage or communication wiring harnesses to be provided.
11. Terminal blocks for incoming and outgoing communications circuit connections.

2.9 GATEWAYS AND ENERGY SERVERS—ENERGY SERVER LOCAL

A. The energy server appliance shall collect and log WAGES (water, air, gas, electricity, steam) data by connecting to meters, as well as environmental parameters, such as temperature, humidity, and CO2 levels connected to its input/output modules. The appliance shall be capable of the following:

1. Logging the historical data for up to two years to its own local storage.
2. Communicating directly to compatible on premise software for gateway access to real-time or historical data used in dashboards, real-time screens, and reports.
3. Basic energy awareness functionality through display of real time and historical energy data.
4. Entry level energy management software in a box.
5. No software to install. Web pages and data visualization embedded in Energy Server.

B. Gateway Features.

1. The energy server shall have the ability to serve as a Modbus serial to Modbus TCP/IP gateway for connected software.
2. The energy server shall have the ability to serve as a gateway for connected input devices.

C. Appliance Operating Features—the appliance shall support the following minimum features:

1. Environmental—operating temperature range: -25°C to + 60°C; Humidity 5% to 95%.
2. Power Supply—24 VDC (+/- 10%); Power over Ethernet (POE Class 3, IEEE 802.3 af) at 50 W.
3. Internal Memory—internal memory for web pages with the ability to utilize SD memory cards for data logging storage.
4. Connectivity—support for a maximum of 64 connected devices (serial port, Ethernet network via another Ethernet gateway or devices with embedded Modbus TCP) for real-time readings and data logging.
5. Digital Inputs—minimum of six IEC62053-31 Class A with LED indication for status and pulse reception. The digital input shall be supplied directly from the data logger (see power supply output section below) or from a 10 to 30 VDC external power supply. The maximum pulse frequency is 25 Hz.
6. Analog Inputs—minimum two inputs supporting RTD probes (1% accuracy), 0-10 V sensors (0.5% accuracy), or 4-20 MA sensors (0.5% accuracy).
7. Ethernet ports—two Ethernet ports, which can be used either as a switch or separated ports (one (1) IP address for each). Ethernet port shall be configurable as DHCP client or DHCP server.
8. Serial port—configurable for RS232/485 with 2-wire and 4-wire support.
9. Protocol: Ethernet–Modbus TCP/IP, HTTP, FTP, SNMP (MIB2), TCP, UDP, IP, ICMP, ARP; Serial–MODBUS.
10. Troubleshooting—indicators to show failure mode and firmware updating; detection and reporting for device communication loss, CPU and memory overuse, weak GPRS signals.

D. Communications Interface—the appliance shall support one of the following three modes of communication depending on the specified ordering option:

1. Wi-Fi—two modes–connection to LAN infrastructure as an access point without additional Wi-Fi infrastructure shall be supported. The appliance shall support uploading logged data through the Wi-Fi connection to a centralized server.
2. GPRS/3G—when equipped with the appropriate cellular contract and SIM card, the appliance shall support uploading logged data through a GPRS or 3G network to a centralized server. Management of the GPRS/3G telecom contract is the responsibility of the customer and is out of scope for this specification.
3. Direct Connect (Gateway—connect directly to compatible on premise software as specified in the other sections of the specification.

E. Configuration and Setup—appliance configuration shall include the following capabilities:

1. On-board web pages for setup and configuration.

2. Equipped with Device Profile for Web Services (DPWS) technology (available on Windows operating systems starting with Vista) with two specific web services, discovery and identification.
3. Login secured with https: SSL protocol.
4. Support for multiple user accounts with encrypted passwords.
5. Configure data logging intervals at 5, 15, 30, or 60 minutes.
6. Configure a different logging interval for each of six (6) device types–water, air, gas, electricity, steam, or environmental values.
7. Count for digital inputs.
8. Export logged data in CSV format.
9. Manage data export through proxy servers.
10. Ability to schedule data file export through email or FTP.
11. Ability to connect to a remote or digital service provider for M2M services.

F. Basic Energy Analytics Capabilities—the appliance shall support some basic energy analytics capabilities without the need for additional software. Features shall include the display of the following:

1. Real-time data through trends.
2. Historical energy data through dashboards and trends.

2.10 ENERGY AND POWER MANAGEMENT SOFTWARE—GENERAL

A. The Energy and Power Management System (EPMS) software platform shall facilitate applications in the broad categories of (a) energy performance, (b) power availability, quality and reliability, and (c) sustainability performance. At a high level, the feature-set shall provide functions in:

1. Real-time monitoring.
2. Alarming and event management.
3. Energy cost analysis.
4. Energy, power, and sustainability data analytics and visualization.

B. The software platform shall be certified for use as a part of an ISO50001 program and verifiably support compliance. In addition, the functionality shall support ongoing ISO50001 programs per the following areas of Section 4 of the ISO standard:

1. Energy review.
2. Energy baseline.
3. Energy performance indicators.
4. Monitoring, measurement, and analysis.
5. Input to management review.

C. The EPMS shall verifiably support compliance with EN 16247-1 for energy audits.

2.11 ENERGY AND POWER MANAGEMENT SOFTWARE—REAL TIME MONITORING

A. The Energy and Power Management System (EPMS) software shall include the capability to provide screens including real-time data about the electrical infrastructure showing incoming utility feeds, medium voltage, and low voltage distribution. Relevant data from other energy and facility metadata, such as water, air, gas, electric, and steam meters (WAGES), industrial process data, weather, occupancy, etc., can be integrated, provided the communications and data infrastructure are in place. The capability to provide real-time monitoring data within other analytics functions, such as dashboard views, shall also be provided.

B. Electrical single line diagrams: The EPMS shall include a set of screens that show the electrical single line diagram for the facility with the following:

1. Links to navigate between various levels of the single line diagram.
2. Animated power component of the single line (for example, MV switchgear, MV transformers, generators, unit substations, LV switchboards, UPS, isolated panel system) shall link to a power equipment details screen, assuming that the necessary protection and metering hardware is in place as defined in the Appendix.

C. Equipment details: The EPMS shall include a set of screens that show equipment details including:

1. Details pertaining to each piece of equipment. This includes a picture of the equipment (if available), local single line (if applicable), information for each electrical section (for example, breaker and disconnect switch), and all alarm points.
2. A link to each of the default diagrams of each meter/protection device that apply to the piece of equipment shall be provided.
3. The EPMS shall have a graphic library with electrical one-line symbols to simplify the creation of single line diagrams.

D. Floor plans: The EPMS shall include the capability to overlay the display of real time data on facility floor plans when available. Links to summary screens, equipment details screens, etc., can be integrated.

E. Status panel: The EPMS shall include a summary status screen for alarm status indication for major power equipment components of the electrical distribution system.

F. Web-enabled real-time tables: The system shall have the following capabilities for interactive side-by-side visualization of real-time measurements:

1. Display a tabular view to compare device readings from multiple meters in the power monitoring network quickly.
2. Permit users to create, modify, view and share table views through a browser without the need for a separate software application.
3. Have built-in functions that allow users to easily and instantly filter out measurements when viewing a table.
4. Support both physical and virtual devices defined in the system.
5. Support exporting real time tabular data into Excel formats.

G. Power monitoring trending: The EPMS shall include graphical charts for real-time trending of power usage (kW, Volt, Amp, and kWh) or any measurement supported by metered equipment such as generators and MV/LV switchgear. These trends shall include the capability to:

1. Trend up to 14 measurements on the same chart (limit may be increased if desired).
2. Customize attributes such as color, line thickness, overlays, display name, and display units for each data series.
3. View the trend using an auto-scaling or manual chart axis.
4. Adjust the desired time viewing window for the trend.
5. Inspect the trend by zooming and panning to focus in on key areas of the trend.
6. Provide drill-down detail for the highlighted trend data point to help identify root causes of concern.
7. Trend measurements with different units on the same chart using two different axes.
8. Provide calculated values of minimum, maximum, and average values for a trend.
9. Configure a target threshold line for comparison against actual measurements.
10. Configure up to two target bands with visual indicators to identify when a measurement is outside specified limits.
11. Display real-time data and/or historical data per data series, with optional back-filling of the real-time data using historical data.
12. Export trend data to .CSV/Excel format.
13. Access trend data from a web browser or mobile environment.
14. Save specified trends in a library for later use.
15. Share trends with other users or restrict use.
16. Simultaneously view multiple trend charts, or alternatively maximize a selected trend to display it in full screen mode.

2.12 ENERGY AND POWER MANAGEMENT SOFTWARE—ALARM AND EVENT ANALYSIS AND NOTIFICATION

A. The Energy and Power Management System (EPMS) software shall provide alarm and event annunciation features that include the following:

1. An alarm viewer that provides a summary of the active alarms shall be provided. The viewer shall:

a. Be visible in any screen when logged into the web interface of the system.
b. Display the total number of unacknowledged alarms, and the breakdown of how many of those alarms are high priority, medium priority and low priority.
c. Provide an audible alarm and a simple means for muting the alarm.
d. Allow a simple mechanism to acknowledge alarms for users with appropriate user privileges.
e. Allow a mechanism to sort and group alarms.
f. Allow a mechanism to set configurable alarm thresholds, for example, high, medium, and low.
g. Allow a mechanism to create user defined alarm views that fit user defined criteria.
h. Provide an active alarms view to show alarms currently in the active state.

B. The EPMS shall provide an alarm notification system.

1. The alarm evaluation and notification system shall ensure that appropriate staff members are notified of power system events. The system shall collect data, evaluate alarm conditions, and annunciate the alarms to specified users through email or SMS text messages.
2. The alarm evaluation and notification system shall include:

a. An alarm evaluation engine.
b. An alarm notification/annunciation engine that supports annunciation through email and SMS text message.
c. Flexible alarm scheduling capabilities.
d. Web-based configuration tools for notification configuration, log viewing, and filtering.
e. The ability to control alarm flooding by intelligent aggregation through alarm filtering and consolidation.
f. Message delivery mechanisms such as:

1) Electronic mail (Email).
2) Text messaging for cell phones (GSM Modem).
3) Short messaging peer-to-peer protocol (SMPP).
4) Simple Network Paging Protocol (SNPP).
5) Simple Network Management Protocol (SNMP).
6) Traditional dial-up Pager (TAP).

2.13 ENERGY AND POWER MANAGEMENT SOFTWARE—DATA ANALYTICS AND VISUALIZATION

A. The Energy and Power Management System (EPMS) software shall provide web-enabled dashboards.

1. The system shall have a web client interface that presents interactive auto-updating dashboard views that may contain water, air, gas, electric, and steam (WAGES) energy summary data, historical data trends, images, and content from any accessible URL address.
2. Users shall be able to create, modify, view, and share their dashboards (including graphics, labels, scaling, measurements, date ranges, etc.) using only a browser and without a separate software application.
3. Users shall be able to create with configurable drag and drop gadgets to show the following data:

a. Images from any web-based content.
b. Energy consumption.
c. Energy cost.
d. Energy comparison.
e. Energy savings.
f. Emissions.
g. Trends.

4. The system shall facilitate kiosk displays by assigning individual dashboards to slideshows to run in unattended mode, scrolling through designated dashboards at a configurable time interval.
5. The system shall permit users to create, save, and share an unlimited number of dashboards and slideshows.

B. The system shall provide a web-enabled reporting platform.

1. The system shall provide a web-enabled reporting tool to view historical data in pre-formatted or user-defined report templates.
2. The system shall support reporting on all supported physical devices and virtual (or calculated) meters as defined in the device hierarchy.
3. Users shall be able to create, modify, view and share their reports in the web reports interface.
4. The reporting tool shall provide standard pre-formatted report templates for:

    a. Billing.
    b. Energy cost.
    c. Load profile.
    d. System-wide interactive power quality with CBEMA/ITIC evaluation.
    e. EN50160 compliance.
    f. EN50160 Edition 4 compliance.
    g. IEE519-1992 Harmonics compliance.
    h. IEC61000-4-30.
    i. 100 ms. power quality.
    j. Energy Usage: period-over-period, by shift, single and multi-device comparison.
    k. Tabular and trend report.
    l. Alarm and event history.
    m. System configuration.
    n. Hourly usage report.
    o. Single and multi-device usage reports.

5. The reporting tool shall support exporting to the following output formats: .HTML, .PDF, .TIFF, .Excel, and .XML.
6. The reporting tool shall be capable of subscriptions to facilitate automatic distribution of reports according to a configurable schedule by saving to network locations, email, or print.
7. The system shall support the ability to trigger the generation and delivery of a pre-configured report based on pre-specified event criteria.The system shall be capable of configuring event monitoring detection filters criteria.
8. The reporting tool shall have a framework to support:

    a. Simple customizations to reports such as colors, image inclusions, turning report sections on/off, and logo changes without programming.
    b. Additional more complex report customization through a programming kit.

9. The reporting tool shall be capable of subscriptions to facilitate automatic distribution of reports according to a configurable schedule by saving to network locations, email, or print.

2.14 ENERGY AND POWER MANAGEMENT SOFTWARE—TECHNICAL INFRASTRUCTURE

A. The Energy and Power Management System (EPMS) software shall provide the following operating system and browser support:

1. All associated core components of the EPMS software operate as Windows operating system services.
2. The web client interface shall support multiple browsers.

B. The EPMS shall provide the following data management support:

1. Microsoft SQL Server database engine per supported configurations.
2. All network configuration settings relating to device routing and addressing, communication gateways, distributed I/O servers, and load-distributing application servers shall be stored in the EPMS databases.
3. Archiving, trimming, and on-demand or scheduled capabilities shall be supported.
4. The capability to view historical data from archived databases shall be included.
5. The EPMS shall be capable of retrieving data from devices in the monitoring network and provide the following abilities:

    a. Interrogate and download logs of interval, waveform, and alarm data stored onboard metering devices and related circuit breaker trip units.
    b. Interrogate and download logs of interval data generated by the software system (software-based logging).
    c. Interrogate and download logs of alarm and event data generated by the software system (software-based alarming).
    d. Automatically re-arm the waveform recorders upon upload of information.
    e. Detect unknown measurement quantities provided by devices in the network, and automatically generate appropriate database references for those quantities without user intervention.

C. The EPMS system shall include an Administrative interface with the following management functions:

1. Security: administer groups and user accounts with role based privileges.
2. Database: initiate backup, archiving, and trimming tasks.
3. Devices: Add or rename devices, map measurements, and communication settings.
4. Connections: Configure connection schedules and manage modem connections.
5. Events: View and manage software system events.

D. The EPMS system shall function without disruptions (including communications, logging, and alarming) and shall remain online during all system administration functions such as adding, modifying, or removing devices in the system; creating, modifying, or removing graphical diagrams, dashboards, tables, and reports; creating, modifying, or removing application logic programs in the application logic engine

E. The EPMS shall support the following device support and management features:

1. The system shall include factory-tested native support for at least 50 electrical distribution devices (energy and power meters, protection relays, circuit breakers, PLCs, etc.).
2. Native comprehensive device support shall include:

    a. Pre-engineered, interactive graphical display screens for viewing and analyzing real-time and historical device data.
    b. All registers pre-mapped to standard measurement names without additional mapping of internal device registers.
    c. Automatic upload of time-stamped onboard data logs, event strings, and waveform captures without additional configuration.
    d. Automatic time synchronization.

3. The system shall support integration with other third party intelligent electronic devices (IEDs) not directly supported natively.
4. The system shall support logical device definitions for user-friendly device and measurement names for inputs/outputs or channels on devices that represent a downstream device (in the case of PLCs and auxiliary inputs) or an individual circuit (in the case of multi-circuit devices). Bulk-import capability to create large numbers of logical devices without manual single-device configuration shall be supported.
5. The system shall support the concept of hierarchies to organize devices structurally into various levels. Examples include Tenants/Racks/Circuits, PDUs/RPPs/Panels, or Buildings/Floors/Rooms. The system shall include the ability to:

    a. Aggregate data at any location in the hierarchy.
    b. Track hierarchy configuration changes over time.
    c. Allow administrators to update names in a given hierarchy at any time (even in the past) to ensure accurate reporting of associated data points (for example, report on energy consumption for a Tenant who has re-located, expanded, added, or removed circuits during the billing period).
    d. Export the hierarchy structure to Excel format.
    e. Bulk-import capability to create and edit large hierarchies without manual per-device setup.

F. The system shall support extensibility in the following ways:

1. Provide a graphical, object-oriented application logic engine to create system-wide logic modules with arithmetic, XML data import, PC-based alarming, and logging capabilities.
2. The application logic engine shall have a comprehensive set of functions to create customized applications programs for functions such as weather or real-time price import, KPI calculations, energy units conversion, data aggregation, data normalization, data comparison, power loss calculations, power factor control, load shedding, etc.

G. The EPMS system shall support system integration in the following ways:

1. Device-level Modbus interoperability.

   a. The system shall be capable of supporting Modbus communicating devices and be capable of functioning as a Modbus master to read/write registers in Modbus devices for monitoring and control applications.
   b. The system shall be capable of Modbus device definition (device drivers) creation to enable integration of third-party Modbus protocol devices.

2. System-level OPC interoperability.

   a. The system shall be OPC DA 2.0.1 compliant (as per the OPC Foundation Compliance Testing process) for OPC Server and OPC Client data sharing applications amongst OPC compliant systems.
   b. The system shall provide default OPC Server tag mappings for all natively supported device types without the need to select, configure, or program the mapping of device registers to OPC tags.
   c. The system shall provide a flexible means to add or change OPC mappings and shall support the ability to add custom measurements.

3. Data-level interoperability.

   a. The system shall support the Extract, Transform, and Load (ETL) data log file transfer mechanism to import and export data log files to integrate functions such as manual data entry, offline device data import, push data to the cloud, or to other systems.
   b. The system shall include a mapping application for specifying log data file import-export mappings and import schedules to facilitate import/export in formats such as .CSV, .XML, etc.

4. Web application level integration.

   a. The system shall include:

      1) The capability to integrate other web applications into its web interface through the use of pluggable web content widgets.
      2) The capability to supply content such as dashboards, reports, trends and diagrams to other external web applications through addressable URLs.

5. Web services integration.

   a. The system shall include web services integration capabilities for machine-to-machine interactions with other application software systems with the following characteristics:

      1) Based on SOAP (Simple Object Access Protocol) protocol specification.
      2) Provide a Web Services Description Language (WSDL), machine-readable description.
      3) Allow access to real-time, historical (i.e., time stamped), and alarm/event type data.

4) Provide the ability to acknowledge alarms by authenticated and authorized clients.
5) Provide digest authentication functionality.
6) Provide the ability to be enabled or disabled.

H. The system shall support internationalization and regional settings for localization. The languages supported by default are: Chinese (Simplified), Chinese (Traditional), English, French, German, Italian, Russian, Spanish, Polish, Czech, and Japanese.

I. The EPMS shall support system configuration and advanced analysis tools in the following ways:

1. The system shall include a monitoring and analysis application with a rich set of power tools for water, air, gas, electric, and steam (WAGES) energy analysis, power quality analysis, power system monitoring and control, and include the following capabilities:

a. Auto-diagram creation capability to create a comprehensive set of linked hierarchical graphical diagrams showing devices and their associated device specific diagrams in the network.
b. Ability to import custom graphics or images to create electrical one-line diagrams, facility maps, plan views, floor layouts, equipment representations, and mimic displays.
c. Support for power quality analysis.

1) Plot PQ events on an ITIC/CBMEA curve or SEMI F47 curve.
2) Manual waveform capture.
3) Visualization or analysis tools for sinusoidal electrical waveforms including waveform overlay, zooming, and calculations for RMS, peak, delta, harmonics spectrum bar charts, and phasor diagrams.

2. Ability to write to device registers for applications such as resetting, triggering, toggling, switching, manual waveform capture, controlling remote devices and equipment, including breakers.
3. Ability to develop custom graphics screens and application logic programs with the devices being offline or disabled to allow for project development in disconnected mode.

J. The system communications infrastructure shall support the following:

1. Multiple communications network topologies including Ethernet/TCP, serial RS-485/RS-232, and Modem dial-up connections.
2. The capability to provide time-synchronization signals over an Ethernet network with 16ms accuracy or better.
3. The capability to communicate simultaneously with multiple devices, including devices on different physical communications channels.
4. Scalability to greater than a thousand devices.
5. The ability to automatically retrieve logged data (interval data, event data, and waveform data) from natively supported devices without additional configuration.
6. The ability to accept or reject duplicate data entries into the database.
7. The ability to schedule connection times for specific time-periods to conserve bandwidth.
8. The ability to automatically disconnect modem connections when all device data is database-synchronized (used to minimize long distance phone charges).

9. Support for modem pooling and assignment of communication sites to specific modems for communications optimization.

2.15 APPLICATIONS—POWER QUALITY MONITORING, COMPLIANCE AND ANALYSIS

A. Power Quality Monitoring: The Energy and Power Management System (EPMS) software shall provide power quality specific screens and reports as follows.

1. Device Level Power quality summary screen—the data collected by any compliant PQ-capable metering device shall be summarized to show:

   a. Voltage disturbances, including the date and time of the last disturbance, the count of the number of transient events, and the count of the number of sag/swell events.
   b. Harmonic measurements, including a link to the harmonics log for the particular device. Additionally, there shall be a link to another screen that shall show the real-time Total Harmonic Distortion (THD) content and the maximum THD.
   c. Flicker measurements.
   d. Logged events, including a link to the event log for the particular device.
   e. Waveform logs, including a link for waveforms captured during transients and sag/swell events.
   f. Further detailed waveform analysis using a tool shall be provided.

2. System Level Power Quality summary screen—the power quality report shall display all power quality events collected in the EPMS for one or more measuring points for a given period of time.

   a. The report shall show a summary table of all the events in a given time period and provide the means to see further details (power quality details report) for any given event.
   b. The summary report shall contain a plot of the Information Technology Industry Council (ITI) (also known as ITIC or CBEMA) curve that displays the worst disturbance from each event listed in the summary table. The summary table shall contain the following components for each event:

      1) Event identifier.
      2) Source.
      3) Event timestamp.
      4) Phase identifier for the worst disturbance during this event (ex., "V1").
      5) Voltage magnitude for the worst disturbance during this event in % of nominal (for example, "68.80%")
      6) Voltage magnitude maximum and minimum on phases V1, V2 and V3 for the worst disturbance during this event in % of nominal.
      7) Duration for the worst disturbance during this event in seconds (for example, "0.084s").
      8) Disturbance type for the worst disturbance during this event (for example, "sag").
      9) ITI (ITIC, CBEMA) tolerance curve violations (for example, "outside tolerance").
      10) Link to the details report for this event.
      11) Link to waveform report for the worst disturbance during this event.

c. Each entry in the summary table shall include a link that provides further details for the given event. The details to be shown are:

1) Disturbance event timestamp.
2) Phase identifier.
3) Voltage magnitude in % of nominal (for example, "68.80%")
4) Voltage magnitude maximum and minimum on phase V1, V2 and V3 in percentage of nominal.
5) Duration in seconds.
6) Disturbance type.
7) ITI (CBEMA) tolerance curve violations (for example, "outside tolerance").
8) Link to waveform report.

d. Each entry in the summary table shall include a link that shows the waveforms of the given event (if any exist). The waveforms shown shall be for both the voltage and current readings of the measuring point.

3. One hundred (100)-millisecond Power Quality Report

a. This report shall display data recorded at 100 millisecond intervals, with a data table for the measured point and selected measurement containing columns labeled: Timestamp, Source Label, Measurement Label, Measurement Unit, and Data Value.

4. IEEE1159.3 Power Quality Data Interchange Format (PQDIF) Support.
5. The system shall provide a mechanism to export power quality data to the non-proprietary standard PQDIF format with support for the following default templates:

a. Flicker: Short-term and long-term flicker disturbance data on the voltage inputs.
b. Sag/Swell: Sag/swell disturbance data for voltage inputs, including minimum, maximum and average values.
c. Sag/Swell Waveforms: Waveform data for voltage sag/swell.
d. Steady-state: Steady-state (RMS) data for trending.
e. Steady-state Waveforms: Waveform data for steady-state data.

6. Disturbance Direction Detection

a. For power quality compliant devices, the system will indicate the direction of the disturbance within the electrical distribution system in event logs, with associated confidence or certainty rating (for example, “Upstream: Confidence Rating - High”, or “Downstream: Confidence Rating – Medium” etc.).

B. Power Quality Compliance Reporting:

1. EN50160 Edition 4 compliance report:

a. The EN50160 voltage characteristics of public distribution systems compliance report shall display a summary of EN50160 compliance for a set of measuring points in the system for a given time period for the following components:

1) Power frequency.

2) Supply voltage variations.
3) Flicker severity.
4) Supply voltage unbalance.
5) Harmonic voltage.
6) Inter-harmonic voltages.
7) Mains signaling voltages.
8) Interruptions of supply voltage.
9) Supply voltage dips and swells.

b. Additionally, the report shall allow for detailed drill-down for a given measuring point and measurement period.

2. IEC61000-4-30 report: The IEC61000-4-30 compliance report shall display a summary of the IEC61000-4-30 compliance for a set of measuring points in the system for a given period. The report shall:

a. Include the following IEC61000-4-30 components: frequency, supply voltage magnitude, flicker, supply voltage unbalance and supply voltage THD.
b. Provide a means to manually enter a baseline value for each component.
c. Display a series of trends for each component listed with each component's manually entered baseline.
d. Include a data table that displays all the power quality-related events for the given report period including voltage dips, voltage swells, and voltage interruptions.

3. IEEE 519 Harmonics Compliance report: The IEEE519 harmonics compliance report shall have the following capabilities:

a. Provide a mechanism to report on IEEE519 limits.
b. Provide a mechanism to report on user defined limits.
c. Ability to determine voltage and Isc/I-l ratio directly from the device, where Isc is the maximum short circuit current at the point of common coupling (PCC), and the I-l is the maximum fundamental frequency demand current.

4. For both individual and total harmonic voltage distortion, display the following:

a. The allowable IEEE519 limits.
b. The % time out of compliance.
c. The number of non-compliant three-second intervals.
d. The number of total measured intervals.
e. Number of missing or invalid intervals.
f. Compliance levels of Warning, Out of compliance, or Compliant.
g. A maximum value with a time-stamp of when that distortion was measured.

5. For both individual and total harmonic distortion for current, display all the values specified in the previous section for every range of harmonic orders.
6. For each phase, voltage, and current provide a graphical plot of THD versus time stamp. On the same plot, plot the allowable limit to allow for visual comparison of compliance.
7. Provide a graphical plot of "average value of voltage per harmonic" and "average value of current per harmonic" as a percentage of fundamental frequency, versus harmonic order to allow for visual identification of the worst harmonic problems.

8. For each phase voltage and current, provide a graphical plot of harmonic content versus time stamp with simultaneous plot lines for a set of harmonic orders (for example, h <= 11). This allows the user to identify the harmonic orders associated with the worst problems to enable mitigation measures such as active filtering.

C. Integration with Power Quality Mitigation Equipment:

1. The system shall natively support interfaces with power quality mitigation equipment for power factor correction, harmonic filtering, voltage sag mitigation (UPS), and transient protection to provide end-to-end solutions for monitoring, correction and optimization of power quality.

2.16 APPLICATIONS—ASSET AND CAPACITY MANAGEMENT

A. Equipment Capacity Planning (NEC 220.87 compliant) reporting shall meet the following criteria:

1. For each device, monitor maximum load and compare to equipment capacity to indicate the degree of equipment loading.
2. Highlight when a user configurable threshold (for example, 80%) is exceeded.
3. Provide the ability to report on all power distribution equipment such as automatic transfer switches, medium and low voltage switch gear, transformers, power distribution panels, uninterruptible power supply, etc.
4. Show the peak load provided by the transfer switch or other equipment during a time period and compare the peak load to equipment capacity.
5. Provide a summary of all transfer switches or equipment in a group or daily information for each piece of equipment in the group.

2.17 APPLICATIONS—ENERGY COST ALLOCATION

A. The Energy and Power Management System (EPMS) software shall include energy cost allocation and bill generation features designed for the following applications.

1. Internal Cost Allocation.
2. Tenant Bill Generation.
3. Utility Bill Verification (Shadow Bill Generation).

B. The EPMS cost allocation and bill generation features shall include:

1. Reporting on energy costs for all energy sources - WAGES (Water, Air, Gas, Electrical and Steam).
2. Aggregating energy costs up to any point in the organizational hierarchy, such as areas, departments, cost centers, tenants etc.
3. Configurable start and end dates for energy cost reporting.
4. Calculated apportionment by creating virtual measurements allocating percentages of physical meters, for example, 20% (Meter 2) + 80% (Meter 3).
5. Calculated net metering by creating summed or subtracted physical meters, for example, Meter 1 + Meter 2 – Meter 3.

6. Common area allocation to allocate calculated values to various entities in the organization hierarchy.
7. Allocation of cost by standard time intervals, such as daily, weekly, monthly, yearly, or by specified time intervals like production shift.
8. Data integrity checks including warnings for data gaps or duplicates.
9. Customization of energy cost reports to allow for custom logos and headers.

C. The EPMS shall include a rate engine with the following capabilities.

1. Pre-engineered rate files for common utility rate structures.
2. Support for rate schedule configuration and business logic through configuration files (no programming).
3. Support for common rate determinants including:

    a. Energy usage (kWh, kVARh, kVAh).
    b. Demand (kW, kVAR).
    c. Power factor penalties.
    d. Co-incident demand.
    e. Time of use rates (off-peak, on-peak, etc.).
    f. Seasonal rates (summer, winter, etc.).
    g. Daily charges.
    h. Tiered or block energy rates (kWh).
    i. Taxes.
    j. Dynamic rate formulas.

4. Web based interface for rate schedule editing.

D. The EPMS shall include the following user-configurable report templates to facilitate energy analysis.

1. Billing Report: Billing report for any entity in the hierarchy with:

    a. Configurable time-periods and rate structures.
    b. Itemized entries with each item in the rate structure and associated costs clearly specified.

2. Billing Summary Report: Billing Report for multiple entities in the hierarchy with

    a. Energy costs per entity represented as a subtotal section.
    b. Grand Total for all entities.

3. Multiple Billing Report: Billing Report for multiple entities in the hierarchy with:

    a. Each individual entity represented as a distinct section.
    b. Itemized entries with each item in the rate structure and associated costs clearly specified.

E. The EPMS will support customizing the cost allocation reporting to different environments such as:

1. Industrial Environment:

a. Energy cost while in operation versus shut down, by shift etc.
b. Energy cost per unit of production.

2. Building Environment:

a. Energy cost while building occupied versus empty.
b. Energy cost per occupant.

3. Data Centers:

a. Energy cost by colocation tenant.
b. Energy cost by PDU, rack etc.

4. Provide above comparisons in graphical format such as bar and pie charts.

F. The EPMS shall have the capability of exporting energy cost data, along with pertinent metadata, to integrate with external billing systems. The export mechanisms must be flexible with

1. Support for common data file formats such as xml, csv and multiple files.
2. Support for XSLT transformations to customize format to match systems for billing, accounting, SAP, ERP etc.

PART 3 - EXECUTION

3.1 SERVICES—INSTALLATION AND COMMISSIONING

A. Installation.

1. System components, including meters, electronic trip units, sensors, motor protection devices, relays, etc. included within power equipment line ups, shall be factory installed, wired, and tested prior to shipment to the job site.
2. All control power, CT, PT, and data communications wiring shall be factory wired and harnessed within the equipment enclosure.
3. Where external circuit connections are required, terminal blocks shall be provided with manufacturer drawings clearly identifying any interconnection requirements and wire types.
4. All external wiring required to connect equipment lineups shall be installed by the electrical contractor.
5. Contractor interconnection wiring requirements shall be clearly identified on the system drawings.
6. Vendor field technicians shall verify accuracy of installation prior to commissioning.

B. System Commissioning and Acceptance.

1. On-site commissioning shall be performed by factory trained personal who shall also use automated commissioning tools wherever metering equipment is involved to improve consistency and quality of commissioning for clients.
2. Central engineering resources in conjunction with onsite factory trained personal shall be involved in preparing a client's system for startup.
3. If needed, a trained and certified project manager shall be provided during project installation and commissioning.
4. Engineering drawings shall be made available to the client for all EPMS projects.
5. On-site commissioning and initial user training of the EPMS shall be included in the project bid.
6. Commissioning shall include a detailed scope of work checklist document with delivered functionality listed and checked.
7. Commissioning shall include a full working demonstration of the system under normal operating conditions and simulated scenarios.
8. For control applications such as automatic transfer, commissioning shall include a thorough verification of the approved sequence of operation in both manual and automatic modes. Testing of source outage and breaker exercising shall be included in test procedures.
9. For control applications, such as automatic transfer, source interruptions are necessary. The owner must schedule appropriate times for such commissioning, and must plan for time (typically a day) for system pre-testing and a day for acceptance testing. Weekends are preferred due to minimized impact on operations.

3.2 SERVICES—TECHNICAL SUPPORT

A. The vendor shall have capabilities to deliver a full suite of ongoing technical support services to optimize and tune performance of the Energy and Power Management System (EPMS). Services shall include but not be limited to the following:

1. Basic product support via telephone and email during regular business hours to provide technical guidance, incident diagnosis, basic troubleshooting, and "how-to" instructions to operate installed software and hardware.
2. Fully staffed technical support teams for advanced problem escalation.
3. Troubleshooting using remote connectivity to the customer system.
4. Self-help web portal access to service packs and knowledge base detailing technical best practices and product details.
5. On-demand self-paced training with energy management, metering infrastructure, and power quality content modules.
6. Reserved support engineer as a "single point of contact" for customer support (when specified).
7. Emergency after-hours support with guaranteed response within two hours (when specified).
8. Software Assurance including service packs and upgrade licenses for installed EPMS software (upgrade-commissioning-services when specified).
9. Power Analysis Diagnostic Report including results of remote diagnostics to assess EPMS system health including configuration, data accuracy, and communications infrastructure.

10. Periodic monitoring of EPMS server and software to proactively alert for system problems.
11. Onsite maintenance including system repairs, database maintenance, firmware upgrades, and software installations.

3.3 SERVICES—TRAINING

A. The vendor shall have capabilities to deliver a full suite of training solutions focused on the operation, maintenance, and optimization of the customer's EPMS system. These training solutions shall address both initial and ongoing training needs for the customer and shall include the following:

1. Training delivered by experienced instructors with direct experience with the installed equipment and teaching proficiency.
2. Majority of the training is hands-on (up to 80%) with the equipment. Each student has access to their own mini power monitoring system through an electrical metering demo case, Ethernet communications, and laptop running applicable metering software, or through a virtual server if attending remotely (not applicable for self-paced on-demand training).
3. Training manuals including agenda, defined objectives for each lesson, detailed content organized by lesson, and descriptive labs to complete hands-on exercises shall be provided.
4. Training content (depending on class) will cover functionality and operation of electric meters, definition and use of various metering data (such as energy, demand, power factor, load profile, time of use, KYZ, etc.), communication methods applied in various design topologies, and capabilities and operation of applicable software.

B. Training options may include but are not limited to:

1. Self-paced on- demand training on energy management, metering infrastructure, and power quality.
2. Hands-on training at client’s site using metering and communications hardware, equipment and relevant software to implement, operate and maintain the power monitoring system.
3. Instructor led remote web based training with real time interaction with trainer and hands on training using virtual servers to perform labs and exercises.
4. At Schneider facility, hands-on training on how to design, implement, and operate the EPMS system.
5. Video recording services to complement custom client onsite training with professional post-production services to provide the customer with a professional customized training DVD.

C. Four hours of onsite training to be provided.

END OF SECTION 260913

SECTION 260923 - LIGHTING CONTROL DEVICES

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. Standalone daylight-harvesting switching controls.
2. Indoor occupancy sensors.
3. Emergency shunt relays.

B. Related Requirements:

1. Section 262726 "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show installation details for occupancy and light-level sensors.

1. Interconnection diagrams showing field-installed wiring.
2. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of lighting control device to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 DAYLIGHT-HARVESTING SWITCHING CONTROLS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Lithonia Lighting; Acuity Brands Lighting, Inc.
2. Sensor Switch, Inc.
3. Watt Stopper.

B. Ceiling-Mounted Switching Controls: Solid-state, light-level sensor unit, with separate power pack (mounted on luminaire where applicable), to detect changes in indoor lighting levels that are perceived by the eye.

C. Electrical Components, Devices, and Accessories:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
3. Sensor Output: Contacts rated to operate the associated power pack, complying with UL 773A. Sensor is powered by the power pack.
4. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
5. General Space Sensors Light-Level Monitoring Range: 10 to 200 fc, with an adjustment for turn-on and turn-off levels within that range.
6. Atrium Space Sensors Light-Level Monitoring Range: 100 to 1000 fc, with an adjustment for turn-on and turn-off levels within that range.
7. Skylight Sensors Light-Level Monitoring Range: 1000 to 10,000 fc, with an adjustment for turn-on and turn-off levels within that range.
8. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling.
9. Set-Point Adjustment: Equip with deadband adjustment of 25, 50, and 75 percent above the "on" set point, or provide with separate adjustable "on" and "off" set points.
10. Test Mode: User selectable, overriding programmed time delay to allow settings check.
11. Control Load Status: User selectable to confirm that load wiring is correct.
12. Indicator: Two digital displays to indicate the beginning of on-off cycles.

2.2 DAYLIGHT-HARVESTING DIMMING CONTROLS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Lithonia Lighting; Acuity Brands Lighting, Inc.
2. Sensor Switch, Inc.
3. Watt Stopper.

B. System Description: Sensing daylight and electrical lighting levels, the system adjusts the indoor electrical lighting levels. As daylight increases, the lights are dimmed.

1. Lighting control set point is based on two lighting conditions:

a. When no daylight is present (target level).
b. When significant daylight is present.

2. System programming is done with two hand-held, remote-control tools.

a. Initial setup tool.
b. Tool for occupants to adjust the target levels by increasing the set point up to 25 percent, or by minimizing the electric lighting level.

C. Ceiling-Mounted Dimming Controls: Solid-state, light-level sensor unit, with separate controller unit, to detect changes in lighting levels that are perceived by the eye.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Sensor Output: 0- to 10-V dc to operate electronic dimming ballasts. Sensor is powered by controller unit.
3. Power Pack: Sensor has 24-V dc, Class 2 power source, as defined by NFPA 70.
4. Light-Level Sensor Set-Point Adjustment Range: 20 to 60 fc.

2.3 INDOOR OCCUPANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Lithonia Lighting; Acuity Brands Lighting, Inc.
2. Sensor Switch, Inc.
3. Watt Stopper.

B. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensors with a separate power pack.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
4. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
5. Mounting:

a. Sensor: Suitable for mounting in any position on a standard outlet box.

b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

6. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
7. Bypass Switch: Override the "on" function in case of sensor failure.
8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.

C. PIR Type: Ceiling mounted; detect occupants in coverage area by their heat and movement.

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.

D. Ultrasonic Type: Ceiling mounted; detect occupants in coverage area through pattern changes of reflected ultrasonic energy.

1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. when mounted on a 96-inch- high ceiling.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.
4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 96-inch- high ceiling.
5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet when mounted on a 10-foot- high ceiling in a corridor not wider than 14 feet.

E. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.

2.4 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Lithonia Lighting; Acuity Brands Lighting, Inc.
2. Sensor Switch, Inc.
3. Watt Stopper.

B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang switchbox.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
3. Switch Rating: Not less than 800-VA fluorescent at 120 V, 1200-VA fluorescent at 277 V, and 800-W incandescent.

C. Wall-Switch Sensor:

1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 900 sq. ft..
2. Sensing Technology: Dual technology - PIR and ultrasonic.
3. Switch Type: SP, field selectable automatic "on," or manual "on" automatic "off."
4. Voltage: 120 V; dual-technology type.
5. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
6. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
7. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.

2.5 EMERGENCY SHUNT RELAY

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Lithonia Lighting; Acuity Brands Lighting, Inc.
2. Lighting Control and Design.
3. Watt Stopper.

B. Description: Normally closed, electrically held relay, arranged for wiring in parallel with manual or automatic switching contacts; complying with UL 924.

1. Coil Rating: 120 V.

2.6 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multi-conductor cable with stranded-copper conductors not smaller than No. 24 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multi-conductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.

B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 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 Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.

B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."

1. Identify controlled circuits in lighting contactors.
2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate lighting control devices and perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Lighting control devices will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.6 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.

3.7 DEMONSTRATION

A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control systems.

B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. Two hour of onsite training to be provided.

END OF SECTION 260923

SECTION 260936 - MODULAR DIMMING CONTROLS

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. This Section includes the following:

1. Manual modular dimming controls.
2. Integrated, multipreset modular dimming controls.

1.3 DEFINITIONS

A. Fade Rate: The time it takes each zone to arrive at the next scene, dependent on the degree of change in lighting level.

B. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling and power-limited circuits.

C. Scene: The lighting effect created by adjusting several zones of lighting to the desired intensity.

D. SCR: Silicon-controlled rectifier.

E. Zone: A fixture or group of fixtures controlled simultaneously as a single entity. Also known as a "channel."

1.4 ACTION SUBMITTALS

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

1. For modular dimming controls; include elevation, dimensions, features, characteristics, ratings, and labels.
2. Device plates and plate color and material.
3. Driver and lamp combinations compatible with dimmers.
4. Wiring Diagrams: Power, signal, and control wiring.

B. Samples for Verification: For master and remote-control stations, and faceplates with factory-applied color finishes and technical features.

1.5 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.

1.6 COORDINATION

A. Coordinate features of devices specified in this Section with systems and components specified in other Sections to form an integrated system of compatible components. Match components and interconnections for optimum performance of specified functions. Include coordination with the following:

1. Division 26 Section "Lighting Control Devices."

PART 2 - PRODUCTS

2.1 GENERAL DIMMING DEVICE REQUIREMENTS

A. Compatibility: Dimming control components shall be compatible with other elements of lighting fixtures, drivers, ballasts, transformers, and lighting controls.

B. Dimmers and Dimmer Modules: Comply with UL 508.

1. Audible Noise and Radio-Frequency Interference Suppression: Solid-state dimmers shall operate smoothly over their operating ranges without audible lamp or dimmer noise or radio-frequency interference. Modules shall include integral or external filters to suppress audible noise and radio-frequency interference.
2. Dimmer or Dimmer-Module Rating: Not less than 125 percent of connected load unless otherwise indicated.

2.2 MANUAL MODULAR MULTISCENE DIMMING CONTROLS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or a comparable product by one of the following:

1. Lithonia Lighting; Acuity Brands Lighting, Inc.
2. Sensor Switch, Inc.
3. Lutron Electronics, Inc.
4. Watt Stopper.

B. Description: Factory-fabricated equipment providing manual modular dimming control consisting of a wall-box-mounted, master-scene controller and indicated number of wall-box zone stations. Controls and dimmers shall be integrated for mounting in one-, two-, or three-gang wall box under a single wall plate. Each zone station shall be adjustable to indicated number of scenes, which shall be recorded on the zone controller.

C. Operation: Automatically change variable dimmer settings of indicated number of zones simultaneously from one preset scene to another when a push button is operated.

D. Each manual modular multiscene dimming controller shall include a master control and remote controls.

E. Each zone shall be configurable to control the following:

1. LED drivers.

F. Memory: Retain preset scenes through power failures for at least seven days.

G. Device Plates: Style, material, and color shall comply with Division 26 Section "Wiring Devices."

H. Master-Scene Controller: Suitable for mounting in a single flush wall box.

1. Switches: Master off, group dim, group bright, and selectors for each scene.
2. LED indicator lights, one associated with each scene switch, and one for the master off switch.

I. Zone Dimmer: Suitable for operating lighting fixtures and drivers specified in Division 26 Section "LED Interior Lighting," and arranged to dim number of scenes indicated for the master-scene controller. Scene selection is at the master-scene controller for setting light levels of each zone associated with scene.

1. Switch: Rocker or Slider style for setting the light level for each scene.
2. LED indicator lights, one associated with each scene.
3. Electrical Rating: 1000 VA, 120 V.

2.3 CONDUCTORS AND CABLES

A. 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. Class 2 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 24 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 WIRING INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 1/2 inch.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and non-power-limited conductors according to conductor manufacturer's written instructions.

D. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.2 IDENTIFICATION

A. Comply with requirements in Division 26 Section "Identification for Electrical Systems" for identifying components and power and control wiring.

B. Label each dimmer module with a unique designation.

C. Label each scene control button with approved scene description.

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 installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Continuity tests of circuits.

2. Operational Test: Set and operate controls to demonstrate their functions and capabilities in a methodical sequence that cues and reproduces actual operating functions.

    a. Include testing of modular dimming control equipment under conditions that simulate actual operational conditions. Record control settings, operations, cues, and functional observations.

D. Remove and replace malfunctioning modular dimming control components and retest as specified above.

E. Test Labeling: After satisfactory completion of tests and inspections, apply a label to tested components indicating test results, date, and responsible agency and representative.

F. Reports: Written reports of tests and observations. Record defective materials and workmanship and unsatisfactory test results. Record repairs and adjustments.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain modular dimming controls. One hour of onsite training to be provided.

B. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control system.

END OF SECTION 260936

SECTION 262416 - PANELBOARDS

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. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.
3. Electronic-grade panelboards.

1.3 DEFINITIONS

A. ATS: Acceptance testing specification.

B. GFCI: Ground-fault circuit interrupter.

C. GFEP: Ground-fault equipment protection.

D. HID: High-intensity discharge.

E. MCCB: Molded-case circuit breaker.

F. SPD: Surge protective device.

G. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of panelboard.

1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details.

2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
4. Detail bus configuration, current, and voltage ratings.
5. Short-circuit current rating of panelboards and overcurrent protective devices.
6. Series rated devices are not allowed.
7. Include evidence of NRTL listing for SPD as installed in panelboard (where available).
8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
9. Include wiring diagrams for power, signal, and control wiring.
10. Key interlock scheme drawing and sequence of operations.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: Two spares for each type of panelboard cabinet lock.
2. Circuit Breakers Including GFCI and GFEP Types: Two spares for each panelboard.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: ISO 9001 or 9002 certified.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NECA 407 and NEMA PB 1.

1.10 FIELD CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

a. Ambient Temperature: Not exceeding 23 deg F to plus 104 deg F.
b. Altitude: Not exceeding 6600 feet.

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet.

C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without Owner's written permission.
3. Comply with NFPA 70E.

1.11 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.

1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace SPD that fails in materials or workmanship within specified warranty period.

1. SPD Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS COMMON REQUIREMENTS

A. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

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

C. Comply with NEMA PB 1.

D. Comply with NFPA 70.

E. Enclosures: Surface-mounted, dead-front cabinets.

1. Rated for environmental conditions at installed location.

    a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
    b. Outdoor Locations: NEMA 250, Type 3R.
    c. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

2. Height: 84 inches maximum.
3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
4. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
5. Finishes:

    a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    b. Back Boxes: Galvanized steel.

F. Incoming Mains:

1. Location: Convertible between top and bottom.
2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.

G. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.

    a. Plating shall run entire length of bus.
    b. Bus shall be fully rated the entire length.

2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.

3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
4. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
5. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.
6. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and listed and labeled by an NRTL acceptable to authority having jurisdiction, as suitable for nonlinear loads in electronic-grade panelboards and others designated on Drawings. Connectors shall be sized for double-sized or parallel conductors as indicated on Drawings. Do not mount neutral bus in gutter.

H. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Terminations shall allow use of 75 deg C rated conductors without derating.
3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
4. Main and Neutral Lugs: Compression or Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
5. Ground Lugs and Bus-Configured Terminators: Compression or Mechanical type, with a lug on the bar for each pole in the panelboard.
6. Feed-Through Lugs: Compression or Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
7. Subfeed (Double) Lugs: Compression or Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
8. Gutter-Tap Lugs: Compression or Mechanical type suitable for use with conductor material and with matching insulating covers. Locate at same end of bus as incoming lugs or main device.
9. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.

I. NRTL Label: Panelboards shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.

J. Future Devices: Panelboards shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

K. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.

2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

2.2 PERFORMANCE REQUIREMENTS

A. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 2.

2.3 POWER PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Square D; by Schneider Electric. (Basis of Design)
2. Eaton.
3. General Electric Company; GE Energy Management - Electrical Distribution.

B. Panelboards: NEMA PB 1, distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches high, provide two latches, keyed alike.

D. Mains: Circuit breaker or Lugs only as indicated on the 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.

G. Contactors in Main Bus: NEMA ICS 2, Class A, electrically or mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.

1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Square D; by Schneider Electric.
2. Eaton.
3. General Electric Company; GE Energy Management - Electrical Distribution.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker or lugs only as indicated on Drawings.

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 or mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.

1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.

F. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.

2.5 ELECTRONIC-GRADE PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Square D; by Schneider Electric. (Basis of Design).
2. Eaton.
3. General Electric Company; GE Energy Management - Electrical Distribution.

B. Panelboards: NEMA PB 1; with factory-installed, integral SPD; labeled by an NRTL for compliance with UL 67 and UL 1449 after installing SPD.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

D. Main Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers.

E. Branch Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers.

F. SPD.

1. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 100 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.
2. Protection modes and UL 1449 VPR for grounded wye circuits with 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:

a. Line to Neutral: 700 V for 208Y/120 V.
b. Line to Ground: 700 V for 208Y/120 V.
c. Neutral to Ground: 700 V for 208Y/120 V.
d. Line to Line: 1200 V for 208Y/120 V.

3. Protection modes and UL 1449 VPR for 240/120-V, single-phase, three-wire circuits shall not exceed the following:

    a. Line to Neutral: 700 V.
    b. Line to Ground: 700 V.
    c. Neutral to Ground: 700 V.
    d. Line to Line: 1200 V.

4. SCCR: Equal to the SCCR of the panelboard in which installed or exceed 100 kA.
5. Inominal Rating: 20 kA.

G. Buses:

1. Copper phase and neutral buses; 200 percent capacity neutral bus and lugs.
2. Copper equipment and isolated ground buses.

2.6 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Square D; by Schneider Electric.
2. Eaton.
3. General Electric Company; GE Energy Management - Electrical Distribution.

B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers:

    a. Inverse time-current element for low-level overloads.
    b. Instantaneous magnetic trip element for short circuits.
    c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic Trip Circuit Breakers:

    a. RMS sensing.
    b. Field-replaceable rating plug or electronic trip.
    c. Digital display of settings, trip targets, and indicated metering displays.
    d. Multi-button keypad to access programmable functions and monitored data.
    e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
    f. Integral test jack for connection to portable test set or laptop computer.
    g. Field-Adjustable Settings:

        1) Instantaneous trip.
        2) Long- and short-time pickup levels.
        3) Long and short time adjustments.
        4) Ground-fault pickup level, time delay, and I squared T response.

4. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
5. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
6. Subfeed Circuit Breakers: Vertically mounted.
7. MCCB Features and Accessories:

    a. Standard frame sizes, trip ratings, and number of poles.
    b. Breaker handle indicates tripped status.
    c. UL listed for reverse connection without restrictive line or load ratings.
    d. Lugs: Compression or Mechanical style, suitable for number, size, trip ratings, and conductor materials.
    e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
    f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    g. Communication Capability: Integral communication module with functions and features compatible with power monitoring and control system specified in Section 260913 "Electrical Power Monitoring and Control."
    h. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
    i. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
    j. Rating Plugs: Three-pole breakers with ampere ratings greater than 150 amperes shall have interchangeable rating plugs or electronic adjustable trip units.
    k. Auxiliary Contacts: One, SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
    l. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
    m. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
    n. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices.
    o. Multipole units enclosed in a single housing with a single handle.
    p. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
    q. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

2.7 IDENTIFICATION

A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.

B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.

C. Circuit Directory: Directory card inside panelboard door, mounted in metal frame with transparent protective cover.

1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

D. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.

1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

2.8 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.

B. Receive, inspect, handle, and store panelboards according to NECA 407 and NEMA PB 1.1.

C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.

D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Comply with NECA 1.

C. Install panelboards and accessories according to NECA 407 and NEMA PB 1.1.

D. Equipment Mounting:

1. Attach panelboard to the vertical finished or structural surface behind the panelboard.

E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

F. Mount top of trim 78 inches above finished floor unless otherwise indicated.

G. Mount panelboard cabinet plumb and rigid without distortion of box.

H. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

I. Mounting panelboards with space behind is recommended for damp, wet, or dirty locations. The steel slotted supports in the following paragraph provide an even mounting surface and the recommended space behind to prevent moisture or dirt collection.

J. Mount surface-mounted panelboards to steel slotted supports 5/8 inch or 1 1/4 inch in depth as necessary based on panel being installed. Orient steel slotted supports vertically.

K. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.
2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.

L. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.

M. Install filler plates in unused spaces.

N. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.

O. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

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 for low-voltage air circuit breakers and low-voltage surge arrestors stated in NETA ATS, Paragraph 7.6 Circuit Breakers and Paragraph 7.19.1 Surge Arrestors, Low-Voltage. Perform optional tests. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:

    a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
    b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
    c. Instruments and Equipment:

        1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

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, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Overcurrent Protective Device Coordination Study."

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.

1. Measure loads during period of normal facility operations.
2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.

3.6 PROTECTION

A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 262416

SECTION 262713 - ELECTRICITY METERING

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 electricity metering.

1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of meter.
2. For metering infrastructure components.
3. For metering software.

B. Shop Drawings: For electricity-metering equipment.

1. Include elevation views of front panels of control and indicating devices and control stations.
2. Include diagrams for power, signal, and control wiring.
3. Wire Termination Diagrams and Schedules: Include diagrams for power, signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features. Differentiate between manufacturer-installed and field-installed wiring.
4. Include series-combination rating data for modular meter centers with main disconnect device.
5. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices used. Describe characteristics of network and other data communication lines.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Submit evidence that meters are compatible with connected monitoring and control devices and systems specified in Section 260913 "Electrical Power Monitoring and Control."

1. Show interconnecting signal and control wiring, and interface devices to show compatibility of meters.
2. For reporting and billing interfaces and adapters, list network protocols and provide statements from manufacturers that input and output devices comply with interoperability requirements of the protocol.

B. Qualification Data: For testing agency.

C. Field quality-control reports.

D. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Application and operating software documentation.
2. Software licenses.
3. Software service agreement.
4. Device address list.
5. Hard copies of manufacturer's operating specifications, user's guides for software and hardware, and PDF files on a USB storage device of hard-copy Submittal.
6. Meter data sheet for each meter, listing nameplate data and serial number, accuracy certification, and test results.
7. Meter installation and billing software startup report.

1.6 FIELD CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Owner shall be notified and issued written permission no fewer than two days in advance of proposed interruption of electrical service.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: An NRTL.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of metering equipment that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Damage from transient voltage surges.

2. Warranty Period: Cost to repair or replace any parts for two years from date of Substantial Completion.
3. Extended Warranty Period: Cost of replacement parts (materials only, f.o.b. the nearest shipping point to Project site), for five years, that failed in service due to transient voltage surges.

1.9 COORDINATION

A. Electrical Service Connections:

1. Coordinate with utility companies and utility-furnished components.

a. Comply with requirements of utility providing electrical power services.
b. Coordinate installation and connection of utilities and services, including provision for electricity-metering components.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

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

B. Comply with UL 916.

2.2 UTILITY METERING INFRASTRUCTURE

A. Install metering accessories furnished by the utility company, complying with its requirements.

B. Meter Sockets:

1. Comply with requirements of electrical-power utility company.
2. Meter Sockets: Steady-state and short-circuit current ratings shall meet indicated circuit ratings.

C. Arc-Flash Warning Labels:

1. Labels: Comply with requirements for "Arc-Flash Warning Labels" in Section 260574 "Overcurrent Protective Device Arc-Flash Study." Apply a 3-1/2-by-5-inch thermal transfer label of high-adhesion polyester for each work location included in the analysis.
2. Labels: Comply with requirements for "Self-Adhesive Equipment Labels" and "Signs" in Section 260553 "Identification for Electrical Systems." Apply a 3-1/2-by-5-inch thermal transfer label of high-adhesion polyester for each work location included in the analysis. Labels shall be machine printed, with no field-applied markings.

    a. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:

        1) Location designation.
        2) Nominal voltage.
        3) Flash protection boundary.
        4) Hazard risk category.
        5) Incident energy.
        6) Working distance.
        7) Engineering report number, revision number, and issue date.

2.3 ELECTRICITY METERS

A. System Description: Able to meter designated activity loads, with or without external alarm, control, and communication capabilities, or other optional features.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Square D; by Schneider Electric – Power Logic PM5000 Series (Basis of Design).
2. Eaton.
3. General Electric Company.

C. General Requirements for Meters:

1. Billing Meters Accuracy: 0.2 percent of reading, complying with ANSI C12.20.
2. Certify that meters comply with ANSI C12.20 requirements by a laboratory accredited by the National Voluntary Laboratory Accreditation Program (NVLAP) of the National Institute of Standards and Technology (NIST). The laboratory shall use test equipment that is certified annually and is traceable to NIST standards.
3. Enclosure: Supplied by meter manufacturer, NEMA 250, Type 1 minimum, with provisions for locking or sealing.
4. Identification: Comply with requirements in Section 260553 "Identification for Electrical Systems."
5. Onboard Nonvolatile Data Storage: kWh, until reset.

6. Sensors: Current-sensing type, supplied by electronic meter manufacturer, with current or voltage output, selected for optimum range and accuracy for meters indicated for this application.

    a. Type: solid core, complying with recommendation of meter manufacturer.

D. kWh Meter: Electronic three-phase meters, measuring electricity use.

1. Voltage and Phase Configuration: Meter shall be designed for use on circuits with voltage rating and phase configuration indicated for its application.
2. Display: LCD with characters not less than 0.25 inch high, indicating accumulative kWh and current kilowatt load. Retain accumulated kWh in a nonvolatile memory, until reset.
3. Display: Digital electromechanical counter, indicating accumulative kWh.

E. kWhd Meter: Electronic three-phase meters, measuring electricity use and demand. Demand shall be integrated over a 15-minute interval.

1. Voltage and Phase Configuration: Meter shall be designed for use on circuits with voltage rating and phase configuration indicated for its application.
2. Display: LCD with characters not less than 0.25 inch high, indicating the following:

    a. Accumulative kWh.
    b. Current time and date.
    c. Current demand.
    d. Historic peak demand.
    e. Time and date of historic peak demand.

3. Retain accumulated kWh and historic peak demand in a nonvolatile memory, until reset.

F. Remote Reading Options:

1. Serial Interface: RS-232.
2. Serial Interface: RS-485, with Modbus RTU protocol.
3. USB interface.
4. TCP/IP adapter.

G. Data Transmission Cable: Comply with requirements in Section 271519 "Data Communications Horizontal Cabling."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with equipment installation requirements in NECA 1.

B. Install raceways and equipment according to utility company's written instructions. Provide empty conduits for metering leads and extend grounding connections as required by utility company.

C. Install arc-flash labels as required by NFPA 70.

D. Wiring Method:

1. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
2. Install unshielded, twisted-pair cable for control and signal transmission conductors, complying with Section 271519 "Data Communications Horizontal Cabling."
3. Minimum conduit size shall be 1 inch.

3.2 IDENTIFICATION

A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

1. Series Combination Warning Label: Self-adhesive labels, with text as required by NFPA 70.
2. Equipment Identification Labels: Self-adhesive labels with clear protective overlay. For residential meters, provide an additional card holder suitable for printed, weather-resistant card with occupant's name.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections with the assistance of a factory-authorized service representative.

E. Tests and Inspections:

1. Equipment and Software Setup:

a. Set meter date and time clock.
b. Test, calibrate, and connect pulse metering system.
c. Set and verify billing demand interval for demand meters.
d. Report settings and calibration results.
e. Set up reporting and billing software, insert billing location names and initial constant values and variable needed for billing computations.

2. Connect a load of known kilowatt rating, 1.5 kW minimum, to a circuit supplied by metered feeder.
3. Turn off circuits supplied by metered feeder and secure them in off condition.
4. Run test load continuously for eight hours minimum, or longer, to obtain a measurable meter indication. Use test-load placement and setting that ensures continuous, safe operation.

5. Check and record meter reading at end of test period and compare with actual electricity used, based on test-load rating, duration of test, and sample measurements of supply voltage at test-load connection. Record test results.
6. Generate test report and billing for each tenant or activity from the meter reading tests.

F. Electricity metering will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

3.4 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.

B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's clerical and maintenance personnel to use, adjust, operate, and maintain the electronic metering and billing software.

END OF SECTION 262713

SECTION 262726 - WIRING DEVICES

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. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Twist-locking receptacles.
3. Isolated-ground receptacles.
4. Tamper-resistant receptacles.
5. Weather-resistant receptacles.
6. Snap switches.
7. Wall-switch and exterior occupancy sensors.
8. Communications outlets.
9. Pendant cord-connector devices.
10. Cord and plug sets.
11. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-frequency interference.

E. TVSS: Transient voltage surge suppressor.

F. UTP: Unshielded twisted pair.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Receptacles for Owner-Furnished Equipment: Match plug configurations.
2. Cord and Plug Sets: Match equipment requirements.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Samples: One for each type of device and wall plate specified, in each color specified.

1.6 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hubbell Incorporated; Wiring Device-Kellems.
2. Leviton Manufacturing Co., Inc.
3. Pass & Seymour/Legrand (Pass & Seymour).

B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

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

B. Comply with NFPA 70.

C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
2. Devices shall comply with the requirements in this Section.

2.3 STRAIGHT-BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Hubbell Incorporated; Wiring Device-Kellems.
    b. Leviton Manufacturing Co., Inc.
    c. Pass & Seymour/Legrand (Pass & Seymour).

B. Isolated-Ground, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Hubbell Incorporated; Wiring Device-Kellems.
    b. Leviton Manufacturing Co., Inc.
    c. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Straight blade; equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

C. Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, and FS W-C-596.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Hubbell Incorporated; Wiring Device-Kellems.
    b. Leviton Manufacturing Co., Inc.
    c. Pass & Seymour/Legrand (Pass & Seymour).

2.4 GFCI RECEPTACLES

A. General Description:

1. Straight blade, non-feed-through type.
2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hubbell Incorporated; Wiring Device-Kellems.
b. Leviton Manufacturing Co., Inc.
c. Pass & Seymour/Legrand (Pass & Seymour).

C. Tamper-Resistant GFCI Convenience Receptacles, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hubbell Incorporated; Wiring Device-Kellems.
b. Leviton Manufacturing Co, Inc.
c. Pass & Seymour/Legrand (Pass & Seymour).

2.5 PENDANT CORD-CONNECTOR DEVICES

A. Description:

1. Matching, locking-type plug and receptacle body connector.
2. NEMA WD 6 Configurations L5-20P and L5-20R, heavy-duty grade, and FS W-C-596.
3. Body: Nylon, with screw-open, cable-gripping jaws and provision for attaching external cable grip.
4. External Cable Grip: Woven wire-mesh type made of high-strength, galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.6 CORD AND PLUG SETS

A. Description:

1. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
2. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.
3. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.7 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A:

1. Single Pole:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Hubbell Incorporated; Wiring Device-Kellems.
2) Leviton Manufacturing Co., Inc.
3) Pass & Seymour/Legrand (Pass & Seymour).

2. Two Pole:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Hubbell Incorporated; Wiring Device-Kellems.
2) Leviton Manufacturing Co., Inc.
3) Pass & Seymour/Legrand (Pass & Seymour).

3. Three Way:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Hubbell Incorporated; Wiring Device-Kellems.
2) Leviton Manufacturing Co., Inc.
3) Pass & Seymour/Legrand (Pass & Seymour).

4. Four Way:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Hubbell Incorporated; Wiring Device-Kellems.
2) Leviton Manufacturing Co., Inc.
3) Pass & Seymour/Legrand (Pass & Seymour).

2.8 WALL PLATES

A. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: 0.035-inch- thick, satin-finished, Type 302 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 and damp locations.

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

2.9 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: Rectangular, 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: Two modular, keyed, color-coded, RJ-45 jacks for UTP cable complying with requirements in Section 271519 "Data Communications Horizontal Cabling."

2.10 POKE-THROUGH ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hubbell Incorporated; Wiring Device-Kellems.
2. Wiremold / Legrand.

B. Description:

1. Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.
2. Comply with UL 514 scrub water exclusion requirements.
3. Service-Outlet Assembly: Flush type with two simplex receptacles and space for two RJ-45 jacks complying with requirements in Section 271519 "Data Communications Horizontal Cabling."
4. Size: Selected to fit nominal 3-inch cored holes in floor and matched to floor thickness.
5. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
6. Closure Plug: Arranged to close unused 3-inch cored openings and reestablish fire rating of floor.
7. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of two, four-pair cables that comply with requirements in Section 271519 "Data Communications Horizontal Cabling."

2.11 FINISHES

A. Device Color:

1. Wiring Devices Connected to Normal Power System: Gray unless otherwise indicated or required by NFPA 70 or device listing.
2. Isolated-Ground Receptacles: Orange.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
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 devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.

9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

H. Adjust locations of floor service outlets to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

A. Install non-feed-through-type GFCI receptacles.

3.3 IDENTIFICATION

A. Comply with Section 260553 "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display 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 unacceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

C. Wiring device will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 262726

SECTION 262813 - FUSES

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. Cartridge fuses rated 600-V ac and less for use in control circuits enclosed switches enclosed controllers.
2. Spare-fuse cabinets.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.

    a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
    b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
3. Current-limitation curves for fuses with current-limiting characteristics.
4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
5. Coordination charts and tables and related data.
6. Fuse sizes for elevator feeders and elevator disconnect switches.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Ambient temperature adjustment information.
2. Current-limitation curves for fuses with current-limiting characteristics.
3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit on translucent log-log graph paper.
4. Coordination charts and tables and related data.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

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

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

1.7 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.8 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Bussmann, Inc.

2. Ferraz Shawmut, Inc.
3. Littelfuse, Inc.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

2.3 SPARE-FUSE CABINET

A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.

1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
2. Finish: Gray, baked enamel.
3. Identification: "SPARE FUSES" in 1-1/2-inch- high letters on exterior of door.
4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Cartridge Fuses:

1. Feeders: Class RK5, time delay.
2. Motor Branch Circuits: Class RK5, time delay.
3. Other Branch Circuits: Class RK5, time delay.
4. Control Circuits: Class CC, time delay.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

B. Install spare-fuse cabinet(s).

3.4 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Shunt trip switches.
3. Molded-case circuit breakers (MCCBs).
4. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Include evidence of NRTL listing for series rating of installed devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Field quality-control reports.

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

C. Manufacturer's field service report.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
2. Fuse Pullers: Two for each size and type.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

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

D. Comply with NFPA 70.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Owner no fewer than seven days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Owner's written permission.
4. Comply with NFPA 70E.

1.10 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. 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 – Basis of Design.
2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

C. Type HD, Heavy Duty, Single Throw, 240-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three 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; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
6. Lugs: Mechanical or Compression type, suitable for number, size, and conductor material.
7. Service-Rated Switches: Labeled for use as service equipment.
8. Accessory Control Power Voltage: Remote mounted and powered; 120-V ac or 208-V ac.

2.2 SHUNT TRIP SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Cooper Bussmann, Inc.
2. Ferraz Shawmut, Inc.
3. Littelfuse, Inc.

C. General Requirements: Comply with UL 50, and UL 98, with 200-kA interrupting and short-circuit current rating when fitted with Class J fuses.

D. Switches: Three-pole, horsepower rated, with integral shunt trip mechanism and Class J fuse block; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

E. Control Circuit: 120-V ac; obtained from integral control power transformer, with primary and secondary fuses, with a control power transformer of enough capacity to operate shunt trip, connected pilot, and indicating and control devices.

F. Accessories:

1. Oiltight key switch for key-to-test function.
2. Oiltight green ON pilot light.
3. Isolated neutral lug; 100 percent rating.

4. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
5. Form C alarm contacts that change state when switch is tripped.

2.3 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. 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.
2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

C. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

D. Thermal-Magnetic Circuit Breakers (less than 400 A): 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.

E. Electronic Trip Circuit Breakers (400 A and larger): Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Instantaneous trip.
2. Long- and short-time pickup levels.
3. Long- and short-time time adjustments.
4. Ground-fault pickup level, time delay, and I^2t response.

F. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

G. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).

H. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical or Compression type, suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.

6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
7. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
8. Alarm Switch: One NO or NC contact as required that operates only when circuit breaker has tripped.
9. Key Interlock Kit (where required): Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
10. Accessory Control Power Voltage: Integrally mounted, self-powered; 120-V or ac 208-V ac.

2.4 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

C. Install fuses in fusible devices.

D. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed switch and circuit breaker, 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.
3. Perform the following infrared scan tests and inspections and prepare reports:

    a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
    b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
    c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Overcurrent Protective Device Coordination Study."

END OF SECTION 262816

SECTION 265119 - LED INTERIOR LIGHTING

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. Interior solid-state luminaires that use LED technology.
2. Lighting fixture supports.

B. Related Requirements:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaires.

4. Include emergency lighting units, including batteries and chargers.
5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
6. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing and Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps and accessories identical to those indicated for the lighting fixture as applied in this Project, IES LM-79, and IES LM-80.

    a. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. LEED Submittals:

1. Product Data for Credit IEQ 4.2: For paints and coatings, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit IEQ 4.2: For paints and coatings, documentation indicating that products comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

D. Samples: For each luminaire and for each color and texture with standard factory-applied finish.

E. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Lighting luminaires.
2. Suspended ceiling components.
3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches of the plane of the luminaires.
4. Structural members to which equipment and/or luminaires will be attached.
5. Initial access modules for acoustical tile, including size and locations.
6. Items penetrating finished ceiling, including the following:

    a. Other luminaires.
    b. Air outlets and inlets.
    c. Speakers.

d. Sprinklers.
e. Access panels.
f. Ceiling-mounted projectors.

7. Moldings.
8. Conduit and Boxes.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

C. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Product Certificates: For each type of luminaire.

E. Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.

F. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.

B. Provide luminaires from a single manufacturer for each luminaire type.

C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.9 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

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

B. Recessed Fixtures: Comply with NEMA LE 4.

C. Bulb shape complying with ANSI C79.1.

D. Lamp base complying with ANSI C81.61.

E. CRI of minimum 80. CCT of 3500K.

F. Rated lamp life of 50,000 hours.

G. Lamps dimmable from 100 percent to 0 percent of maximum light output.

H. Internal driver.

I. Nominal Operating Voltage: 120 V ac.

1. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

2.2 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access: 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.

C. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:

a. "USE ONLY" and include specific lamp type.
b. Lamp diameter, shape, size, wattage, and coating.
c. CCT and CRI for all luminaires.

2.3 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.4 LUMINAIRE FIXTURE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage minimum.

D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.

E. Flush-Mounted Luminaire Support:

1. Secured to outlet box.
2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

F. Wall-Mounted Luminaire Support:

1. Attach per manufacturer’s instuctions.
2. Do not attach luminaires directly to gypsum board.

G. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

H. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

I. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

3.5 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to one visit to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

1. During adjustment visit, inspect all luminaires. Replace lamps or luminaires that are defective.
2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 265119

SECTION 265219 - EMERGENCY AND EXIT LIGHTING

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. Emergency lighting units.
2. Exit signs.
3. Luminaire supports.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Emergency Lighting Unit: A lighting unit with internal or external emergency battery powered supply and the means for controlling and charging the battery and unit operation.

D. Fixture: See "Luminaire" Paragraph.

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of emergency lighting unit, exit sign, and emergency lighting support.

1. Include data on features, accessories, and finishes.
2. Include physical description of the unit and dimensions.
3. Battery and charger for light units.
4. Include life, output of luminaire (lumens, CCT, and CRI), and energy-efficiency data.

5. Include photometric data and adjustment factors based on laboratory tests, complying with IES LM-45, for each luminaire type.

    a. Testing Agency Certified Data: For indicated luminaires and signs, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires and signs shall be certified by manufacturer.
    b. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Sustainable Design Submittals:

1. Product Data: Indicating luminaire is certified by ENERGY STAR.

D. Samples: For each product and for each color and texture specified.

E. Product Schedule:

1. For emergency lighting units. Use same designations indicated on Drawings.
2. For exit signs. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Luminaires.
2. Suspended ceiling components.
3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches of the plane of the luminaires.
4. Structural members to which equipment will be attached.
5. Size and location of initial access modules for acoustical tile.
6. Items penetrating finished ceiling including the following:

    a. Other luminaires.
    b. Air outlets and inlets.
    c. Speakers.
    d. Ceiling-mounted projectors.
    e. Sprinklers.
    f. Access panels.

7. Moldings.
8. Conduit and boxes.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

C. Product Certificates: For each type of luminaire.

D. Product Test Reports: For each luminaire for tests performed by manufacturer and witnessed by a qualified testing agency.

E. Sample Warranty: For manufacturer's warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in emergency, operation, and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.9 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two year(s) from date of Substantial Completion.

B. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Emergency Power Unit Batteries: Five years from date of Substantial Completion. Full warranty shall apply for first year and prorated warranty for the remaining four years.

2. Warranty Period for Self-Powered Exit Sign Batteries: Five years from date of Substantial Completion. Full warranty shall apply for first year and prorated warranty for the remaining six years.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

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

B. NRTL Compliance: Fabricate and label emergency lighting units, exit signs, and batteries to comply with UL 924.

C. Comply with NFPA 70 and NFPA 101.

D. Comply with NEMA LE 4 for recessed luminaires.

E. Internal Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body and compatible with ballast.

1. Emergency Connection: Operate luminaire continuously at an output of 1100, or as otherwise specified on drawing, lumens each upon loss of normal power. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire ballast.
2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
3. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

    a. Ambient Temperature: Less than 0 deg F or exceeding 104 deg F, with an average value exceeding 95 deg F over a 24-hour period.
    b. Ambient Storage Temperature: Not less than minus 4 deg F and not exceeding 140 deg F.
    c. Humidity: More than 95 percent (condensing).
    d. Altitude: Exceeding 3300 feet.

4. Test Push-Button and Indicator Light: Visible and accessible without opening luminaire or entering ceiling space.

    a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

5. Battery: Sealed, maintenance-free, nickel-cadmium type.

6. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
7. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

F. External Type: Self-contained, modular, battery-inverter unit, suitable for powering one or more lamps, remote mounted from luminaire.

1. Emergency Connection: Operate one LED lamp continuously. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire driver.
2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
3. Nightlight Connection: Operate lamp in a remote luminaire continuously.
4. Battery: Sealed, maintenance-free, nickel-cadmium type.
5. Charger: Fully automatic, solid-state, constant-current type.
6. Housing: NEMA 250, Type 1 enclosure listed for installation inside, on top of, or remote from luminaire. Remote assembly shall be located no less than half the distance recommended by the emergency power unit manufacturer, whichever is less.
7. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
8. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
9. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.2 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access:

1. Smooth operating, free of light leakage under operating conditions.
2. Designed to permit relamping without use of tools.
3. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Conduit: Rigid galvanized steel, Electrical metallic tubing, or Flexible metallic conduit, minimum 3/4 inch in diameter. Conduit as noted on drawings.

2.3 METAL FINISHES

A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.4 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Support Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for conditions affecting performance of luminaires.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.

C. Examine walls, floors, roofs, and ceilings for suitable conditions where emergency lighting luminaires will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

3.5 STARTUP SERVICE

A. Perform startup service:

1. Charge emergency power units and batteries minimum of one hour and depress switch to conduct short-duration test.
2. Charge emergency power units and batteries minimum of 24 hours and conduct one-hour discharge test.

3.6 ADJUSTING

A. Adjustments: Within 12 months of date of Substantial Completion, provide on-site visit to do the following:

1. Inspect all luminaires. Replace all emergency power units, batteries, signs, or luminaires that are defective.

    a. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

2. Conduct short-duration tests on all emergency lighting.

END OF SECTION 265219

SECTION 265613 - LIGHTING POLES AND STANDARDS

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. Poles and accessories for support of luminaires.

1.3 DEFINITIONS

A. EPA: Equivalent projected area.

B. Luminaire: Complete lighting fixture.

C. Pole: Luminaire-supporting structure, including tower used for large-area illumination.

D. Standard: See "Pole."

1.4 ACTION SUBMITTALS

A. Product Data: For each pole, accessory and luminaire-supporting, arranged as indicated.

1. Include data on construction details, profiles, EPA, cable entrances, materials, dimensions, weight, rated design load, and ultimate strength of individual components.
2. Include finishes for lighting poles and luminaire-supporting devices.
3. Anchor bolts.

B. LEED Submittals:

1. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.
2. Certificates for Credit MR 6 or Credit MR 7: Chain-of-custody certificates indicating that poles and standards comply with forest certification and chain-of-custody requirements. Include statement indicating cost for each certified wood product.

C. Shop Drawings:

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Detail fabrication and assembly of poles and pole accessories.
4. Foundation construction details, including material descriptions, dimensions, anchor bolts, support devices, and calculations, signed and sealed by a professional engineer licensed in the state of installation.
5. Anchor bolt templates keyed to specific poles and certified by manufacturer.
6. Method and procedure of pole installation. Include manufacturer's written installations.

1.5 INFORMATIONAL SUBMITTALS

A. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements according to AASHTO LTS-6-M and that load imposed by luminaire and attachments has been included in design. The certification shall be based on design calculations signed and sealed by a professional engineer.

B. Material Test Reports:

1. For each foundation component, by a qualified testing agency.
2. For each pole, by a qualified testing agency.

C. Source quality-control reports.

D. Field quality-control reports.

E. Sample Warranty: Manufacturer's standard warranty.

F. Soil test reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For poles to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include pole inspection and repair procedures.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Pole repair materials.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for foundation testing.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store poles on decay-resistant skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.

B. Retain factory-applied pole wrappings on metal poles until right before pole installation. Handle poles with web fabric straps.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of pole(s) that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within a specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs from special warranty period.

1. Warranty Period: Five years from date of Substantial Completion.
2. Warranty Period for Corrosion Resistance: Five years from date of Substantial Completion.
3. Warranty Period for Color Retention: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Characteristics: Comply with AASHTO LTS-6-M.

B. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied according to AASHTO LTS-6-M.

C. Live Load: Single load of 500 lbf distributed according to AASHTO LTS-6-M.

D. Ice Load: Load of 3 lbf/sq. ft., applied according to AASHTO LTS-6-M for applicable areas on the Ice Load Map.

E. Wind Load: Pressure of wind on pole and luminaire, calculated and applied according to AASHTO LTS-6-M.

1. Basic wind speed for calculating wind load for poles 50 feet high or less is 100 mph.

a. Wind Importance Factor: 1.0.
b. Minimum Design Life: 25 years.
c. Velocity Conversion Factor: 1.0.

F. Strength Analysis: For each pole, multiply the actual EPA of luminaires and brackets by a factor of 1.25 to obtain the EPA to be used in pole selection strength analysis.

G. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.

2.2 STEEL POLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hapco.
2. Hubbell Incorporated.
3. Lithonia Lighting; Acuity Brands Lighting, Inc.

B. Source Limitations: For poles, obtain each color, grade, finish, type, and variety of pole from single source with resources to provide products of consistent quality in appearance and physical properties.

C. Poles: Comply with ASTM A 500/A 500M, Grade B carbon steel with a minimum yield of 46,000 psig; one-piece construction up to 40 feet in height with access handhole in pole wall.

1. Shape: Round, tapered; Round, straight; Square, tapered; Square, straight.
2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

D. Brackets for Luminaires: Detachable, cantilever, without underbrace.

1. Adaptor fitting welded to pole, allowing the bracket to be bolted to the pole-mounted adapter, then bolted together with stainless-steel bolts.
2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire. Match pole material and finish.

E. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.

F. Fasteners: Stainless steel, size and type as determined by manufacturer. Corrosion-resistant items compatible with support components.

1. Materials: Compatible with poles and standards as well as the substrates to which poles and standards are fastened and shall not cause galvanic action at contact points.
2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.

G. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Section 260526 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size indicated, and accessible through handhole.

H. Handhole: Oval shaped, with minimum clear opening of 2-1/2 by 5 inches, with cover secured by stainless-steel captive screws.

I. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.

J. Galvanized Finish: After fabrication, hot-dip galvanize according to ASTM A 123/A 123M.

K. Factory-Painted Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces according to SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, according to SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
2. Interior Surfaces of Pole: One coat of bituminous paint, or otherwise treat for equal corrosion protection.
3. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high gloss, high-build polyurethane enamel.

    a. Color: As selected by Architect from manufacturer's full range.

L. Powder-Coat Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces according to SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair powder coat bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, according to SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
2. Powder Coat: Comply with AAMA 2604.

    a. Electrostatic-applied powder coating; single application and cured to a minimum 2.5- to 3.5-mils dry film thickness. Coat interior and exterior of pole for equal corrosion protection.
    b. Color: As selected by Architect from manufacturer's full range.

2.3 POLE ACCESSORIES

A. Base Covers: Manufacturers' standard metal units, finished same as pole, and arranged to cover pole's mounting bolts and nuts.

2.4 MOUNTING HARDWARE

A. Anchor Bolts: Manufactured to ASTM F 1554, Grade 55, with a minimum yield strength of 55,000 psi.

1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C.
2. Bent rods in diameter and length in accordance with manufacturer’s recommendation.
3. Threading: Uniform National Coarse, Class 2A.

B. Nuts: ASTM A 563, Grade A, Heavy-Hex

1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C.

2. Two or four (in accordance with manufacturer's recommendation) nuts provided per anchor bolt, shipped with nuts pre-assembled to the anchor bolts.

C. Washers: ASTM F 436, Type 1.

1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C.
2. One or Two (in accordance with manufacturer's recommendation) washers provided per anchor bolt.

2.5 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine poles, luminaire-mounting devices, and pole accessories before installation. Components that are scratched, dented, marred, wet, moisture damaged, or visibly damaged are considered defective.

C. Examine roughing-in for foundation and conduit to verify actual locations of installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 POLE FOUNDATION

A. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123 M; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."

B. Anchor Bolts: Install plumb using manufacturer-supplied template, uniformly spaced.

3.3 POLE INSTALLATION

A. Alignment: Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on pole.

B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features unless otherwise indicated on drawing.

1. Fire Hydrants and Water Piping: 60 inches.
2. Water, Gas, Electric, Communications, and Sewer Lines: 10 feet.
3. Trees: 15 feet from tree trunk.

C. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Section 033000 "Cast-in-Place Concrete."

1. Use anchor bolts and nuts selected to resist seismic forces defined for the application and approved by manufacturer.
2. Grout void between pole base and foundation. Use non-shrink or expanding concrete grout firmly packed to fill space.
3. Install base covers unless otherwise indicated.
4. Use a short piece of 1/2 -inch diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.

D. Poles and Pole Foundations Set in Concrete-Paved Areas: Install poles with a minimum 6-inch-wide, unpaved gap between the pole or pole foundation and the edge of the adjacent concrete slab. Fill unpaved ring with pea gravel. Insert material to a level 1 inch below top of concrete slab.

E. Raise and set pole using web fabric slings (not chain or cable) at locations indicated by manufacturer.

3.4 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum using insulating fittings or treatment.

B. Steel Conduits: Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- thick, pipe-wrapping plastic tape applied with a 50-percent overlap.

3.5 GROUNDING

A. Ground Metal Poles and Support Structures: Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole unless otherwise indicated.
2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

3.6 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.7 FIELD QUALITY CONTROL

A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:

1. Inspect poles for nicks, mars, dents, scratches, and other damage.
2. System function tests.

END OF SECTION 265613

SECTION 265619 - EXTERIOR LIGHTING

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. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.
2. Luminaire supports.

B. Related Requirements:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
2. Section 265613 "Lighting Poles and Standards" for poles and standards used to support exterior lighting equipment.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color rendering index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of luminaire.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.

3. Include physical description and dimensions of luminaire.
4. Lamps, include life, output (lumens, CCT, and CRI), and energy-efficiency data.
5. Photometric data and adjustment factors based on laboratory tests, complying with IES Lighting Measurements Testing and Calculation Guides, of each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project, IES LM-79, and IES LM-80.

    a. Manufacturer's Certified Data: Photometric data certified by manufacturer’s laboratory with a current accreditation under the NVLAP for Energy Efficient Lighting Products.
    b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

6. Wiring diagrams for power, control, and signal wiring.
7. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.

B. LEED Submittals:

1. Product Data for Credit EA 5: For specified metering equipment.
2. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.

C. Samples: For each luminaire and for each color and texture indicated with factory-applied finish.

D. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

E. Delegated-Design Submittal: For luminaire supports.

1. Include design calculations for luminaire supports.

1.5 INFORMATIONAL SUBMITTALS

A. 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. Luminaires.
2. Structural members to which equipment and luminaires will be attached.
3. Underground utilities and structures.
4. Existing underground utilities and structures.
5. Above-grade utilities and structures.
6. Existing above-grade utilities and structures.
7. Building features.
8. Vertical and horizontal information.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

C. Product Certificates: For each type of the following:

1. Luminaire.

D. Product Test Reports: For each luminaire, for tests performed by either manufacturer and witnessed by a qualified testing agency, or by a qualified testing agency.

E. Source quality-control reports.

F. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires to include in operation and maintenance manuals.

1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. LED Drivers: Two of each type and rating installed.
2. Glass, Acrylic, and Plastic Lenses, Covers, and Other Optical Parts: One for every 100 of each type and rating installed. Furnish at least one of each type.
3. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
4. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturers' laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products and complying with applicable IES testing standards.

C. Provide luminaires from a single manufacturer for each luminaire type.

D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

E. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

F. Mockups: For exterior luminaires, complete with power and control connections.

1. Obtain Architect's approval of luminaires in mockups before starting installations.
2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed work.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

1.10 FIELD CONDITIONS

A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.

B. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

1.11 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures, including luminaire support components.
b. Faulty operation of luminaires and accessories.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Period: 2 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

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

B. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. UL Compliance: Comply with UL 1598 and listed for wet location.

D. Lamp base complying with ANSI C81.61.

E. CRI of 70. CCT of 3000 K.

F. L70 lamp life of 50,000 hours.

G. Lamps dimmable from 100 percent to 0 percent of maximum light output.

H. Internal driver.

I. Nominal Operating Voltage: 120 V ac.

J. Source Limitations: For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

2.2 LUMINAIRE TYPES

A. See Luminaire Schedule on drawings.

2.3 MATERIALS

A. Metal Parts: Free of burrs and sharp corners and edges.

B. Sheet Metal Components: Corrosion-resistant aluminum, Stainless steel, or Epoxy-coated steel. Form and support to prevent warping and sagging.

C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit re-lamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during re-lamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.

D. Diffusers and Globes:

1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
2. Glass: Annealed crystal glass unless otherwise indicated.
3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

E. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

F. 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.

G. Housings:

1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
2. Provide filter/breather for enclosed luminaires.

H. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:

a. "USE ONLY" and include specific lamp type.
b. Lamp diameter, shape, size, wattage and coating.
c. CCT and CRI for all luminaires.

2.4 FINISHES

A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

C. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.

a. Color: See Luminaire Schedule.

D. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.

a. Color: As selected from manufacturer's standard catalog of colors.

2.5 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.

C. Examine walls, roofs, and canopy ceilings and overhang ceilings for suitable conditions where luminaires will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is substantially complete, clean luminaires used for temporary lighting and install new lamps.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Comply with NECA 1.

B. Install lamps in each luminaire.

C. Fasten luminaire to structural support.

D. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and re-lamping.
3. Support luminaires without causing deflection of finished surface.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

E. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls.

F. Wiring Method: Install cables in raceways. Conceal raceways and cables.

G. Install luminaires level, plumb, and square with finished grade unless otherwise indicated. Install luminaires at height and aiming angle as indicated on Drawings.

H. Coordinate layout and installation of luminaires with other construction.

I. Adjust luminaires that require field adjustment or aiming.

J. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.4 INSTALLATION OF INDIVIDUAL GROUND-MOUNTED LUMINAIRES

A. Aim as indicated on Drawings.

B. Install on concrete base with top six inches above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 033000 "Cast-in-Place Concrete."

3.5 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.6 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.7 FIELD QUALITY CONTROL

A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Verify operation of photoelectric controls.

C. Illumination Tests:

1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IES testing guide(s):

a. IES LM-5.
b. IES LM-50.
c. IES LM-52.
d. IES LM-64.
e. IES LM-72.

2. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

D. Luminaire will be considered defective if it does not pass tests and inspections.

E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain luminaires.

3.9 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to one visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 265619

SECTION 270000 - COMMUNICATIONS

PART 1 GENERAL

1.1 SUMMARY

A. This specification is intended to define the standards and criteria to be used in the installation and documentation of a network infrastructure to support the Greenville Transit Activity Center, Greenville, North Carolina. This specification coupled with construction drawings shall form the basis for the system installation. This specification does not apply to voice/data cabling for work area outlets, only to other systems requiring TCP/IP Ethernet cabling. i.e. CCTV, Access Control, Visual Message Boards, etc.

B. This specification is based on NFPA 70 (NEC), IEEE C2 (NESC), ANSI/TIA/EIA Telecommunication Standards, and BICSI methodologies (TDMM and CO-OSP).The requirements within those documents are not superseded by this document unless specifically stated. As required, NEC and NESC code requirements cannot be superseded by this document at any time. ANSI/TIA/EIA standards and BICSI methodologies may be superseded, as specified, or may be made stricter by this document. Not all codes, standards, and methodologies are specifically addressed by this document. The absence of a specific reference to an element of these codes, standards, and methodologies does not relinquish compliance with those elements.

C. Unauthorized deviations from this specification may require re-design, re-construction, or re-installation of ISP/OSP elements at the Contractors' expense. Contractors shall get prior approval to deviate from this specification or from ANSI/TIA/EIA standards and BICSI methodologies. Contractors cannot deviate from NEC and NESC.

D. "Codes" refer to the NFPA 70 (National Electrical Code) and IEEE C2 (National Electric Safety Code). "Standards" refer to ANSI, ASTM, and UL standards. "Methodologies" refers to BISCI.

E. Like standards and codes, this document uses the word "shall" to indicate mandatory requirements and "may" or "should" to indicate optional components. Conflicts within this document are to be resolved by Greenville Transit System owner prior to application of the specification by a Contractor.

F. Sections Include:

1. Section 270526: Grounding and Bonding for Communications Systems.
2. Section 270529: Hangers and Supports for Communications Systems.
3. Section 270533: Conduits and Backboxes for Communications Systems.
4. Section 270536: Cable Tray for Communications Systems.
5. Section 270553: Identification for Communications Systems.

G. CAUTION! Use of this Section without including all of the above-listed items will result in the omission of basic requirements.

1.2 REFERENCES

A. ANSI/TIA/EIA standards referenced above may include multiple components which apply to the Greenville Transit Activity Center project. In all cases, the current versions or succeeding documents for the codes, standards, and methodologies listed above shall be used.

B. Should conflicts exist within the standards, the more stringent shall apply.

C. Division 01 Specifications.

1.3 DEFINITIONS

A. Cable Plant Infrastructure Elements:

1. Information Transport System: Any copper cabling or optical fiber whose purpose is to move any type of information on the campus. This may include data, video, voice, fire alarm, security, access control, and other low-voltage networks.
2. Inside Cable Plant: That part of the Information Technology System running within a building. This document does apply to Inside Cable Plant elements passing through any element of the outside cable plant pathway. It includes the workstation outlet assembly, cabling to the workstation from the network rooms, backbone cabling within a building, backbone cabling running between physically contiguous buildings that does not pass through Outside Cable Plant elements, network racks and hardware (routers, switches, hubs, firewalls, etc.), patch panels, any punch blocks not terminating cable from outside the building, fiber distribution panels not terminating optical fiber from outside the building, patch cords, and cross-connect cables/wires. The Inside Cable Plant will be referred to as “ISP” within this document. The ISP is managed by the Telecommunication group.
3. Outside Cable Plant: That part of the Information Transport System running between buildings, from a building to a definable exterior point, between definable exterior points, or from a non – Greenville Transit source to an Greenville Transit building or definable exterior point. It includes the termination hardware at both ends of the cable, including protection modules, telecommunication punch blocks, fiber distribution panels, interior splices for outside to inside optical fiber transition, and any other initial device into which an outside cable attaches. The Outside Cable Plant does not include backbone cable running between physically contiguous buildings unless the cabling enters an OSP pathway element (e.g. OSP conduits, maintenance holes, etc.). The Outside Cable Plant includes underground cabling and aerial cabling. The Outside Cable Plant may be referred to as “OSP” within this document and the phrase and abbreviation are used interchangeably.

4. Telecommunications: Telecommunications refers to the system owner at Greenville Transit. This group manages the voice/data network hardware/software. Telecommunications sets installation standards for voice/data cabling within buildings.

B. Specific Elements:

1. Cable: An assembly of one or more insulated conductors or optical fibers, within an enveloping sheath.
2. Campus: Includes all buildings or structures owned or leased by Greenville Transit Activity Center with a direct physical cable connection to the contiguous campus through Greenville Transit Activity Center owned or leased conduits, including those pathways.
3. Dead pairs: Unused copper pairs terminating within a splice case, but without being spliced to an outgoing cable.
4. Grounding electrode: A conductor, usually a rod, pipe or plate (or group of conductors) in direct contact with the earth for the purpose of providing a low-impedance connection to the earth.
5. Grounding electrode conductor: The conductor used to connect the grounding electrode to the equipment grounding conductor, or to the grounded conductor of the circuit at the service equipment, or at the source of a separately derived system.
6. Handbox: A rectangular or square underground pathway element similar to a small maintenance hole, which cannot be fully entered, that allows for a pulling point or splice point in a pathway.
7. Handhole: A round underground pathway element similar to a handbox, which cannot be fully entered, that allows for a pulling point in a pathway.
8. Identifier: An item of information that links a specific element of the Information Transport System infrastructure with its corresponding record.
9. Infrastructure (Information Transport System): A collection of those Information Transport System components, excluding equipment, that together provides the basic support for the distribution of all information within a building or campus.
10. Linkage: A connection between a record and an identifier or between records.
11. Maintenance Hole: An underground pathway element large enough for a person to fully enter and work. Used to provide access to underground cables to pull, splice, and maintain. Formerly known as a manhole.
12. Media (Information Transport System): Wire, cable, or conductors used for the Information Transport System.
13. Outlet box: A metallic or nonmetallic box used to hold Information Transport System outlets/connectors or transition devices.
14. Outlet/connector (Information Transport System): A connecting device in the work area on which horizontal cable or outlet cable terminates.
15. Pathway: A facility for the placement of Information Transport System cable.
16. Record: A collection of detailed information related to a specific element of the Information Transport System Infrastructure.
17. Report: A presentation of a collection of information from various records.
18. Space (Information Transport System): An area used for housing the installation and termination of Information Transport System equipment and cable, e.g., equipment rooms, network rooms, work areas, and maintenance holes/handboxes/handholes.

19. Splice: A joining of conductors in a splice closure, meant to be permanent.
20. Splice box: A box, located in a pathway run, intended to house a cable splice.
21. Splice closure: A device used to protect a splice.
22. Termination position: A discrete element of termination hardware where Information Transport System conductors are terminated.
23. Work area (work station): A building space where the occupants interact with Information Transport System terminal equipment.

C. Acronyms And Abbreviations:

1. ABF: Air Blown Fiber
2. ACR: Attenuation-to-Crosstalk Ratio.
3. ADA: Americans with Disabilities Act.
4. AFF: Above finished floor.
5. ANSI: American National Standards Institute.
6. ASTM: American Society for Testing and Materials (ASTM International)
7. AWG: American Wire Gauge
8. BD: Building distributor (replacing main-cross connect and MDF as "building service" room identifiers)
9. BICSI®: Building Industry Consulting Service International, Inc.
10. BTU: British Thermal Unit
11. CATV: Community Antenna Television (cable television)
12. CD: Campus distributor (replacing main-cross connect and MDF as "campus-wide service" room identifiers
13. dB: Decibel
14. EF: Entrance Facility
15. EIA: Electronic Industries Alliance
16. ELFEXT: Equal Level Far-End Crosstalk
17. EMC: Electromagnetic Compatibility
18. EMI: Electromagnetic Interference
19. ER: Equipment Room
20. FCC: Federal Communications Commission
21. FD: Floor distributor (replacing network room, intermediate and horizontal cross-connect, and telecommunications as "building service" room identifiers)
22. FDDI: Fiber Distribution Data Interface
23. FDU: Fiber Distribution Unit
24. FEXT: Far-End Crosstalk
25. FOTP: Fiber Optic Test Procedure
26. Freq.: Frequency
27. GE: Grounding equalizer (replacing TBBIBC)
28. Gnd: Ground
29. GTAC: Greenville Transit Activity Center
30. HB: Handbox
31. HC: Horizontal Cross-Connect (replaced by floor distributor “FD”)
32. HH: Handhole
33. HVAC: Heating, Ventilation, and Air Conditioning
34. Hz: Hertz
35. IC: Intermediate Cross-Connect (replaced by building distributor “BD”)
36. IDC: Insulation Displacement Connectors
37. IDF: Intermediate Distribution Frame (replaced by “BD” or “FD”)

38. IEEE: Institute of Electrical and Electronics Engineers
39. ISO: International Organization for Standardization
40. ISP: Inside Cable Plant
41. Mbps: Megabits per second
42. MC: Main Cross-Connect (replaced by campus distributor “CD”)
43. MDF: Main Distribution Frame (replaced by “CD” or “BD”)
44. MH: Maintenance (Man) Hole
45. MHz: Megahertz
46. NEC: National Electrical Code, NFPA 70
47. NESC: National Electric Safety Code, IEEE C2
48. NFPA: National Fire Protection Association
49. NR: Network Room
50. OSHA: Occupational Safety and Health Administration
51. OSP: Outside Cable Plant
52. OTDR: Optical Time Domain Reflectometer
53. PR: Pair
54. RCDD®: Registered Communications Distribution Designer
55. RFI: Radio Frequency Interference
56. RH: Relative Humidity
57. SM: Single Mode
58. TBB: Telecommunication Bonding Backbone
59. TBBIBC: Telecommunication Bonding Backbone Interconnecting Bonding Conductor (replaced by grounding equalizer “GE”)
60. TGB: Telecommunications Grounding Busbar
61. TIA: Telecommunications Industry Association
62. TMGB: Telecommunications Main Grounding Busbar
63. TR: Telecommunications Room
64. UL: Underwriters Laboratory
65. UPS: Uninterruptible Power Supply
66. WAO: Work Area Outlet

1.4 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 a RCDD / RCDD/NTS or Commercial Installer, Level 2.
2. Installation Supervision: Installation shall be under the direct supervision of a Registered Technician, 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 a RCDD, or Commercial Installer Level 2 to perform the on-site inspection.

B. Provide grounding of cabinets, racks and IDF equipment enclosures in accordance with latest version of grounding, Bonding and Electrical Protection chapter of the BICSI TDM Manual, TIA/EIA 607, and NFPA 70.

C. Perform work in accordance with the State of North Carolina and local AHJ standards.

D. Maintain one copy of each referenced standard on site.

E. The Contractor shall have extensive experience (3+ years) with the specified manufacturers' hardware and cabling.

F. All installers shall have had experience with the specified manufacturers' hardware and cabling. BICSI Installer Level I experience may be limited to class-based training using the manufacturers' hardware and cabling.

G. All installers shall be BICSI registered installers. Seventy-five percent or more of installers shall be BICSI Installer Level II. Up to twenty-five percent of installers may be BICSI Installer Level I. Workers not involved in installing cable elements (e.g. laborers delivering/moving materials, installing grounding by an electrician, or workers installing pathway elements) do not have to be registered.

H. All team leads shall be BICSI registered Technicians. The Contractor shall provide statements in the bid documents of experience for all proposed team leads. The statements shall include industry-specific training and certifications (with dates verifying active status on registrations/certifications), project experience, experience with cabling up to and including Category 6A cabling, and experience as a team lead. The Contractor may provide additional material.

I. Only installers trained and certified by the manufacturer shall be allowed to install copper products. Installers must possess the highest level of certification available by the manufacturer for the specific structured cable solution being installed.

J. Only installers trained and certified by the manufacturer shall be allowed to terminate and test optical fiber. Others specified above may pull/place optical fiber cable under the supervision of an installer trained and certified by the manufacturer.

K. The Contractor may provide proof of registration/certification of planned installers in bid documents. If not included in the bid documents, the Contractor shall provide a narrative on the levels of registration/certification of their installers within the bid documents. The Contractor shall provide proof of registration/certification for the final list of installers prior to the start of work.

L. Greenville Transit reserves the right to reject any unregistered or uncertified installers performing work for which they are not registered/certified. The Contractor shall be responsible for any loss of work, delays in schedules, or extra costs as a result of the use of unregistered/uncertified workers. Additional effort on the part of the Contractor to maintain the installation schedule as a result of the above mentioned loss time shall be the Contractor's responsibility and at the Contractor's additional expense.

M. Any exception to this specification must be approved by Greenville Transit IT/Infrastructure Services prior to installation. Any deviation from this specification must be approved by Greenville Transit IT/Infrastructure Services prior to installation. Any questions on interpretation shall be resolved by Greenville Transit IT/Infrastructure Services.

1.5 QUALIFICATIONS

A. The manufacturing company of products specified in this section is required to have a minimum of five years documented experience.

B. The installing company specializing in performing work of this section is required to have a minimum of three years documented experience approved by the manufacturer.

1.6 UNITS OF MEASURE

A. dB: Decibel

B. in: Inch(es)

C. ft: Foot or feet

D. m: Meter

E. nm: Nanometer

1.7 SYSTEM DESCRIPTION

A. This specification addresses Telecommunications network pathways, spaces, media, grounding, and identification requirements to support the telecommunications network infrastructure.

B. Specific areas covered by this specification are:

1. Definition of the inter-building pathway and cabling requirements necessary to connect the project building(s) to the incoming service facilities as well as each other.
2. Definition of an intra-building pathway and space system to house the telecommunications network cabling system and associated electronic transport equipment. This pathway and space system shall be designed to support the known and anticipated systems and cables that may be utilized within the spaces.
3. Definition of backbone cables and its distribution and termination methods.
4. Definition of horizontal distribution cables and work area outlet configuration. This definition will also include termination methods to be utilized.
5. Definition of patch cables and their requirements.
6. Definition of the telecommunications network grounding infrastructure.
7. Definition of the administration and labeling system.

1.8 SUBMITTALS

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

1.9 WARRANTY

A. The Contractor shall adhere to the warranty requirement for all installations. The Contractor shall install all copper components of the installed manufacturer's system-wide solution to the specifications and requirements needed to extend the longest and most extensive performance warranty available under the installed solution(s). Data cabling shall adhere to the warranty requirements of the cable manufacturer. Universal cabling shall adhere to the above data cabling requirements. The contractor shall be a manufacturer authorized contractor.

B. The Contractor shall install all fiber components of the installed manufacturer's system-wide solution to the specifications and requirements needed to extend the longest and most extensive performance warranty available under the installed solution.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 270000

SECTION 270526 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. This Section supplements Section 260526, Grounding and Bonding for Electrical Systems, to specify the requirements necessary to furnish and install:

1. Communications ground conductors.
2. Equipment, raceway, cable tray, and cable ground connections.
3. Ground busbar hardware.
4. Equipment rack and cabinet grounding.
5. Splice case grounding.

B. Related Sections:

1. This Section shall be used in conjunction with the following other specifications and related Contract Documents to establish the total requirements for communications grounding:

a. Division 01 Specifications.
b. Section 270000 - Communications.
c. Section 260526 – Grounding and Bonding for Electrical Systems.

C. CAUTION! Use of this Section without including all of the above-listed items will result in the omission of basic requirements.

D. In the event of conflict regarding communications grounding requirements between this Section and any other section, the provisions of this Section shall govern.

1.2 REFERENCES

A. Building Industry Consulting Service International, Inc.

1. BICSI TDMM Manual – Telecommunications Distribution Methods Manual.

B. National Fire Protection Association:

1. NFPA 70 – National Electrical Code.

C. Telecommunications Industry Association/Electronic Industries Alliance:

1. ANSI/TIA-607-B – Commercial Building Grounding and Bonding Requirements for Telecommunications.

1.3 SYSTEM DESCRIPTION

A. Communications system grounding and bonding extending beyond the grounding electrode system and building ground ring provided for in Section 260526, Grounding and Bonding for Electrical Systems.

B. Metallic communications conduit, wireway, and cable tray systems grounding and bonding.

C. Building and telecommunications ground busbar hardware in communications rooms.

D. Equipment cabinet and rack ground bars.

E. Bonds of exposed noncurrent-carrying metal parts of communications equipment, metal raceway, and cable tray systems.

F. Establishing a suitable network ground is critical in grounding network equipment. A network ground is always required. Refer to ANSI/TIA-607-B standard.

G. Do not use the following elements as grounding electrodes:

1. Building plumbing systems.

H. Contractors shall not attach grounding conductors from the main telecommunications busbar or protectors to the main electrical building grounding busbar, grounding electrode conductor, or any element of the main electrical service distribution panel. Contractors shall provide the conductor and connector in a position to allow a licensed electrician to make the final connection of the Telecommunications grounding system to the electrical grounding system.

I. Contractors shall not make modifications to the telecommunications grounding system without notifying Greenville Transit IT Services/Infrastructure Services in advance.

J. Performance requirements: Grounding System Resistance: 5 ohms or less.

1.4 SUBMITTALS

A. Administrative Requirements: Submittal procedures.

B. Product Data: Manufacturer's descriptive literature for each system component specified in this section.

C. Submit Data Center, Computer Room, Entrance Facility, Main Distribution Frame (MDF), Telecommunications Room, Telecommunications Ground Busbar, and IDF ground terminal block schedule listing test results which verify ground connection loss to the building main ground pigtail is 5 ohms or less.

D. Submit test results, which verify that resistance from intra-room cable tray systems to telecommunications grounding busbars is less than 5 ohms. Measurements shall be taken from section of cable tray section furthest from telecommunications grounding busbars.

E. Submit test results for racks and cabinets to telecommunications ground busbar, located within communications rooms, which verify resistance is less than 5 ohms.

F. Submit test results, which verify resistance of ground connections made from computer room raised floor to building ground busbars is less than 5 ohms.

G. Submit test results, which verify resistance of telecommunications equipment, located in maintenance holes, to ground bus bar, also located in maintenance hole is less than 5 ohms.

1.5 CLOSEOUT SUBMITTALS

A. Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations of components and grounding electrodes.

1.6 QUALITY ASSURANCE

A. Provide grounding, surge protection and lightning protection of telecommunications system in accordance with latest version of Grounding, Bonding and Electrical Protection chapter of the BICSI TDM Manual, ANSI/TIA-607-B, and NFPA 70.

B. Perform work in accordance with the State of North Carolina and local AHJ standards.

C. Maintain one copy of each referenced standard on site.

1.7 QUALIFICATIONS

A. The manufacturing companies of products specified in this section are required to have a minimum of five years documented experience.

B. The installing company specializing in performing work of this section is required to have a minimum of three years documented experience approved by the manufacturer.

1.8 COORDINATION

A. Contractor to coordinate with Greenville Transit IT Services/Infrastructure Services system owner prior to commencing any grounding installations.

1. Convene a minimum of one meeting one week prior to commencing work of this section.

PART 2 PRODUCTS

2.1 GROUND WIRE

A. Ground Wire: Grounding conductors of the size and type shown on the drawings, or use a minimum of 6-AWG insulated copper wire per ANSI/TIA – 607 - B.

2.2 GROUND BUSBAR

A. Solid copper busbar predrilled for two-hole lug connections, with a minimum thickness of 1/4 inch, for wall and backboard mounting using standoff insulators, and sized as indicated on the Drawings. For example:

1. Chatsworth 10- by 4-inch busbar 10622-010.
2. Chatsworth 20- by 4-inch busbar 10622-020.
3. Or Approved Equivalent.

2.3 GROUND CONNECTORS

A. Below Grade: Exothermic-welded type connectors by Cadweld or Thermoweld or approved equivalent.

B. Above Grade:

1. Bonding Jumpers: Irreversible compression type connectors by T&B, Burndy, or Anderson, using zinc-plated fasteners and external tooth lockwashers or equivalent.
2. Ground Busbars: Two-hole compression type lugs using tin-plated copper or copper alloy bolts and nuts.
3. Rack and Cabinet Ground Bars: One-hole compression-type lugs using zinc-plated or copper alloy fasteners.

2.4 GROUND CONDUCTOR FOR GROUNDING RAISED FLOOR STRINGER SYSTEM

A. Provide minimum of 6 AWG for bond/connections made from raised floor stringer system to building ground electrode system.

2.5 CORROSION INHIBITORS

A. In areas where increased risk of corrosion is anticipated, use corrosion inhibitor appropriate for protecting a connection between the metals used; e.g., Ideal NOALOX antioxidant 30-030 for zinc or aluminum-to-aluminum connections, KOPAR-Shield, or equivalent.

2.6 EQUIPMENT RACK AND CABINET GROUND BARS

A. Solid copper ground bars designed for mounting on the framework of open or cabinet-enclosed equipment racks with minimum dimensions of 1/4-inch thick by 3/4-inch wide; e.g., Chatsworth ground bar 10610-019 or equivalent. Required on all Telecommunications equipment racks and cabinets.

2.7 GROUND STRIP

A. Telecommunication ground strips used in maintenance holes; e.g., Erico, Burndy, Harger, or equivalent: Copper, selected to provide coverage throughout the length of the maintenance hole. Width of 1 inch and a thickness of 1/8 inch.

2.8 GROUND JUMPER

A. Where painted mounting brackets are used or where there is no electrically continuous ground path between telecommunication racks and telecommunications equipment, provide a grounding connection between telecommunications equipment and telecommunications racks using #6 AWG minimum ground conductors.

2.9 TELECOMMUNICATION GROUND RODS

A. Telecommunications ground rods; used in maintenance hole applications shall be constructed of copper clad steel / bar stock or rebar, 3/4 inch in diameter, 10 feet long, driven full length into the earth. Use solid bronze mechanical connector.

2.10 GROUND TERMINAL BLOCKS

A. Screw lug-type terminal blocks at any equipment mounting location (e.g., backboards and hinged cover enclosures) where rack-type ground bars cannot be mounted.

PART 3 EXECUTION

3.1 EXAMINATION

A. Administrative Requirements: Verification of existing conditions, before starting work.

B. Verify final backfill and compaction has been completed before driving ground rods.

3.2 PREPARATION

A. Remove paint, rust, mill oils and surface contaminants at connection points.

3.3 INSTALLATION

A. General Ground System Installation.

1. Approved building ground sources are specified by Section 260526, Grounding and Bonding for Electrical Systems.
2. Furnish and install all wire and hardware required to properly ground, bond, and connect communications raceway, basket style tray, metallic cable shields, and equipment to a ground source.
3. Bonding jumpers shall be continuous with no splices. Use the shortest length of bonding jumper possible.
4. Bond raised floor stringer system (computer rooms) to building grounding system. Refer to Section 260526, Grounding and Bonding for Electrical Systems.
5. Provide ground paths, which are permanent and continuous with a resistance of 5 ohms or less from raceway, basket tray, and equipment connections to the building grounding electrode. The resistance across individual bonding connections shall be 10 milliohms or less.

6. Below-Grade Grounding Connections: When making thermite welds, wire brush or file the point of contact to a bare metal surface. Use thermite welding cartridges and molds in accordance with the manufacturer's recommendations. After welds have been made and cooled, brush slag from the weld area and thoroughly clean the joint and area. Notify Contractor prior to backfilling any ground connections.
7. Above-Grade Grounding Connections: When making bolted or screwed connections to attach bonding jumpers, remove paint to expose the entire contact surface by grinding where necessary; thoroughly clean all connector, plate, and other contact surfaces; and apply an appropriate corrosion inhibitor to all surfaces before joining.
8. Bonding Jumpers:

    a. Use insulated ground wire of the size and type shown on the Drawings or use a minimum of 6-AWG insulated copper wire.
    b. Assemble bonding jumpers using insulated ground wire terminated with irreversible compression connectors.
    c. Use compression connectors of proper size for conductors specified. Use connector manufacturer's compression tool.

9. Bonding Jumper Fasteners:

    a. Conduit: Fasten bonding jumpers using screw lugs on grounding bushings or conduit strut clamps, or the clamp pads on push-type conduit fasteners. When screw lug connection to a conduit strut clamp is not possible, fasten the plain end of a bonding jumper wire by slipping this plain end under the conduit strut clamp pad; tighten the clamp screw firmly. Where appropriate, use zinc-plated external tooth lock washers.
    b. Wireway and Cable Tray: Fasten bonding jumpers using zinc-plated bolts, external tooth lock washers, and nuts. Install protective cover, e.g., zinc-plated acorn nuts, on any bolts extending into wireway or cable tray to prevent cable damage.
    c. Ground Plates and Busbars: Fasten bonding jumpers using two-hole irreversible compression lugs. Use tin-plated copper or copper alloy bolts, external tooth lock washers, and nuts.
    d. Channel strut and Raised Floor Stringers: Fasten bonding jumpers using zinc-plated, self-drill screws and external tooth lock washers.

B. Communication Room Grounding:

1. Main Telecommunications Ground Busbar: Provide Telecom ground busbar hardware and connect to pigtail extensions of the building grounding ring or main electrical system ground provided by others. Verify that the ground pigtail is the same type and size conductor used for the main building grounding ring (usually 4/0). This ground busbar is required even if a building ground busbar is available in the room.

2. Telecommunications Ground Busbars:

   a. Provide communications room telecommunications ground busbar hardware at cable tray height as indicated on the Drawings.
   b. Connect the telecommunications ground busbar to the main telecommunications ground busbar using two-hole irreversible compression lugs and a grounding jumper of the same size as the pigtail extension of the main building grounding ring (usually 4/0).

3. Telephone-Type Cable Tray (Runway) Systems: Make ground connections by installing the following bonding jumpers:

   a. 6-AWG bonding jumper between the telecommunications ground busbar and the nearest access to the cable tray.
   b. One 6-AWG bonding jumper across each cable tray junction.

4. VE 1 Type Cable Tray Systems: Install 6-AWG bonding jumper between VE 1 cable tray section end located within communications room and the telecommunications ground busbar or the room ground busbar, whichever is closest.
5. Self-Supporting and Cabinet-Mounted Equipment Rack Ground Bars:

   a. Bond each rack to the overhead cable tray using a 6 AWG bonding jumper.
   b. Ground all cable shields to the closest rack or cabinet ground lug or bus and equipment chassis located on an equipment rack or cabinet to the rack or cabinet ground bar using 6-AWG bonding jumpers.

6. Backboards: Provide a screw lug-type terminal block or drilled and tapped copper strip near the top of backboards used for communications cross-connect systems. Connect backboard ground terminals to closer of the telecommunications ground busbar or telephone-type cable tray system using an insulated 6-AWG bonding jumper.
7. Other Communication Room Ground Systems: Ground all metallic conduit, wireways, and other metallic equipment located away from equipment racks or cabinets to the cable tray or the telecommunications ground busbar, whichever is closer, using insulated 6-AWG ground wire bonding jumpers.

C. Maintenance Hole Grounding:

1. Provide ground rod, constructed of copper clad steel bar stock or rebar, 3/4 inch in diameter, 10 feet long, driven full length into the earth. Install ground rod outside maintenance holes in the conduit raceway trench. Connect ground rods to flat copper strip inside the maintenance hole with a No. 6 AWG copper ground conductor.
2. Provide telecommunications flat copper strip on the interior wall surface of the maintenance hole which is bonded to grounding rod or building ground grid, whichever is used, and to precast reinforcing bar structure.

   a. Bonding surface shall be free and clean of paint.

b. Corrosion inhibitor shall be applied to bonding locations in areas expected to promote corrosion. Use oxidation-inhibitor appropriate for protecting the connection between metals used.

3. Ground and bond telecommunication metallic conduit and ducting to telecommunication flat copper strip using #6AWG ground conductor. Length of conductor shall be kept as short as possible.

3.4 FIELD QUALITY CONTROL

A. Quality Requirements – Execution and Closeout Requirements. Field inspecting, testing, adjusting and balancing.

B. Visually inspect from each bus bar to main grounding electrode service location.

C. Test in accordance with BICSI TDMM Manual, ANSI/TIA-607-B, IEEE 142 and NFPA 70.

D. When improper grounding is found, check entire project and correct. Perform retest.

END OF SECTION 270526

SECTION 270529 – HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. This section includes basic materials and methods for fastening and supporting communications products and equipment and firestopping of communications equipment openings in walls and floors.

B. Section includes:

1. Conduit supports.
2. Formed steel channel.
3. Spring steel clips.
4. Sleeves.
5. Mechanical sleeve seals.
6. Firestopping relating to communications work.
7. Firestopping accessories.
8. Equipment bases and supports.

C. Related Sections:

1. Division 01 Specifications.
2. Section 260529 – Hangers and Supports for Electrical Systems.

D. CAUTION! Use of this Section without including all of the above-listed items will result in the omission of basic requirements.

E. In the event of conflict between this Section and any other Section regarding Hangers and Supports for Communications Systems, the provisions of this Section will govern.

1.2 REFERENCES

A. ASTM International:

1. ASTM E84 Rev A – Standard Test Method for Surface Burning Characteristic of Building Material.
2. ASTM E119 Rev A– Standard Test Methods for Fire Tests of Building Construction and Materials.
3. ASTM E814 Rev A – Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
4. ASTM E1966 – Standard Test Method for Fire-Resistive Joint Systems.

B. FM Global:

1. FM – Approval Guide: A Guide to Equipment, Materials and Services Approved by Factory Mutual Research for Property Conservation.

C. National Fire Protection Association:

1. NFPA 70 – National Electrical Code.

D. Underwriters Laboratories Inc.:

1. UL 263 – Fire Tests of Building Construction and Materials.
2. UL 723 – Tests for Surface Burning Characteristics of Building Materials.
3. UL 1479 – Fire Tests of Through-Penetration Firestops.
4. UL 2079 Tests for Fire Resistance of Building Joint Systems.
5. UL – Fire Resistance Directory.

E. Intertek Testing Services (Warnock Hersey Listed):

1. WH – Certification Listings.

1.3 SYSTEM DESCRIPTIONS

A. Firestopping Materials: UL 1479 to achieve fire ratings as noted on Drawings for adjacent construction, but not less than 1 hour fire rating.

1. Ratings may be 3-hours for firestopping in through-penetrations of 4-hour fire rated assemblies unless otherwise required by applicable codes.

1.4 PERFORMANCE REQUIREMENTS

A. Firestopping:

1. Conform to applicable code and UL1479 for fire resistance ratings and surface burning characteristics.
2. Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

1.5 SUBMITTALS

A. Submittal Procedures: Requirements for submittals.

B. Product Data:

1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
2. Firestopping: Submit data on product characteristics, performance and limitation criteria.

C. Manufacturer's Installation Instructions:

1. Hangers and Supports: Submit special procedures and assembly of components.
2. Firestopping: Submit preparation and installation instructions.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

E. Engineering Judgments: For conditions not covered by UL or WH listed designs, submit judgments by licensed professional engineer suitable for presentation to authority having jurisdiction for acceptance as meeting code fire protection requirements.

1.6 CLOSEOUT SUBMITTALS

A. Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations of hangers and supports on the plan drawings. Provide manufactures and model numbers of actual hanger and supports used.

1.7 QUALITY ASSURANCE

A. Through Penetration Firestopping of Fire Rated Assemblies: UL1479 or ASTM E814 with 0.10 inch water gauge minimum positive pressure differential to achieve fire ratings as indicated on Drawings, but not less than 1-hour.

B. Through Penetration Firestopping of Non-Fire Rated Floor and Roof Assemblies: Materials to resist free passage of flame and products of combustion.

1. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.
2. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.

C. Fire Resistant Joints in Fire Rated Floor, Roof and Wall Assemblies: ASTM E1966 or UL 2079 to achieve fire resistant rating as indicated on drawings for assembly in which joint is installed.

D. Fire Resistant Joints Between Floor Slabs and Exterior Walls: ASTM E119 with 0.10 inch water gage minimum positive pressure differential to achieve fire separation rating as indicated on drawings for floor assembly.

E. Surface Burning Characteristics: 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

F. Perform work in accordance with the State of North Carolina and local AHJ standards.

G. Maintain one copy of each referenced standard on site.

1.8 QUALIFICATIONS

A. The manufacturing company of products specified in this section is required to have a minimum of five years documented experience.

B. The installing company specializing in performing work of this section is required to have a minimum of three years documented experience approved by the manufacturer.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

C. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Product Requirements: Environmental conditions affecting products on site.

B. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F.

C. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.

D. Provide ventilation in areas to receive solvent cured materials.

1.11 SUPPORT HANGERS AND APPLICATIONS

A. Interior Dry Non-Process Locations: Metallic conduit supports and channel.

B. Exterior Locations: Non-metallic conduit supports and channel.

PART 2 PRODUCTS

2.1 METALLIC CONDUIT SUPPORTS

A. Manufacturers:

1. Cooper B-Line Systems.
2. Unistrut Corporation.
3. O-Z/Gedney.
4. Substitutions: As approved.

B. Hanger Rods: Threaded high tensile strength galvanized carbon steel with free running threads.

C. Beam Clamps: Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.

D. Conduit clamps for trapeze hangers: Galvanized steel, notched to fit trapeze with single bolt to tighten.

E. Conduit Clamps - General Purpose: One hole malleable iron for surface mounted conduits.

F. Cable Ties: High strength nylon temperature rated to 185 degrees F. self locking.

2.2 METALLIC FORMED CHANNEL

A. Manufacturers:

1. Cooper B-Line Systems.
2. Unistrut Corporation.
3. Substitutions: As approved.

B. Product Description: Hot Dip galvanized 12 gauge thick steel. With holes 1-1/2 inches on center.

2.3 METALLIC SPRING CLIPS

A. Manufacturers:

1. B-Line Systems.
2. Unistrut Corporation.
3. Substitutions: As approved.

B. Product Description: Mounting hole and screw closure.

2.4 SLEEVES

A. Furnish materials in accordance with Fire Code standards.

B. Sleeves for conduits Through Non-fire Rated Floors: 18 gage thick galvanized steel.

C. Sleeves for conduits Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.

D. Sleeves for conduits Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.

E. Fire-stopping Insulation: Glass fiber type, non-combustible.

2.5 MECHANICAL SLEEVE SEALS

A. Manufacturers:

1. Thunderline Link-Seal, Inc.
2. Calpico Inc.
3. Substitutions: As Approved.

B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.6 FIRESTOPPING

A. Manufacturers:

1. Dow Corning Corp.

2. 3M Fire Protection Products.
3. Hilti Corp.
4. Specified Technologies Inc.

B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application on the project.

1. Silicone Elastomeric Firestopping: Multiple component silicone elastomeric compound and compatible silicone sealant.
2. Foam Firestopping Compounds: Multiple component foam compound.
3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
4. Fiber Stuffing and Sealant Firestopping: Composite of mineral ceramic fiber stuffing insulation with silicone elastomer for smoke stopping.
5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
7. Firestop Pillows: Formed mineral fiber pillows.
8. The mixing of firestopping products in an assembly is not permissible.

C. Color: Varies my manufacturer.

2.7 FIRESTOPPING ACCESSORIES

A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.

B. Dam Material (Permanent):

1. Mineral fiberboard.
2. Mineral fiber matting.
3. Sheet metal.
4. Alumina silicate fire board.

C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

D. General:

1. Furnish UL listed products or products tested by independent testing laboratory.
2. Select products with rating not less than rating of wall or floor being penetrated.

E. Non-Rated Surfaces:

1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where conduit is exposed.
2. For exterior wall openings below grade, furnish modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill annular space between conduit and cored opening or water-stop type wall sleeve.

2.8 NON-METALLIC CONDUIT SUPPORTS

A. Manufacturers:

1. Cooper B-Line Systems.
2. Enduro Composites.
3. Carlon.
4. Substitutions: Not permitted.

B. Hanger Rods: Threaded FRP (vinyl ester resin) with free running threads.

C. Beam Clamps: FRP with tapered hole in base and back to accept either bolt or hanger rod. Set screw: stainless steel.

D. Conduit clamps for trapeze hangers: Fiberglass reinforced thermoplastic polyester resin, notched to fit trapeze with single stainless steel bolt to tighten.

E. Cable Ties: High strength nylon temperature rated to 185º F. self locking.

2.9 NON-METALLIC FORMED CHANNEL

A. Manufacturers:

1. Enduro Composites.
2. Cooper B-Line Systems.
3. Kindorf.
4. Substitutions: As approved.

B. Product Description: Fiberglass reinforced vinyl ester resin with holes 1½ inches on center.

2.10 NON-METALLIC SPRING CLIPS

A. Manufacturers:

1. Enduro Composites.
2. Cooper B-Line Systems.
3. Kindorf.
4. Substitutions: As approved.

B. Product Description: Fiberglass reinforced vinyl ester resin mounting hole and screw enclosure.

PART 3 EXECUTION

3.1 EXAMINATION

A. Administrative Requirements: Verification of existing conditions before starting work.

B. Verify openings are ready to receive sleeves.

C. Verify openings are ready to receive firestopping.

3.2 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.

B. Remove incompatible materials affecting bond.

C. Install backing damming materials to arrest liquid material leakage.

D. Do not drill or cut structural members.

3.3 INSTALLATION - HANGERS AND SUPPORTS

A. Anchors and Fasteners:

1. Concrete Structural Elements: Provide expansion anchors.
2. Steel Structural Elements: Provide beam clamps.
3. Concrete Surfaces: Provide self-drilling anchors and expansion anchors.
4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Provide toggle bolts and hollow wall fasteners.
5. Solid Masonry Walls: Provide expansion anchors and preset inserts.
6. Sheet Metal: Provide sheet metal screws.
7. Wood Elements: Provide wood screws.

B. Inserts:

1. Install inserts for placement in concrete forms.
2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut flush with top of slab.

C. Install conduit and raceway support and spacing in accordance with NEC.

D. Do not fasten supports to pipes, ducts, mechanical equipment, or other conduit.

E. Install multiple conduit runs on common hangers.

F. Supports:

1. Fabricate supports from structural steel or formed channel. Install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.
2. Install surface mounted cabinets and panels with minimum of four anchors.
3. In wet and damp locations install non-metallic channel supports to stand cabinets and panels 1 inch off wall.
4. Support vertical conduit at every other floor.
5. Apply cold galvanizing compound to cut ends of formed steel channel.

3.4 INSTALLATION - FIRESTOPPING

A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping.

B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.

C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating to uniform density and texture.

D. Compress fibered material to maximum 40 percent of its uncompressed size.

E. Remove dam material after firestopping material has cured.

F. Fire Rated Surface:

1. Seal opening at floor, wall, partition, ceiling, and roof as follows:

    a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
    b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
    c. Pack void with backing material.
    d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
2. Where cable tray, conduit, wireway, trough, and piping penetrates fire rated surface, install firestopping product in accordance with manufacturer's instructions.

G. Non-Rated Surfaces:

1. Seal opening through non-fire rated wall, partition floor, ceiling, and roof opening as follows:

    a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
    b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
    c. Install type of firestopping material recommended by manufacturer.

2. Install floor plates or ceiling plates where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
3. Exterior wall openings below grade: Assemble rubber links of mechanical seal to size of conduit and tighten in place, in accordance with manufacturer's instructions.
4. Interior partitions: Seal conduit penetrations at computer rooms, telecommunication rooms and data rooms. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

H. Label all firestopping locations and record location and type of firestopping assembly used.

3.5 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

A. Provide housekeeping pads of concrete, minimum 3-1/2 inches thick and extending 6 inches beyond supported equipment, with embedded steel welding/bolting channel, as detailed on the drawings. Refer to Section 033000.

B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.

C. Construct supports of formed steel channel. Brace and fasten with flanges bolted to structure.

3.6 INSTALLATION - SLEEVES

A. Exterior watertight entries: Seal with adjustable interlocking rubber links.

B. Conduit penetrations not required to be watertight: Sleeve and fill with silicon foam.

C. Set sleeves in position in forms. Provide reinforcing around sleeves.

D. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

E. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.

F. Where conduit or raceway penetrates floor, ceiling, or wall, close off space between conduit or raceway and adjacent work with stuffing fire stopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

G. Install stainless steel escutcheons at finished surfaces.

3.7 FIELD QUALITY CONTROL

A. Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.

B. Inspect installed firestopping for compliance with specifications.

C. Verify all firestopping locations are labeled and cataloged.

3.8 CLEANING

A. Execution and Closeout Requirements: Requirements for cleaning.

B. Clean adjacent surfaces of firestopping materials.

C. Record firestop locations on drawings.

3.9 PROTECTION OF FINISHED WORK

A. Protect adjacent surfaces from damage by material installation.

END OF SECTION 270529

SECTION 270533 – CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes conduit and tubing, surface raceways, wireways, outlet boxes, pull and junction boxes, and handholes.

B. Related Sections:
1. Division 01 Specifications.
2. Section 260533 - Raceway and Boxes for Electrical Systems.
3. Section 262726 - Wiring Devices.
4. Section 270526 - Grounding and Bonding for Communications Systems.
5. Section 270529 - Hangers and Supports for Communications Systems.
6. Section 270536 - Cable Tray for Communications Systems.
7. Section 270553 - Identification for Communications Systems.

C. CAUTION! Use of this Section without including all of the above-listed items will result in the omission of basic requirements.

1.2 REFERENCES

A. National Electrical Manufacturers Association:
1. NEMA C80.1 - Rigid Steel Conduit.
2. NEMA C80.3 - Specification for Electrical Metallic Tubing NEMA C80.1 - Rigid Steel Conduit.
3. NEMA C80.3 - Specification for Electrical Metallic Tubing.
4. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
5. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
6. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
7. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.
8. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
9. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

B. National Fire Protection Association: NFPA 70 – National Electrical Code (NEC)

1.3 SYSTEM DESCRIPTION

A. Raceway and boxes located as indicated on Drawings, and at other locations required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceway to complete wiring system.

B. Outdoor Locations, Above Grade: Provide galvanized rigid steel conduit. Provide cast metal or nonmetallic outlet, pull, and junction boxes.

C. Concealed Dry Locations: Provide electrical metallic tubing (EMT) conduit with compression fittings. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.

D. Exposed Dry Locations: Provide electrical metallic tubing conduit with compression fittings or aluminum cable tray. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.

E. Concrete Encased: Provide rigid non-metallic conduit.

1.4 SUBMITTALS

A. Submittal Procedures: Requirements for submittals.

B. Product Data: Submit for the following:
1. Flexible metal conduit.
2. Liquidtight flexible metal conduit.
3. Nonmetallic conduit.
4. Raceway fittings.
5. Conduit bodies.
6. Surface raceway.
7. Wireway.
8. Pull and junction boxes.
9. Handholes.

C. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.5 CLOSEOUT SUBMITTALS

A. Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents:
1. Record actual routing of conduits larger than 3/4 inch.
2. Record actual locations and mounting heights of outlet, pull, and junction boxes.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

B. Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of a RCDD / RCDD/NTS or Commercial Installer, Level 2.

C. Installation Supervision: Installation shall be under the direct supervision of a Registered Technician, Level 2 Installer, who shall be present at all times when work of this section is performed at project site.

D. Field Inspector: Currently registered by BICSI as a RCDD, or Commercial Installer Level 2 to perform the on-site inspection.

E. Provide grounding of cabinets, racks and IDF equipment enclosures in accordance with latest version of grounding, Bonding and Electrical Protection chapter of the BICSI TDMM Manual, ANSI/TIA-607-B, and NFPA 70.

F. Perform work in accordance with the State of North Carolina and local AHJ standards.

G. Maintain one copy of each document on site.

1.7 QUALIFICATIONS

A. The manufacturing company of products specified products specified in this section are required to have a minimum of five years documented experience.

B. The installing company specializing in performing work of this section is required to have a minimum of three years documented experience approved by the manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Product Requirements: Product storage and handling requirements.

B. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

C. Protect PVC conduit from sunlight.

1.9 COORDINATION

A. Administrative Requirements: Coordination and project conditions.

B. Coordinate mounting heights, orientation and locations of outlets mounted above counters, benches, and backsplashes.

PART 2 PRODUCTS

2.1 METAL CONDUIT

A. Manufacturers:
   1. Western Conduit.
   2. Allied Conduit.
   3. Substitutions: As approved.

B. Rigid Steel Conduit: NEMA C80.1.

C. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit.

2.2 FLEXIBLE METAL CONDUIT

A. Manufacturers:
   1. Anamet Electrical, Inc.
   2. Substitutions: As approved.

B. Product Description: Interlocked steel construction.

C. Fittings: NEMA FB 1.

2.3 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

A. Manufacturers:
1. Anamet Electrical, Inc.
2. Substitutions: As approved.

B. Product Description: Interlocked steel construction with PVC jacket.

C. Fittings: NEMA FB 1.

2.4 ELECTRICAL METALLIC TUBING (EMT)

A. Manufacturers:
1. Western Conduit.
2. Allied Conduit.
3. Substitutions: As approved.

B. Product Description: NEMA C80.3; galvanized tubing.

C. Fittings and Conduit Bodies: NEMA FB 1; malleable iron, compression type.

2.5 NONMETALLIC CONDUIT

A. Manufacturers:
1. Carlon Electrical Products.
2. Substitutions: As approved.

B. Product Description: NEMA TC 2; Schedule 80 PVC.

C. Fittings and Conduit Bodies: NEMA TC 3.

2.6 WIREWAY

A. Manufacturers:
1. Square D Company.
2. Circle AW Company.
3. Legrand.
4. Hoffman Company.
5. Cooper B-Line.
6. Substitutions: As approved.

B. Product Description: General purpose, oil tight, dust-tight and rain tight type wireway.

C. Knockouts: Manufacturer's standard.

D. Size: As shown on the Drawings.

E. Cover: Hinged cover with full gaskets.

F. Connector: Slip-in.

G. Fittings: Lay-in type with removable top.

H. Finish: Rust inhibiting primer coating with gray enamel finish.

2.7 OUTLET BOXES

A. Manufacturers:
1. Carlon Electrical Products.
2. Hubbell Wiring Devices.
3. Thomas & Betts.
4. Circle AW Company.
5. Substitutions: As Approved.

B. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
1. Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2 inch male fixture studs where required.
2. Concrete Ceiling Boxes: Concrete type.

C. Nonmetallic Outlet Boxes: NEMA OS 2.

D. Cast Boxes: NEMA FB 1, Type FD, plastic coated cast feralloy. Furnish plastic coated cover with gasket by box manufacturer. Furnish threaded hubs.

E. Wall Plates for Finished Areas: As specified by Greenville Transit IT system owner.

F. Wall Plates for Unfinished Areas: Furnish cover with gasket.

2.8 PULL AND JUNCTION BOXES

A. Manufacturers:
1. Carlon Electrical Products.
2. Hubbell Wiring Devices.
3. Thomas & Betts Corp.
4. Walker Systems Inc.
5. The Wiremold Co.
6. Brooks Co.
7. Substitutions: As approved.

B. Sheet Metal Boxes: NEMA OS 1, galvanized steel. Provide painted or powder coated boxes in process areas.

C. Surface Mounted Cast Metal Box: NEMA 250, Type 4X flat-flanged, surface mounted junction box:
1. Material: Galvanized cast iron.
2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.

D. Recessed Cast Metal Box; NEMA 250, Type 6, outside flanged recessed cover box for flush mounting:
   1. Material: Galvanized cast iron.
   2. Cover: Nonskid cover with neoprene gasket and stainless steel cover screws.

E. Handholes and Boxes: Pre-cast concrete communications hand holes:
   1. Manufacturers:
      a. Hubbell – Quazite.
      b. Jensen.
      c. Old Castle.
      d. Substitutions: As approved.
   2. Cable Entrance: Pre-cut (2) 4 ¾ inch x 4 ¾ inch conduit entrances at bottom of each side.
   3. Cover: Concrete composite, weatherproof cover with nonskid finish and penta head bolts.
   4. Cover Legend: “COMM,” etc. as indicated on the drawings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Administrative Requirements: Coordination and project conditions.

B. Verify outlet locations and routing and termination locations of raceway prior to rough-in.

3.2 INSTALLATION

A. Install Work in accordance with State of North Carolina and the local Authority Having Jurisdiction (AHJ) Standards.

3.3 INSTALLATION - RACEWAY

A. Raceway routing is shown in approximate locations unless dimensioned. Route to complete wiring system.

B. Arrange raceway supports to prevent misalignment during wiring installation.

C. Support raceway per Section 270529.

D. Group related raceway; support using conduit rack. Construct rack using steel channel specified in Section 270529; provide space on each for 25 percent additional raceways.

E. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports

F. Do not attach raceway to ceiling support wires or other piping systems.

G. Construct wireway supports from steel channel specified in Section 270529.

H. Route exposed raceway parallel and perpendicular to walls.

I. Route raceway installed above accessible ceilings parallel and perpendicular to walls.

J. Route conduit in and under slab from point-to-point.

K. Maintain clearance between raceway and piping for maintenance purposes.

L. Maintain 12 inch clearance between raceway and surfaces with temperatures exceeding 104 degrees F.

M. Cut conduit square using metal saw; de-burr cut ends.

N. Bring conduit to shoulder of fittings; fasten securely.

O. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for minimum 20 minutes.

P. Install conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.

Q. Install no more than the equivalent of two 90 degree bends between boxes. Install conduit bodies to make sharp changes in direction, as around beams. Install factory elbows for bends in metal conduit larger than 2 inch size.

R. Avoid moisture traps; install junction box with drain fitting at low points in conduit system.

S. Install fittings to accommodate expansion and deflection where raceway crosses control, and expansion joints.

T. Install suitable pull string or cord in each empty raceway except sleeves and nipples.

U. Install suitable caps to protect installed conduit against entrance of dirt and moisture.

V. Close ends and unused openings in wireway.

3.4 INSTALLATION - BOXES

A. Install wall mounted boxes at elevations to accommodate mounting heights as shown on the Drawings.

B. Adjust box location up to 4 feet prior to rough-in to accommodate intended purpose.

C. Orient boxes to accommodate wiring devices oriented as specified in Section 270529.

D. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.

E. In Accessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.

F. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.

G. Do not install flush mounting box back-to-back in walls; install with minimum 6 inches separation. Install with minimum 24 inches separation in acoustic rated walls.

H. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.

I. Install stamped steel bridges to fasten flush mounting outlet box between studs.

J. Install flush mounting box without damaging wall insulation or reducing its effectiveness.

K. Install adjustable steel channel fasteners for hung ceiling outlet box.

L. Do not fasten boxes to ceiling support wires or other piping systems.

M. Support boxes independently of conduit.

N. Install gang box where more than one device is mounted together. Do not use sectional box.

O. Install gang box with plaster ring for single device outlets.

3.5 INSTALLATION OF HANDHOLES

A. Install handhole over a compacted 6 inch ¾” gravel base.

B. Install handhole to be flush with finished grade, walkway, or roadway.

C. Dry pack concrete around conduit entrances.

D. Install plugs in unused conduits and seal around cabling to prevent pests from entering conduits.

3.6 INTERFACE WITH OTHER PRODUCTS

A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods in accordance with this Section.

B. Locate ceiling mounted outlet boxes to allow separation from luminaires positioned as indicated on Drawings and reflected ceiling plan.

C. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

3.7 ADJUSTING

A. Execution and Closeout Requirements: Testing, adjusting, and balancing.

B. Adjust flush-mounting outlets to make front flush with finished wall material.

C. Install knockout closures in unused openings in boxes.

3.8 CLEANING

A. Execution and Closeout Requirements: Final cleaning.

B. Clean interior of boxes to remove dust, debris, and other material.

C. Clean exposed surfaces and restore finish.

END OF SECTION 270533

270536 - CABLE TRAY FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes cable tray.

B. Related Sections:

1. Division 01 Specifications.
2. Section 270526 - Grounding and Bonding for Communications Systems.
3. Section 270529 - Hangers and Supports for Communications Systems.

1.2 REFERENCES

A. National Electrical Manufacturers Association:

1. NEMA VE 1 - Metallic Cable Tray Systems
2. NEMA VE 2 - Cable Tray Installation Guidelines

B. NFPA 70 - National Electrical Code

1.3 SYSTEM DESCRIPTION

A. Ventilated trough type cable trays consisting of two longitudinal members (side rails) with a corrugated bottom welded to the side rails. The ventilated trough permits easy access to the tray and provides continuous ventilation of cables installed in the tray. A continuous ground conductor fixing system is accomplished by the use of approved splices and bonding jumpers.

1.4 SUBMITTALS

A. Administrative Requirements: Submittal procedures.

B. Shop Drawings: Indicate tray type, dimensions, support points, and finishes.

C. Product Data: Submit fittings and accessories.

D. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.5 CLOSEOUT SUBMITTALS

A. Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual routing of cable tray and locations of supports.

1.6 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 a RCDD / RCDD/NTS or Commercial Installer, Level 2.
2. Installation Supervision: Installation shall be under the direct supervision of a Registered Technician, 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 a RCDD, or Commercial Installer Level 2 to perform the on-site inspection.

B. Provide grounding of wire mesh cable tray in accordance with latest version of Grounding, Bonding and Electrical Protection chapter of the BICSI TDM Manual, ANSI/TIA-607-B, and NFPA 70.

C. Perform work in accordance with the State of North Carolina and local AHJ standards.

D. Maintain one copy of each document on site.

1.7 QUALIFICATIONS

A. The manufacturing company of products specified products specified in this section are required to have a minimum of five years documented experience.

B. The installing company specializing in performing work of this section is required to have a minimum of three years documented experience approved by the manufacturer.

1.8 COORDINATION

A. Pre-Installation Meetings:

1. Convene minimum one meeting, one week prior to commencing work of this section.

B. The contractor is to coordinate with the Greenville Transit IT Services/Infrastructure Services, prior to commencing any basket tray installations.

PART 2 PRODUCTS

2.1 WIRE MESH CABLE TRAY

A. Manufacturer:

1. Cooper B-Line.
2. Legrand.
3. Or Equal.

B. Product Description: System specified shall be UL Classified and listed.

C. Material: Carbon Steel.

D. Finish: Hot dipped galvanized.

E. Applicable Standards:

1. NEMA VE1 Standard for Metal Cable Tray Systems
2. IEC 61537 Cable Tray Systems and Cable Ladder Systems for Electrical Installations

F. Inside Width: 12 inches, 18 inches and 24 inches, as indicated on drawings.

G. Overall Depth: 4 inches and 6 inches as indicated on drawings.

H. Straight Section Length: 10 feet.

I. Furnish manufacturer's standard clamps, hangers, brackets, splice plates, reducer plates, blind ends, drop-outs, barrier strips, barrier bridges, connectors, and grounding straps.

2.2 WARNING SIGNS

A. Engraved Nameplates: 1/2 inch black letters on yellow laminated plastic nameplate, engraved with: WARNING! DO NOT USE CABLE TRAY AS WALKWAY, LADDER, OR SUPPORT. USE ONLY AS MECHANICAL SUPPORT FOR CABLES AND TUBING!

PART 3 EXECUTION

3.1 EXAMINATION

A. Inspect areas to receive cable management system. Notify the Engineer of conditions that would adversely affect the installation or subsequent utilization of the system. DO NOT proceed with the installation until the unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Install Wire Mesh Cable Tray in accordance with NEMA VE 2.

B. Support trays and fasten to structure and finishes in accordance with Section 270529. Install supports at each connection point, at end of each run, and at other points to maintain spacing between supports of five feet minimum.

C. Install expansion connectors where recommended by manufacturer.

D. Install firestopping in accordance with Section 270529 to sustain ratings when passing cable tray through fire-rated elements.

E. Ground and bond Wire Mesh Basket tray in accordance with Section 270526 and manufacturers specifications.

F. Install warning signs at 50 feet centers along cable tray, located to be visible.

END OF SECTION 270536

SECTION 270553 - IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Nameplates.
2. Labels.
3. Wire markers.
4. Conduit markers.
5. Stencils.
6. Underground Warning Tape.
7. Lockout Devices.

B. Related Sections:

1. Division 01 Specifications.

C. This Section shall be used in conjunction with the following other specifications and related Contract Documents to establish the total requirements for communications identification:

1. Section 260553 – Identification for Electrical Systems.
2. Section 270000 – Communications.

D. CAUTION! Use of this Section without including all of the above-listed items will result in omission of basic requirements.

E. In the event of conflict regarding communications identification requirements between this Section and any other section, the provisions of this Section shall govern.

1.2 REFERENCES

A. Reference Standards.

B. See ANSI/TIA -606-B, Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.

1.3 SYSTEM DESCRIPTION

A. This Section specifies the requirements necessary to furnish and install communications space, pathway, telecommunication racks, cable, termination hardware, and equipment labeling and marking.

1.4 SUBMITTALS

A. Provide the following within 30 days after award of Contract:

1. Communications identification plan.
2. Samples of label materials, finished labels and nameplates.

1.5 CLOSEOUT SUBMITTALS

A. Execution and closeout requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations of tagged devices; include tag numbers. Provide this information in the form of hard copy redline construction drawing mark ups to Owner's Representative.

1.6 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 a RCDD / RCDD/NTS or Commercial Installer, Level 2.
2. Installation Supervision: Installation shall be under the direct supervision of a Registered Technician, 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 a RCDD, or Commercial Installer Level 2 to perform the on-site inspection.

B. Provide identification for communications systems in accordance with latest version of Telecommunication Administration chapter of the BICSI TDMM Manual, ANSI/TIA-606-A, and NFPA 70.

C. Perform work in accordance with the State of North Carolina and local AHJ standards.

1.7 QUALIFICATIONS

A. The manufacturing company of products specified in this section is required to have a minimum of three years documented experience.

B. The installing company specializing in performing work of this section is required to have a minimum of three years documented experience approved by the manufacturer.

1.8 COORDINATION

A. Contractor to coordinate with Greenville Transit IT system owner for final approval of the standard labeling scheme prior to commencing installation.

PART 2 PRODUCTS

2.1 MATERIALS

A. Nameplates: Unless otherwise specified, provide engraved, three-layer laminated plastic, minimum 3/16-inch-high black letters on a white background. Telecommunications Room, MDF IDF, and cable tray nameplates are specified below.

B. Adhesive-Backed Labels: Use a label-making machine or printer to construct adhesive-backed label tabs from plastic or paper strips. Handwritten labels are unacceptable.

C. Cable Labels:

1. Four-pair UTP and Fiber Optic Cables in Horizontal Segment: Provide adhesive-backed labels suitable for printing and bonding to cables.
2. Fiber Optic Cable in Backbone Segments: Provide white, laminated plastic style suitable for printing and secure attachment.

D. Patch Panel Labels: Cardboard-like strips that slip inside clear plastic designation strips or label holders located on protector panels and wiring blocks. These are color coded for use with typewriter. Labels may be provided with the equipment or added by the use of adhesive attached cardholders or labels.

E. Fiber Optic Distribution Unit (FDU) Labels: Labels may be provided with the equipment or added by the use of adhesive attached cardholders or labels.

F. Telecommunications Outlet (TO) Labels: Use a printer or label-making machine to construct adhesive-backed label tabs from plastic or paper strips. Handwritten labels are unacceptable.

PART 3 EXECUTION

3.1 EXAMINATION

A. The Contractor to coordinate with Greenville Transit IT Services/Infrastructure Services for approved labeling prior to commencing installation.

3.2 PREPARATION

A. The Contractor shall develop an identification plan for communications materials and equipment which accommodates the specific system products furnished, i.e., cable, wiring blocks, FDUs, other equipment room components, T.O.’s, etc. This plan shall address proposals for implementation of the requirements included in this specification section for label placement, materials to be used, the printing methods and format.

3.3 INSTALLATION

A. Degrease and clean surfaces to receive nameplates or labels.

B. Install nameplates and/or labels parallel to equipment lines.

END OF SECTION 270553

SECTION 270800 - COMMISSIONING OF COMMUNICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies the requirements necessary for the testing and commissioning of fiber optic and copper Communications cabling.

B. Related Sections: This section shall be used in conjunction with the following other specification sections and related contract documents to establish the total requirements for the testing and commissioning of fiber and copper communications cabling:

1. Division 01 Specifications.
2. Section 270000 – Communications.
3. Section 270526 - Grounding and Bonding for Communications Systems.
4. Section 270553 - Identification for Communications Systems.
5. Section 271119 - Communications Termination Blocks and Patch Panels.
6. Section 271519 - Data Communications Horizontal Cabling.
7. Section 271543 - Communications Faceplates and Connectors.

C. CAUTION! Use of this Section without including all of the above-listed items will result in omission of basic requirements.

D. In the event of conflict regarding Commissioning of Communications requirements between this Section and any other section, the provisions of this Section shall govern.

1.2 REFERENCES

A. American National Standards Institute / Telecommunications Industry Association.

1. ANSI/TIA-568-C.0 – Commercial Building Telecommunication Cabling Standard Optical Fiber Testing and Limits.
2. ANSI/TIA-568-C.2 – Commercial Building Telecommunication Cabling Standard Balanced Twisted Pair Testing and Limits.
3. ANSI/TIA-526 - Standard Test Procedure for Fiber Optic Systems
4. ANSI/TIA-526.7 - OFSTP 7 Measurement of Optical Power Loss of Installed Singlemode Fiber Cable Plant
5. ANSI/TIA-526.14A - OFSTP 14A Optical Power Loss of Installed Multimode Fiber Cable Plant
6. ANSI/TIA-TSB-67 – Transmission Performance Specifications for Field Testing of Unshielded Twisted Pair Cabling Systems.

1.3 SYSTEM DESCRIPTION

A. Contractor will implement a comprehensive plan for the testing and commissioning of all cabling and infrastructure components comprising the communications distribution system. The communications distribution system may be used to support one or more of the following services and systems:

1. Voice services.
2. Local area networks.
3. Data telecommunications.
4. Video services.
5. Wireless systems.
6. Facilities management systems.
7. Access Systems.

B. The work locations and limits of work are shown on the Drawings.

1.4 SUBMITTALS

A. Calibration certification of test equipment. (Must be less than 1 year old prior to completion of testing).

B. Product Data: Manufacturer's descriptive literature for test equipment specified in this section.

C. All balanced twisted pair field testers shall be factory calibrated each calendar year by the field test equipment manufacturer as stipulated by the manuals provided with the field test unit. The calibration certificate shall be provided for review prior to the start of testing.

D. All optical fiber test equipment shall be factory calibrated as recommended by the field test equipment manufacturer. The calibration certificate shall be provided for review prior to the start of testing.

1.5 CLOSEOUT SUBMITTALS

A. Test documentation as listed in specification.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Testing Responsibility: Fiber and Copper Testing shall be under the direct supervision of a RCDD / RCDD/NTS or Commercial Installer Level 2.
2. Installation Supervision: Installation shall be under the direct supervision of a Registered Technician, Commercial Installer Level 2, 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 a RCDD, or Commercial Installer Level 2 to perform the on-site inspection.

B. All Category 6 field testing shall be performed with an approved Level IV balanced twisted-pair field test device.

C. All installed Category 6 channels shall perform equal to or better than the minimum requirements as specified by the current ANSI/TIA-C.1 standards for Category 6. If the cable manufacturer has a separate, more stringent set of test standards required to certify the total solution being installed, the contractor shall use the more stringent requirements.

D. The contractor shall provide the Greenville Transit IT system owner with printed electronic forms of all tests. The test results shall be unedited and as presented by the tester software. With the test results, the contractor shall provide software from the tester manufacturer to enable viewing of test results in its' native form. If software is not available, test results may be provided in comma-delimited text format. This must be pre-approved by the Greenville IT systems owner.

E. Perform work in accordance with the State of North Carolina and local AHJ standards.

F. Maintain one copy of each document on site.

1.7 QUALIFICATIONS

A. The manufacturing company of the testing equipment specified in this section, is required to have a minimum of five years documented experience.

B. The installing company specializing in performing work of this section is required to have a minimum of three years documented experience approved by the manufacturer.

1.8 COORDINATION

A. The contractor is to coordinate with the Greenville IT system owner, prior to commencing any testing of fiber optic or copper cable.

1. Convene a minimum of one meeting one week prior to commencing work of this section.

B. Before Acceptance Tests are scheduled, the Contractor is to perform his own system checkout. Furnish required test equipment and perform the Work necessary to determine and modify performance of system to meet requirements.

1. Maintain documentation of performance tests for review by the Greenville Transit IT system owner during the System Acceptance Tests.

PART 2 - PRODUCTS

2.1 GENERAL

A. Twisted-Pair Cabling Tests: Level IV accuracy Field Testers are required for use for all Category 3 or higher Category cabling. The appropriate, TIA, factory default settings are required to be used without modification.

B. Fiber Optic Cabling Tests: Optical Time Domain Reflectometer (OTDR) and Optical Power Meter and Light Source shall meet or exceed applicable requirements in TIA/EIA-568-C.0. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

PART 3 - EXECUTION

3.1 PREPARATION

A. The contractor shall set the testers to the correct cable, by manufacturer and name, to ensure correct parameters are used during testing. Test setting selected from options provided in the field testers shall be compatible with the installed cable under test.

3.2 TESTING

A. Unshielded Twisted-Pair Cable System Testing:

1. Category 6 balanced unshielded twisted-pair horizontal cables, whose length shall not exceed 90 m (295 ft) for the basic link, and 100 m (328 ft) for the channel shall be 100 percent tested according to ANSI/TIA-568-C.2. Test parameters include wire map plus ScTP shield continuity (when present), length, NEXT loss (pair-to-pair), NEXT loss (power sum), ELFEXT loss (pair-to-pair), ELFEXT loss (power sum), return loss, insertion loss, propagation delay, and delay skew.
2. Requirements and recommendations for connections, test configurations, measurement procedures and precautions that are specified in the manuals provided with the tester shall be followed. Test settings selected from the options provided in the field testers shall be compatible with the installed cabling under test. It is important to select the proper test settings based on the installed components and configuration of the cabling system to be tested. Tester settings that need to be reviewed for proper testing include the Permanent Link or Channel, type of cable, NVP of cable, and performance of the category or class of cabling to be qualified.
3. All 4-pair cabling shall be tested in accordance with the Level IV Field Tester, Category 6 or higher category using the Permanent Link, factory default settings. The appropriate factory default settings are required to be used without modification.
4. Any cable links with pairs that fail to meet performance test criteria shall be re-terminated, or replaced by the Contractor at no cost to the Owner.
5. Submit final field test documentation in list form. Utilize cable test summary form shown in Section 4.1 for test findings.

B. Fiber Optic Cable Reel Testing

1. On-reel cable testing to be performed prior to installation.
2. The Contractor shall be responsible for performing metered fiber optic tests on complete reels of any cable with fiber optic components, as soon as possible after delivery to the project site. On-the-reel testing shall be performed and approved prior to cable placement.
3. Visually inspect all cable reels to ensure there is no damage and that each reel holds one continuous cable.

4. Number each reel, list reel number on manufacturer's product test data shipped with the cable reel, and submit product test data to Owner.
5. Ensure factory-produced manufacturer's product test data conforms to product specifications included elsewhere in the Communications specifications.
6. Submit documentation to the Greenville IT system owner for Approval that provides the proposed testing sequence, expected duration, and scheduled date for the testing.
7. Testing procedures shall permit recording of factory and field-tested parameters for each fiber, including space for sign-off by Contractor and the Greenville Transit IT system owner.
8. Test each multimode fiber optic strand for continuity and loss in dB/km, at 850 nm and 1,300 nm, using a recording type OTDR with disk storage capability.
9. Test each singlemode fiber optic strand for continuity and loss in dB/km, at 1,310 nm and 1,550 nm, using a recording type OTDR with disk storage capabilities.
10. Any reel containing fiber strands that do not meet the manufacturer's test data criteria shall be replaced by the provider.
11. Submit field test documentation for each reel in list form, prior to installation, including Contractor's signature for Greenville Transit IT system owner approval. Submit final field test documentation in list form. Utilize cable test summary form shown on Section 4.1 for test findings.

C. Fiber Optic Cable System Testing:

1. Optical fiber field-testing requirements must adhere to TIA TSB-140, Additional guidelines for field-testing length, loss, and polarity of optical fiber cabling systems. The Tier 2 testing shall apply to all singlemode and multimode optical fiber cabling regardless of whether it is backbone or horizontal cabling. This bulletin is intended to clarify and not replace ANSI/TIA -526-7, Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant, Method A.1, one jumper reference and ANSI/TIA -526-14A, Measurement of Optical Power Loss of Installed Multimode Fiber Cable Plant, Method B, one jumper reference.
2. Optical Fiber Link Performance shall be tested with both the following:

    a. Agilent WIRESCOPE PRO test set with fiber adaptor or approved equal.

        1) End-to-end attenuation testing (3-step procedure).

            a) Multi-mode: ANSI/TIA-526-14A, Method B.
            b) Singlemode: ANSI/TIA-526-7.

    b. Corning Optical Time Domain Reflectometer (OTDR) or approved equal.

3. Testing shall be done after installation to ensure that the cable system meets the attenuation specifications.
4. Calculate maximum allowable link loss budgets for each optical fiber link based on worst-case loss limits and using 0.75 dB per mated connector pair for multimode fiber and 0.5dB per mated connector pair for singlemode fiber.
5. Test each installed and connectorized singlemode and multimode link for end-to-end attenuation through FDU's and/or communications outlet terminations using a power meter with a stabilized light source as well as OTDR.
6. OTDR traces revealing a point discontinuity greater that 0.2 dB in a multimode fiber at any of the tested wavelengths or any discontinuity showing a reflection at that point shall

be a valid basis for rejection of that fiber by the Owner. The installation of that cable shall be reviewed in an effort to remove any external stress that may be causing the fault. If such efforts do not remove the fault, that cable and the associated terminations shall be replaced at the expense of the Contractor.

7. OTDR traces of individual optical fiber "signatures" obtained as specified below shall be provided to the Greenville Transit IT system owner in hard copy for initial field review and acceptance and in electronic format on compact disk (CD) when completed. Trace files shall be so named as to identify each individual fiber by location in the cable system and fiber number or color. The Contractor shall also provide along with this documentation, a licensed copy of software that will allow for the display of OTDR traces on a DOS based personal computer (PC supplied by the Owner).
8. Test Jumpers: Refer to ANSI/TIA -526-7, Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant, Method A.1, one jumper reference and ANSI/TIA -526-14A, Measurement of Optical Power Loss of Installed Multimode Fiber Cable Plant, Method B, one jumper reference.
9. Test Reports: Include field test results for each fiber strand. The test summary shall include:

    a. Cable identification as it appears on the cable schedule.
    b. Cable identification as it is labeled according to Section 270553, Identification for Communications Systems.
    c. Pass or fail status for each fiber strand. (If a strand fails at one wavelength and passes at the other wavelength, the strand has failed).

10. Any fiber strands that fail to meet performance test criteria shall be re-terminated, re-connectorized, or replaced by the Contractor free of charge.
11. Electronic Media: Provide electronic media with final comprehensive schedules for the project in the software and format selected by Greenville Transit IT system owner.
12. Submit final field test documentation in list form. Utilize cable test summary form shown on Section 4.1 for test findings.

PART 4 - APPENDICES

4.1 FIELD TEST DOCUMENTATION FORMS

A. Fiber Optic Cable Post-Installation Cable Test Summary.

B. Horizontal Unshielded Twisted-Pair Test Summary.

C. On-The-Reel Fiber Optic Cable Test Summary.

D. Fiber Optic Attenuation Performance Test.

FIBER OPTIC CABLE POST-INSTALLATION CABLE TEST SUMMARY							
	CABLE IDENTIFICATION		STATUS		CABLE IDENTIFICATION		STATUS
ITEM	CABLE SCHEDULE LABEL	CABLE ID ACCORDING TO SPECIFICATIONS	PASS OR FAIL	ITEM	CABLE SCHEDULE LABEL	CABLE ID ACCORDING TO SPECIFICATIONS	PASS OR FAIL
1				26			
2				27			
3				28			
4				29			
5				30			
6				31			
7				32			
8				33			
9				34			
10				35			
11				36			
12				37			
13				38			
14				39			
15				40			
16				41			
17				42			
18				43			
19				44			
20				45			
21				46			
22				47			
23				48			
24				49			
25				50			

HORIZONTAL UNSHIELDED TWISTED-PAIR TEST SUMMARY				
	CABLE IDENTIFICATION			STATUS
ITEM	CABLE SCHEDULE LABEL	CABLE ID AS IT APPEARS ON THE INDIVIDUAL TEST REPORTS	CABLE ID ACCORDING TO SPECIFICATIONS	PASS OR FAIL
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				

ON-THE-REEL FIBER OPTIC CABLE TEST SUMMARY				
	CABLE IDENTIFICATION			STATUS
ITEM	CABLE SCHEDULE LABEL	OTDR PRINT-OUT LABEL	CABLE ID ACCORDING TO SPECIFICATIONS	PASS OR FAIL
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				

FIBER OPTIC ATTENUATION PERFORMANCE TEST							
Project Name:			Project #				
SEGMENT IDENTIFICATION							
Cable Run Number:		Source	Destination				
Building and Room Name:							
FDU Identification:							
TEST EQUIPMENT IDENTIFICATION							
	Calibration Date	Source Serial Number	Receiver Serial Number				
Attenuation Set							
FIBER SPECIFICATONS		CALCULATED SEGMENT ATTENUATION					
Manufacturer:		Segment Length: KM					
Part number:							
Core Diameter:	62.5 uM or 50 uM		850 nm	1300 nm	1550 nm		
Cladding Diameter:	125 uM	End-to-End loss:	dB	dB	N/A		
Max. Loss @ 850nm:	3.5 dB/KM	Splices: 0	0.00 dB	0.00 dB	0.00 dB		
Max. Loss @ 1300nm:	1.5 dB/KM	Mated Pair: 1	.75 dB	.75 dB	.75 dB		
Grade:	ISO/IEC OM1 or OM2	Total Attenuation	dB	dB	N/A dB		
MEASURED SEGMENT ATTENUATION							
FIBER NO.	850nm Wavelength Measured at	1300nm Wavelength Measured at	FIBER NO.	850nm Wavelength Measured at	1300nm Wavelength Measured at		
1	dB	dB	13	dB	dB		
2	dB	dB	14	dB	dB		
3	dB	dB	15	dB	dB		
4	dB	dB	16	dB	dB		
5	dB	dB	17	dB	dB		
6	dB	dB	18	dB	dB		
7	dB	dB	19	dB	dB		
8	dB	dB	20	dB	dB		
9	dB	dB	21	dB	dB		
10	dB	dB	22	dB	dB		
11	dB	dB	23	dB	dB		
12	dB	dB	24	dB	dB		
Test Performed By:			Date:				
Test Submitted By:			Date:				
Test Approved By:(Construction Manager)			Date:				
Test Observed By:(Design)			Date:				

END OF SECTION 270800

SECTION 271116 - COMMUNICATIONS CABINETS, RACKS, FRAMES AND ENCLOSURES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies the requirements to furnish and install a communications room subsystem to terminate and distribute the campus, vertical, and horizontal subsystems, including:

1. Backboards.
2. Network equipment frames and cabinets.
3. Communications equipment racks.
4. Server equipment frames and cabinets.
5. Cable management accessories.
6. Cabinet blank-off panels.

1.2 REFERENCES

A. This Section shall be used in conjunction with the following other specifications and related Contract Documents to establish the total requirements for the communications cabinets, racks, frames and enclosures:

1. Division 01 Specifications.
2. Section 270000 – Communications.
3. Section 270526 - Grounding and Bonding for Communications Systems.
4. Section 270553 - Identification for Communications Systems.

B. CAUTION! Use of this Section without including all of the above-listed items will result in omission of basic requirements.

C. In the event of conflict regarding communications cabinets, racks, frames and enclosures requirements between this Section and any other section, the provisions of this Section shall govern.

1.3 SYSTEM DESCRIPTION

A. The communications cabinets, racks, frames and enclosures subsystem refers to the passive components used to house terminations of cabling subsystems and distribute communications services. This subsystem includes installations in the Data Center, Entrance Facility (EF), Main Distribution Frame (MDF) and Telecommunications Rooms (TR), RACK/IT Rooms.

B. Cabinet: Freestanding, floor-mounted, modular enclosure, designed to house and protect rack-mounted electronic equipment. It includes: doors (front/rear), locksets, sidewalls, and also includes a top (with or without fans). Multiple cabinets, side by side ("bayed together" may share a set of sidewalls one on each end). Cabinets may be used to mount network equipment, servers, or passive cabling products. Wall mounted cabinets may also include some of the above features.

C. Rack: An open, freestanding, floor-mounted or wall mounted structure, typically made of aluminum or steel, used to mount equipment; usually referred to as an equipment rack. Floor mounted racks have two vertical rails for mounting equipment connected with a horizontal cross member at the top and stabilizing base on the bottom with no sides or doors. Primarily used for passive cabling products, but also used for Network equipment in the Data Center, Telecommunications Rooms and IDF locations.

1.4 SUBMITTALS

A. Provide the following within 30 days after award of Contract:

1. Communications room material lists.
2. Provide single-line shop drawings indicating cable routing within communication rooms.

1.5 CLOSEOUT SUBMITTALS

A. See Division 01.

B. Record location of termination backboards, racks, and cabinets showing distribution raceway and cable tray.

C. Communications room layout showing completions and as-built corrections.

D. Front of bay elevation drawings showing completions and as-built corrections.

E. Provide as-built records of frame and equipment rack addressing or numbering by frame, shelf, or row.

F. Provide as-built wiring block, patch panel, and FDU addressing or numbering lists as installed.

1.6 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 a RCDD / RCDD/NTS or Commercial Installer Level 2.
2. Installation Supervision: Installation shall be under the direct supervision of a Registered Technician, Commercial Installer Level 2, 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 a RCDD, or Commercial Installer Level 2 to perform the on-site inspection.

B. Provide grounding of cabinets, racks and equipment enclosures in accordance with latest version of Grounding, Bonding and Electrical Protection chapter of the BICSI TDMM Manual, Section 270526 – Grounding and Bonding for Communications Systems, ANSI/TIA-607-B, OESC, and NFPA 70.

C. Perform work in accordance with the State of North Carolina and local AHJ standards.

D. Maintain one copy of each document on site.

1.7 QUALIFICATIONS

A. The manufacturing company of products specified in this section is required to have a minimum of five years documented experience.

B. The installing company specializing in performing work of this section is required to have a minimum of three years documented experience approved by the manufacturer.

1.8 FIELD MEASUREMENTS

A. Measure for and then place fully assembled racks and cabinets at their associated final location prior to anchoring to assure no spatial and equipment conflicts.

B. Verify ground loop upon installation completion as per Section 270526 - Grounding and Bonding for Communications Systems.

1.9 COORDINATION

A. The contractor is to coordinate with the Greenville Transit IT system owner, prior to commencing any cabinet, rack or enclosure installation.

1. Convene a minimum of one meeting one week prior to commencing work of this section.

PART 2 - PRODUCTS

2.1 GENERAL

A. Materials and equipment shall conform to the specifications included in Section 270000 - Communications.

B. Furnish and install labeling materials as specified in Section 270553 - Identification for Communications Systems.

2.2 COMMUNICATION ROOM EQUIPMENT RACKS

A. Manufacturers:

1. Chatsworth Products.
2. No substitutions.

B. Product Description

1. Part number – 46393-703.
2. 19”W x 84”H (516 mm x 2.1 m) aluminum open two post rack.
3. Color – Black.
4. No substitutions.

2.3 COMMUNICATION ROOM EQUIPMENT FRAMES AND CABINETS

A. Not used.

2.4 VERTICAL WIRE MANAGERS

A. Manufacturer:

1. Panduit:

a. Part number – PRV679.

2. No substitutions.

2.5 HORIZONTAL WIRE MANAGERS

A. Manufacturer:

1. Panduit:

a. Part number – WMP1E.
b. Horizontal cable management to be placed above and below each patch panel.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify that surfaces are ready to receive work.

B. Verify that field measurements are as shown on the Drawings.

3.2 INSTALLATION

A. Cut standard sections of materials, such as straight channel, runway, and threaded rod, to length in the field.

B. Install communications backboards, cabinets, boxes, raceways, framing, cable tray, equipment racks, and other related materials and equipment plumb, securely attached in accordance with the manufacturer's specifications and procedures.

C. Install blank-off panels in cabinets, in all unused spaces to fill voids to minimize the passage of free air from the front to the rear of each cabinet.

D. Ground and bond the system as specified in Section 270526 - Grounding and Bonding for Communications Systems.

E. Identify and label the system as specified in Section 270553 - Identification for Communications Systems.

END OF SECTION 271116

SECTION 271119 - COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies the requirements necessary to furnish and install wall, rack and cabinet mounted blocks, patch panel components and fiber optic distribution units utilized to terminate various telecommunications infrastructure cabling and connectivity.

B. Section Includes:

1. Fiber Optic Distribution Units.
2. UTP Patch Panels.
3. 110 Style Termination Blocks and Associated Hardware.

C. Related Sections: This section shall be used in conjunction with the following other specifications and related Contract Documents to establish the total requirements for Communications Termination Blocks and Patch Panels:

1. Division 01 Specifications.
2. Section 270000 – Communications.
3. Section 270526 – Grounding and Bonding for Communications Systems.
4. Section 270553 – Identification for Communications Systems.
5. Section 271116 – Communications Cabinets, Racks, Frames and Enclosures.
6. Section 271519 – Data Communications Horizontal Cabling.

D. CAUTION! Use of this Section without including all of the above-listed items will result in omission of basic requirements.

E. In the event of a conflict regarding communications termination blocks and patch panels requirements between this Section and any other section, the provisions of this Section shall govern.

F. All materials shall be listed by UL and shall bear the UL label. If UL has no published standards for a particular item, the other national independent testing standards shall apply and such items shall bear those labels. Where UL has an applicable system listing and label, the entire system shall be so labeled.

1.2 REFERENCES

A. Refer to the most recent version, update or addenda of the following:

1. See Division 01.
2. NFPA 70 - National Electrical Code; National Fire Protection Association.

3. All applicable State Electrical Codes as well as those set forth by the local Authority Having Jurisdiction (AHJ).
4. NEMA and ANSI/TIA Standards where applicable standards have been established.
5. Soares Book on Grounding, 2002.
6. Building Industry Consulting Services International (BICSI) Manuals:

    a. Telecommunications Distributions Methods Manual (TDMM) 13th Edition.
    b. Information Transport Systems Installation Methods Manual (ITSIMM) 6th Edition.

1.3 SYSTEM DESCRIPTION

A. Furnish and install all necessary materials, apparatus and devices to provide termination blocks, patch panels and fiber optic distribution units required to complete connectivity of the telecommunications system. These system components are to be utilized for housing the terminations of backbone and horizontal fiber optic and copper cabling as well as allowing for cross-connecting or inter-connecting purposes.

1.4 SUBMITTALS

A. See Division 01.

B. Product Data: Manufacturer's descriptive literature for each system component specified in this section.

1.5 CLOSEOUT SUBMITTALS

A. See Division 01.

B. Provide as-built records of patch panel terminations within cabinets, equipment racks, and IDF locations by addressing the copper patch panels and fiber optic distribution units by number and location.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Component manufacturers shall be ISO 9001:2000 and offer products that are RoHS compliant.

B. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

C. Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of a RCDD / RCDD/NTS or Commercial Installer Level 2.

1. Installation Supervision: Installation shall be under the direct supervision of a Registered Technician, Commercial Installer Level 2, who shall be present at all times when work of this section is performed at project site.

2. Field Inspector: Currently registered by BICSI as a RCDD, or Commercial Installer Level 2 to perform the on-site inspection.

D. Contractor shall be a manufacturer certified installer and shall provide documentation proving such.

E. Provide grounding of telecommunications equipment in accordance with the latest version of Grounding, Bonding and Electrical Protection chapter of the BICSI TDMM Manual, ANSI/TIA-607-B and NFPA 70.

F. Perform work in accordance with the State of North Carolina and local AHJ standards.

G. Maintain one copy of each document on site.

1.7 QUALIFICATIONS

A. The manufacturing companies of products specified in this section are required to have a minimum of five years documented experience.

B. The installing company specializing in performing work of this section is required to have a minimum of three years documented experience approved by the manufacturer.

1.8 WARRANTY

A. Manufacturer Warranty:

1. The installed passive components of the work described in the contract documents shall also be covered under a manufacturer supported extended twenty (20) year warranty/guarantee related to installed materials, supported applications and the installation workmanship.
2. This guarantee and extended warranty shall be supported in writing by both the connectivity and cable manufacturer.

1.9 PROJECT CONDITIONS

A. Do not deliver or install termination blocks or patch panels in equipment racks, cabinets, or IDF locations until spaces are enclosed and weather tight, wet work in spaces is complete and dry and work above ceilings is complete.

1.10 COORDINATION

A. The contractor is to coordinate with the Greenville Transit IT system owner, prior to the installation of termination blocks, copper patch panels, and fiber optic distribution unit’s within racks, cabinets, or IDF locations.

B. Convene a minimum of one meeting one week prior to commencing work of this section.

PART 2 - PRODUCTS

2.1 GENERAL

A. All termination blocks, patch panels and fiber optic distribution units and associated accessories must comply with applicable manufacturer's warranty requirements and be from approved manufacturers as listed. All termination equipment must be installed by a certified manufacturer's design & installation contractor.

B. IDC type wiring blocks and patch panels will use the 110 style termination tool for the termination of copper conductors.

C. All Category 6 wiring components, when combined as a system, must meet or exceed the Category 6 performance specifications when tested according to ANSI/TIA -568-C.2.

D. All patch panels are to provide adequate space for individual port labeling on the front and cable/connector labeling on the back.

E. All fiber optic distribution units, trays, adapter plates and bulkhead coupler inserts shall have factory numerical labeling included in the design and presentation to the user side of the panel.

F. The fiber optic adapter plates that house bulkhead coupler inserts for the mating of fiber optic cabling terminations shall accept LC style fiber optic connectors for single mode fiber optic cable and SC style fiber optic connectors for multi-mode fiber optic cable.

G. Provide any accessory products related to the Category 6A rated UTP systems and the termination of the copper data cable, management capabilities, and grounding components required to provide a complete and functional infrastructure system.

H. Provide any accessory products related to the fiber optic enclosure and the termination of the fiber optic cable including slack trays, bulkhead inserts, fiber strain relief and management capabilities, and grounding components required to provide a complete and functional infrastructure system.

2.2 FIBER OPTIC DISTIRIBUTION TERMINATION EQUIPMENT

A. Manufacturer:

1. Panduit.
2. No substitutions.

B. Product Description:

1. Rack-mounted Fiber Optic Distribution Unit.

a. Part number – FCE2U.

2. LC style Singlemode Fiber Optic Adapter Plates.

a. Part number – FAP6WBUDLCZ.

2.3 COPPER HORIZONTAL CABLE TERMINATION EQUIPMENT

A. Manufacturer:

1. Panduit/
2. No substitutions.

B. Product Description:

1. 48 Port Modular, Category 6 Rated Unshielded Patch Panel Kit.

a. Part number – DP48688TGY.

C. 110 Style Connecting Block:

1. 96 Pair with connecting blocks.

a. Part number – GPB24-X.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to installation, verify racks and cabinets are clean and dust free before installing equipment.

B. Verify that all equipment to be installed has not been damaged in shipping.

3.2 PREPARATION

A. Prior to installation, the contractor will verify racks and cabinets are plumb before installing equipment.

3.3 INSTALLATION

A. Install wiring block, patch panels and fiber optic distribution units utilizing the proper 12-24 type screws. Verify that all equipment is installed level.

B. Wiring blocks and patch panel location identifiers are used on Drawings and schedules to direct the work. Each terminating position on a wiring block or patch panel is assigned a number, which identifies the location. Patch Panels are to utilize the associated numbering provided by cable schedule for port sequencing.

C. Fiber optic distribution unit location identifiers are used on Drawings and schedules to direct the work. Each terminating position on a fiber optic adapter plate bulkhead insert is assigned a number, which identifies the location. Adapter panels are to utilize the associated numbering provided by cable schedule for port sequencing.

END OF SECTION 271119

SECTION 271519 - DATA COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. This section specifies the requirements necessary to furnish and install a horizontal twisted-pair cable distribution system utilized for all TCP/IP Ethernet systems. Including but not limited to voice/data, CCTV, wireless access points, access control, VMBs, etc.

1.2 RELATED SECTIONS

A. This section shall be used in conjunction with the following other specifications and related contract documents to establish the total requirements for the Data Communications Horizontal Cabling:

1. Division 01 Specifications.
2. Section 270000 – Communications.
3. Section 270526 - Grounding and Bonding for Communications Systems.
4. Section 270553 - Identification for Communications Systems.
5. Section 270800 – Commissioning of Communications.
6. Section 271116 - Communications Cabinets, Racks, Frames and Enclosures.
7. Section 271119 - Communications Termination Blocks and Patch Panels.

B. CAUTION! Use of this Section without including all of the above-listed items will result in omission of basic requirements.

C. In the event of conflict regarding Data Communication Horizontal Cabling requirements between this Section and any other section, the provisions of this Section shall govern.

1.3 SYSTEM DESCRIPTION

A. The communications horizontal cabling refers to intra-building twisted-pair communications cabling connecting the Telecommunications Room or IDF communications cabinets to telecommunications outlets (TO’s) located at individual work areas, TV, CCTV etc. as well as associated patch cables.

1.4 PROJECT RECORD DOCUMENTS

A. Submit horizontal cable schedule check off list for each installed, terminated, and labeled cable showing completions and as-built corrections.

B. Submit horizontal cable schedule listing test results and verification for each cable pair installed.

C. Provide as-built termination block and patch panel addressing and/or numbering lists for cables installed.

1.5 SUBMITTALS

A. See Division 01.

B. Shop Drawings: Indicate cable type, dimensions, support points, and finishes based on expected cable fill ratios.

C. Product Data: Submit cable specifications.

D. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.6 CLOSEOUT SUBMITTALS

A. See Division 01.

B. Project Record Documents: Record actual routing of data communications horizontal cables through ceiling spaces and tray and locations.

1.7 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 a RCDD / RCDD/NTS or Commercial Installer Level 2.
2. Installation Supervision: Installation shall be under the direct supervision of a Registered Technician, Commercial Installer Level 2, 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 an RCDD, or Commercial Installer Level 2 to perform the on-site inspection.

B. Perform work in accordance with the State of North Carolina and local AHJ standards.

C. Maintain one copy of each document on site.

1.8 QUALIFICATIONS

A. The manufacturing company of products specified in this section is required to have a minimum of five years documented experience.

B. The installing company specializing in performing work of this section is required to have a minimum of three years documented experience approved by the manufacturer.

1.9 COORDINATION

A. Pre-Installation Meetings:

1. See Division 01.
2. Convene minimum one meeting, one week prior to commencing work of this section.

B. The contractor is to coordinate with the Greenville Transit IT system owner, prior to commencing data communications horizontal cabling installations. Review cable routing within Telecommunications Room or IDF communications cabinets with Owner prior to installing cables.

PART 2 - PRODUCTS

2.1 CATEGORY 6 UTP HORIZONTAL CABLE

A. Manufacturer:

1. Panduit.
2. No substitutions.

B. Product Description:

1. Category 6 UTP CMR cable.
2. 23 AWG, solid conductors.
3. Meets or exceeds ANSI/TIA 568-C.2.
4. Category 6 and ISO 11801 2nd Edition Class E standards.
5. Performance characterized to 250 MHz.
6. Cable to be Intertek ETL SEMKO UL Listed (CMP/CMR).
7. Cable jacket color to be blue.
8. Part number – PUR6C04BU-C.

2.2 CATEGORY 6 UTP HORIZONTAL PATCH CABLE

A. Manufacturer:

1. Panduit.
2. No substitutions.

B. Product Description:

1. Category 6 UTP Modular Patch Cords.
2. Part number – UTPSPL*Y (* = length).
3. Meets or exceeds ANSI/TIA 568-C.2.
4. Color: White.
5. Provide two Category 6 Modular Patch cords for each cable. (One at patch panel and one at workstation).
6. Contractor to coordinate lengths with Greenville Transit IT system owner prior to ordering material.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Inspect each Cat. 6 box/reel prior to installing for any signs of damage during shipping. Install NO cable from any damaged packages.

B. Notify the Engineer of Record of conditions that would adversely affect the installation or subsequent utilization of the communications horizontal cabling system. DO NOT proceed with the installation until the unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. The amounts of horizontal cables to be placed to any telecommunications outlet, is indicated on drawings. Contractor to utilize appropriate cable type for all construction areas (such as plenum rated, non-plenum or hazardous).

B. Install cable after interior of building has been physically protected from the weather and mechanical work likely to damage conductors has been completed. Provide protection for exposed cables where subject to damage.

1. When installing cable, insure that lengths of cable dressed along the floor are protected from traffic.

C. Install communications cable in accordance with manufacturer's instructions so as not to exceed the manufacturer's specified pulling tension.

D. Horizontal Cable Support: Between T.O. locations and cable tray, support horizontal cables within conduit. Cables are routed through conduit, in open ceiling spaces, above the ceiling tiles to wire mesh basket tray.

E. Install pull string or pull tape in each empty communications conduit containing a bend or over 10 feet in length.

F. Communications Cable Ties: Cable ties and other cable management clamps shall be no more than hand tightened and shall fit snugly, but not compress, crimp, or otherwise change the physical characteristics of the cable jacket or distort the placement of twisted-pair components. Replace cable-exhibiting stresses due to over tightening of cable management devices. Use the following types of cable ties:

1. Plenum Building Areas: Where cable passes through open return air space, use plenum-rated Velcro ties.
2. Nonplenum Building Areas: Use conventional flame-retardant Velcro ties.

G. After installing and terminating cables serving hazardous areas, seal cables in conduit at conduit sealing fittings, using an approved sealing compound.

H. Identify and label all horizontal cables and patch cables as specified in Section 270553 Identification for Communications Systems.

I. Conduct cable reel and final performance tests specified in Section 270800 Commissioning of Communications.

3.3 OFFICE FURNITURE/POWER POLE INSTALLATION

A. Remove tele/power pole raceway access covers prior to bringing cable down from the ceiling.

B. Raise end of panel cable guides in the panel base when installing in the panel base.

C. Remove cables from the ceiling and dress along tele/power poles and panel base. Dress cables in one direction at a time.

D. When cables either enter a top cap or exit a base panel, insure that bend radius is maintained and that protective grommets are installed over sharp edges.

1. Install horizontal cable support above the top entrance of the tele/power pole raceway to maintain bend radius into the raceway and help keep cable away from sharp edges.
2. Insure edge protection, e.g., grommets, clips, etc., is in place prior to installing cable.

E. Wherever possible, lay cable into tele/power poles and cable base. Do not pull cable through cable channel unless necessary because the wing walls are in place.

F. Extreme care is to be taken when pulling cables down through the tele/power pole and into the panel base to insure that the jacket is not abraded and that cuts, kinks, or sharp bends are not put in the cable jacket.

G. When installing data communications horizontal cables from tele/power poles to a standard panel base, the cable fill ratio for that opening will follow the State of North Carolina and Local Authority Having Jurisdiction (AHJ) standards.

END OF SECTION 271519

SECTION 271543 - COMMUNICATIONS FACEPLATES AND CONNECTORS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies the requirements necessary to furnish and install Communications Faceplates and Connectors for horizontal distribution system outlet terminations.

1.2 RELATED SECTIONS

A. This Section shall be used in conjunction with the following other specification sections and related Contract Documents to establish the total requirements for the communications system:

1. Division 01 Specifications.
2. Section 270000 – Communications.
3. Section 270553 - Identification for Communications Systems.
4. Section 270800 - Commissioning of Communications.
5. Section 271519 - Data Communications Horizontal Cabling.

B. CAUTION! Use of this Section without including all of the above-listed items will result in omission of basic requirements.

C. In the event of conflict regarding the Communications Faceplates and Connectors in this section with any other section, the provisions of this section shall govern.

1.3 REFERENCES

A. NFPA 70 - National Electrical Code; National Fire Protection Association.

B. See Division 01.

C. ANSI/TIA-568-C.

D. BICSI Telecommunications Distribution Methods Manual (TDMM) 13th Edition.

1.4 SYSTEM DESCRIPTION

A. A single copper channel solution shall be installed for the horizontal distribution system for each building on the entire project campus. Contractor shall furnish and install manufacturer standard series faceplates and connectors in various configurations as indicated on the drawings. Coordinate final faceplate type and port configurations with Greenville Transit IT system owner prior to commencement of system installation.

B. The standard connector to be installed at communications outlet locations within the horizontal distribution system for each building on the entire project campus is the Category 6 RJ-45 modular jack insert. Two inserts will be installed at each work area outlet location.

C. Each communications work area outlet will require five cables and RJ-45 modular jack inserts unless otherwise noted on the drawings. i.e. Camera and WAP locations will receive one cable and one RJ-45 modular jack insert.

1.5 SUBMITTALS

A. See Division 01.

B. Product Data: Manufacturer's descriptive literature for each system component specified in this section.

1.6 CLOSEOUT SUBMITTALS

A. See Division 01.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Termination Responsibility: Termination of all horizontal distribution system cable terminations shall be under the direct supervision of a RCDD / RCDD/NTS or Commercial Installer Level 2.
2. Installation Supervision: Installation shall be under the direct supervision of a Registered Technician, Commercial Installer Level 2, 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 an RCDD, or Commercial Installer Level 2 to perform the on-site inspection.

B. Perform work in accordance with the State of North Carolina and local AHJ standards.

1.8 QUALIFICATIONS

A. The manufacturing company of products specified in this section is required to have a minimum of five years documented experience.

B. The installing company specializing in performing work of this section is required to have a minimum of three years documented experience approved by the manufacturer. All termination equipment must be installed by a manufacturer certified contractor.

1.9 COORDINATION

A. The contractor is to coordinate with the Greenville Transit IT system owner, prior to commencing termination of any horizontal distribution cabling.

1. Convene a minimum of one meeting one week prior to commencing work of this section.

PART 2 - PRODUCTS

2.1 GENERAL

A. All faceplates and connectors must comply with the approved manufacturer's warranty requirements and be from the approved manufacturer as listed.

B. Faceplates Manufacturer:

1. Panduit:

a. Mini-Com Classic Series.
b. Port quantity based on area and type of use.

2. No substitutions.

C. Stainless Steel Wall Phone Faceplates Manufacturer:

1. Panduit:

a. Part number – KWP6PY.

2. No substitutions.

D. Category 6 UTP Connector Modules Manufacturer:

1. Panduit:

a. Part number – CC688IW.

2. No substitutions.

E. Blank Insert Manufacturer:

1. Panduit:

a. Part number – CMBIW-X.

2. No substitutions.

F. Icon Manufacturer:

1. Not used.

G. Surface Mount Box Manufacturer:

1. Panduit:

a. 1 Port Part number – CBX1IW-A.

2. No substitutions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are free of dust and dirt and are ready to receive work.

3.2 INSTALLATION

A. The contractor shall provide 12” of cable slack in flush mounted, surface mounted, and raceway boxes, providing the manufacturer’s bend radius are not exceeded. Some of the slack may be pulled back to junction boxes, raceways, basket tray or concealed space. Slack beyond the outlet box shall be easily pulled out of the box and shall not be secured with cable ties or otherwise secured beyond the box to prevent this movement.

B. The contractor shall install the communications outlet faceplate as shown on the drawings with port quantities sufficient to terminate all horizontal distribution cables housed within that same outlet location, unless noted otherwise.

C. The contractor shall install the quantity of Category 6 (unshielded) rated RJ-45 connector modules at the communications outlet location as shown on the drawings sufficient to terminate all horizontal distribution cables housed within that same outlet location, unless noted otherwise.

D. All 8 position 8 pin Category 6 rated RJ-45 connector modules shall be terminated utilizing the T568B pin/pair configuration. All four pairs shall be terminated.

E. The contractor shall provide blank insert modules in 4 and 6 port communications faceplates, as required.

F. The contractor shall label outlets as shown on the drawings. All labels are to meet the requirements of Section 270553 - Identification for Communications Systems.

END OF SECTION 271543

SECTION 275116 - PUBLIC ADDRESS SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes:

1. Public Address System – Page Control Unit.
2. Public Address Speakers and Associated Appurtenances.
3. Mass Notification System.
4. Visual Message Boards.

B. Related Sections:

1. This section shall be used in conjunction with the following other specifications and related Contract Documents to establish the total requirements for public address and mass notification systems:

    a. Division 01 Specifications.
    b. Section 270526 - Grounding and Bonding for Communications Systems.
    c. Section 270533 - Conduits and Backboxes for Communications Systems.
    d. Section 270553 - Identification for Communications Systems.
    e. Section 271519 – Data Communications Horizontal Cabling.

2. It should be noted that these specifications are to be considered applicable for project-wide use. In certain instances, all related sections may not be issued with a particular drawing package (such as site underground specifications for internal buildings). Contractor to refer to specifications table of contents within each construction documentation package to ensure all requirements are understood and provided.
3. CAUTION! Use of this section without including all of the above-listed items will result in omission of basic requirements.
4. In the event of conflict regarding public address and mass notification requirements between this section and any other section, the provisions of this Section shall govern.

1.2 SYSTEM DESCRIPTION

A. This Section specifies the requirements necessary to furnish and install a complete and functioning end to end public address system for voice (and music). Contractor will ensure system installed and is fully functional as per manufacturer’s written installation manuals and specifications. Contractor shall balance and adjust system to meet requirements of the installation. This system will interface with the mass notification system which will be capable of playing pre-recorded messages.

1.3 SUBMITTALS

A. See Division 01.

B. Product Data: Submit manufacturer’s catalog data (cut sheets) on features ratings and performance for each component and system for approval within 30 days after award of contract.

C. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

D. Test Reports: Indicate procedures and results for specified field testing and inspection.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

F. Manufacturer's Field Reports: Indicate activities on site, adverse findings, and recommendations.

G. Manufacturer’s Statement of Warranty.

1.4 CLOSEOUT SUBMITTALS

A. See Division 01.

B. Project Record Documents: Record actual routing of public address communications horizontal cables and associated conduit through ceiling spaces and all final equipment locations.

C. Operation and Maintenance Data: Submit instructions for adjusting, operating, and extending system, and repair procedures and spare parts documentation.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

B. Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of a RCDD / RCDD/NTS or Commercial Installer Level 2.

C. Installation Supervision: Installation shall be under the direct supervision of a Registered Technician, Commercial Installer Level 2, who shall be present at all times when work of this section is performed at project site.

D. Field Inspector: Currently registered by BICSI as an RCDD, or Commercial Installer Level 2 to perform the on-site inspection.

E. Perform work in accordance with the State of North Carolina and local AHJ standards.

F. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

A. The manufacturing company of products specified in this section is required to have a minimum of five years documented experience.

B. The installing company specializing in performing work of this section is required to have a minimum of three years documented experience approved by the manufacturer.

1.7 COORDINATION

A. Pre-Installation Meetings:

1. See Division 01.
2. Convene minimum one meeting, one week prior to commencing work of this section.

B. The contractor is to coordinate with the Greenville Transit IT system owner, prior to commencing public address communications horizontal cabling and equipment installations. Review cable routing and speaker locations with Owner prior to installing cables.

PART 2 PRODUCTS

2.1 AMPLIFICATION AND CONTROL EQUIPMENT

A. Manufacturers:

1. VALCOM Model V-2006A Six Zones (Plus) Page Control Unit.
2. Approved Equal.

B. Product Description: Wall or shelf (rack) mounted, minimum four zone, one-way, page control unit with integrated single and warble tone generator and power supply. The unit shall provide the following:

1. Page input.
2. Page override input.
3. Background music input.
4. Voice activated switching to automatically cutoff music during a voice page.
5. Volume controls to control tones and background music levels.
6. Provide two separate outputs, one page only output and one page with background music output.
7. “Power on” LED.

C. In connection with the telephone system, the unit shall provide loop current to the system for access and a “dry” tip and ring connection. A battery feed switch located on the unit shall turn loop current on or off to the tip and ring connections.

D. The unit shall provide both screw terminals and an RJ-11 jack for paging input connections. Provide screw terminals for music input and all output connections.

E. The chassis shall be AC grounded.

F. Both Page inputs shall have an impedance of 600 ohms. Music source impedance shall be 8 to 600 ohms. Output impedance shall be 8 ohms.

2.2 SPEAKERS

A. Suspended Ceiling:

1. Manufacturer: VALCOM.
2. Model: V-1020C.
3. Approved equal:

a. Product Description: 8 inch one way flush mount ceiling speaker assembly, complete with speaker, amplifier, built-in volume control and round grille.
b. Power Supply Required: -24 VDC.
c. Provide raceways and conduits (as necessary) to speaker locations shown on Drawings.
d. Speaker assembly, amplifier module, housing and hardware shall be electrically and acoustically matched for a frequency response of 80 Hz to 15 kHz.
e. The grille shall be constructed of steel, finished in semi-gloss white enamel.
f. Each speaker receives 4 wires (2 pairs). (2) – Audio (Tip & Ring) and (2) – Power (-24VDC). Cables to branch speakers labeled to indicate sequential numbering consistent with certification testing result and Drawing identification.

B. Wall Mounted:

1. Manufacturer: VALCOM.
2. Model: V-1016-W.
3. Approved Equal.
4. Product Description:

a. Wall surface mounted speaker assembly complete with 8 inch speaker, amplifier, built-in volume control, sloped baffle and mounting bracket.
b. Power Supply Required: -24 VDC.
c. Provide raceways and conduits (as necessary) to speaker locations shown on Drawings.
d. Speaker assembly, amplifier module, housing and hardware shall be electrically and acoustically matched for a frequency response of 80 Hz to 15 kHz.
e. Cloth grille.
f. Each speaker receives 4 wires (2 pairs). (2) – Audio (Tip & Ring) and (2) – Power (-24VDC). Cables to branch speakers labeled to indicate sequential numbering consistent with certification testing result and Drawing identification.

C. Horn

1. Manufacturer: VALCOM.
2. Model: V-1030C-GY.
3. Approved Equal.

4. Product Description:

    a. 5 watt amplified horn speaker, weather resistant, reentrant, with 5 watt amplifier, volume control, horn housing, mounting base and I-beam clip.
    b. Power Supply Required: -24 VDC.
    c. Provide raceways and conduits (as necessary) to speaker locations shown on Drawings.
    d. Speaker assembly, amplifier module, housing and hardware shall be electrically and acoustically matched for a frequency response of 225 Hz to 14 kHz.
    e. High impact ABS plastic horn.
    f. Each speaker receives 4 wires (2 pairs). (2) – Audio (Tip & Ring) and (2) – Power (24VDC). Cables to branch speakers labeled to indicate sequential numbering consistent with certification testing result and Drawing identification.

D. Vandal Resistant Horns:

1. Manufacturer: Valcom.
2. Model: V-1080.
3. Accessories:

    a. Stainless Steel Vandal-Resistant Enclosure w/Faceplate: Model V-9805.

4. Approved Equal.

E. Mass Notification System:

1. Manufacturer: Cooper Industries.
2. Model: Safepath SPMNS.
3. Approved Equal.
4. Product Description:

    a. Voice Messages:

        1) Live microphone override.
        2) 5 digitally pre-recorded MNS voice messages.
        3) 3 digitally pre-recorded fire voice messages.
        4) Flexible, field-programmable messaging capabilities.

    b. Contacts for PA system interface.
    c. Power:

        1) 24VDC, 33AH Max rechargeable battery back-up power circuitry built-in.

    d. Speaker Outputs:

        1) 25V or 70.7V power limited.

e. Agency Approvals:

1) UL2572 for MNS, UL Standard 864, 9th edition, UL Standard 1711.

2.3 BRIDGE AND BACKBOX ASSEMBLY

A. Manufacturers:

1. VALCOM Model V-9916M.
2. Approved Equal.
3. Product Description:

a. Metal backbox and support bridge combination for speaker installation.
b. Speaker Backbox: Insulated with sound-deadening material. The metal backbox and support bridge are to be finished for rust prevention.

2.4 PUBLIC ADDRESS HORIZONTAL SPEAKER CABLE

A. Manufacturer:

1. Belden.
2. Approved Equal.
3. Product Description:

a. Belden 2 pair Unshielded Twisted Pair Audio Cable.
b. 24 AWG thru 16 AWG, stranded tinned copper conductors.
c. CMG, CMP rated.
d. Wire sizing based on run length.

2.5 VISUAL MESSAGE BOARDS

A. Manufacturers:

1. Luminator Technology Group.
2. Approved equals.

B. Outdoor – Bus Islands:

1. Display Capabilities:

a. Double Sided.
b. Text Lines: 6.
c. Graphics: Bit mapped graphics up to full matrix size.
d. Effects: Scroll (left/right, right/left, roll (up/down, down/up) and flash.

2. Features:

a. Watchdog: Hardware watchdog timer with automatic or manual reset capability.

b. Diagnostics: LED, LRU, and internal software monitoring locally stored and reported to server.
c. Real-time Clock: Battery backed real-time clock.
d. Software Upgradeable: Remote software upgradeable in the field.

3. Communication Interfaces:

a. 802.3: 10BaseT, 10BaseF, 100BaseTX, 100BaseFX.

4. Display

a. LED Matrix.
b. Pixel Pitch.
c. Brightness: 3500 Cd/M².
d. Viewing Angle: 30 Degrees minimum (15 degrees off perpendicular in all directions).
e. LED reliability: 100,000 hours minimum.
f. Contrast ration: 1000:1.

5. Construction:

a. NEMA 4X.
b. Display window: Shatter-proof, UV resistant, laminated glass, 0.25” thickness.

6. Environmental:

a. Operating Temperature: -20C to +50C.
b. Relative Humidity: 95%.

C. Indoor Ticket Counter:

1. Single sided.
2. Same features as outdoor unit except NEMA 1 rated.

PART 3 EXECUTION

3.1 EXAMINATION

A. Inspect each system component and associated appurtenances prior to installing for any signs of damage during shipping. Install NO equipment from any damaged packages.

B. Inspect each twisted pair box/reel prior to installing for any signs of damage during shipping. Install NO cable from any damaged packages.

C. Notify the Engineer of Record of conditions that would adversely affect the installation or subsequent utilization of the public address and mass notification systems. DO NOT proceed with the installation until the unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. The public address horizontal speaker cables are to be placed in conduit from the page control unit location in the Telecommunications Room to speaker locations, as indicated on Drawings, in a daisy chain configuration. No more than 30 speakers per routed chain of speakers. Contractor to utilize appropriate cable and conduit installation type for all construction areas (such as plenum rated, non-plenum or hazardous).

B. Install cable after interior of building has been physically protected from the weather and mechanical work likely to damage conductors has been completed. Provide protection for exposed cables where subject to damage.

1. When installing cable, insure that lengths of cable dressed along the floor are protected from traffic.

C. Install communications cable in accordance with manufacturer's instructions so as not to exceed the manufacturer's specified pulling tension.

D. Horizontal Cable Support: Between speaker locations, support horizontal cables within conduit. Cables are to be routed through conduit that is placed in open ceiling spaces, above the ceiling tiles to each speaker bridge and backbox support assembly.

E. Conduit installed in hazardous, classified areas shall use threaded fittings. No compressions or screw tight fittings are permitted in these areas.

F. Install pull string or pull tape in each empty communications conduit containing a bend or over 10 feet in length.

G. Communications Cable Ties: Cable ties and other cable management clamps shall be no more than hand tightened and shall fit snugly, but not compress, crimp, or otherwise change the physical characteristics of the cable jacket or distort the placement of twisted-pair components. Replace cable-exhibiting stresses due to over tightening of cable management devices. Use the following types of cable ties:

1. Plenum Building Areas: Where cable passes through open return air space, use plenum-rated Velcro ties.
2. Nonplenum Building Areas: Use conventional flame-retardant Velcro ties.

H. After installing and terminating cables serving hazardous areas, seal cables in conduit at conduit sealing fittings, using an approved sealing compound.

I. Identify and label all public address horizontal speaker cables as specified in Section 270553, Identification for Communications Systems.

J. Install speakers at designated locations utilizing required appurtenances. Coordinate final location and installation with system owner and all other trades. Center speakers in acoustical tile when installed in lay-in ceilings utilizing manufacturer's recommended support methods (backbox and support bridge assembly).

K. Connect a maximum of 30 speakers to Page Control Unit. Notify Engineer of Record if more than 30 speakers require connectivity. Do not proceed with installation until written notification/direction is received regarding corrective action.

L. Terminate all tip and ring circuits from speakers to Page Control Unit per manufacturer's specifications. Do not exceed 30 speakers per circuit.

M. Label all cables and install engraved plastic nameplates in accordance with Section 270553 Identification for Communications Systems.

N. Ground and bond public address, music equipment, and mass notification equipment in accordance with Section 270526 Grounding and Bonding for Communications Systems.

3.3 FIELD QUALITY CONTROL

A. Quality Requirements Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.

B. Measure and record sound power levels at designated locations.

C. Provide for inspection by authorized client representative of installation, adjustments, final connections, system testing, and Owner training.

D. Verify installation is complete and performs according to specified requirements.

3.4 ADJUSTING

A. Adjust transformer taps for appropriate sound level.

B. Adjust devices and wall plates to be flush and level.

C. Verify mass notification messages are audible.

3.5 QUALITY ASSURANCE

A. Guarantee 100% of all systems installed are free of defects and meet the specifications. Any components or installation practices that do not meet recognized industry standards shall be replaced at no additional cost to the Owner.

END OF SECTION 275116

SECTION 280513 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY

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. UTP cabling.
2. 62.5/125-micrometer, multimode optical-fiber cabling.
3. Composite Cable (Fiber/Copper)
4. Control-voltage cabling.
5. Control-circuit conductors.
6. Identification products.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. IDC: Insulation displacement connector.

C. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

D. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).

E. RCDD: Registered Communications Distribution Designer.

F. NRTL: Nationally Recognized Testing Laboratories

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordinate layout and installation of electronic safety and security cabling with Owner's telecommunications and LAN equipment and service suppliers.

B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Installation data for UTP and optical-fiber cables as specified in TIA 569-C-1.

B. Shop Drawings:

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
2. Cabling administration drawings and printouts.
3. Wiring diagrams to show typical wiring schematics, including the following:

   a. Cross-connects.
   b. Patch panels.
   c. Patch cords.

4. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.

B. Source quality-control reports.

C. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: An NRTL.

1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test optical-fiber cable to determine the continuity of the strand, end to end. Use optical-fiber flashlight.
2. Test optical-fiber cable on reels. Use an optical time domain reflectometer to verify the cable length, and locate cable defects, splices, and connector; include the loss value of each. Retain test data and include the record in maintenance data.
3. Test each pair of UTP cable for open and short circuits.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

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

2.2 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, smooth one side, 3/4 by 48 by 96 inches.

2.3 UTP CABLE

A. Manufacturers:

1. Belden CDT.
2. Commscope.
3. Panduit.
4. Approved Equal.

B. Description: 100-ohm, four-pair UTP, covered with a blue thermoplastic jacket.

1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA-568-C.1 for performance specifications.
3. Comply with TIA-568-C.2, Category 6.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:

    a. Communications, General Purpose: Type CM or Type CMG.
    b. Communications, Plenum Rated: Type CMP, complying with NFPA 262.
    c. Communications, Riser Rated: Type CMR, complying with UL 1666.

2.4 UTP CABLE HARDWARE

A. Manufacturers:

1. Belden.
2. Commscope.
3. Panduit.
4. Approved Equal.

B. UTP Cable Connecting Hardware: IDC type, using modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of the same category or higher.

C. Patch Panels: 110-style for Category 6. Provide ports for the number of cables terminated on the patch panel, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

2.5 OPTICAL FIBER CABLE

A. Basis of Design Product: Subject to compliance with requirement, provide product indicated on Drawings or comparable product by one of the following:

1. Belden.
2. TE.
3. BerkTek.
4. Corning.
5. Approved Equal.

B. Description: Multimode, 50/125 - micron, 24-fiber, nonconductive, tight buffer, optical-fiber cable.

1. Comply with ICEA S-83-596 for mechanical properties.
2. Comply with TIA-568-C.3 for performance specifications.
3. Comply with TIA-492AAAB for detailed specifications.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:

    a. General Purpose, Nonconductive: Type OFN or Type OFNG.
    b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
    c. Riser Rated, Nonconductive: Type OFNR, complying with UL 1666.
    d. General Purpose, Conductive: Type OFC or Type OFCG.
    e. Plenum Rated, Conductive: Type OFCP, complying with NFPA 262.
    f. Riser Rated, Conductive: Type OFCR, complying with UL 1666.
    g. OSP, Nonconductive.
    h. Indoor/Outdoor.

5. Conductive cable shall be steel armored type.
6. Maximum Attenuation: 3.50 db/km at 850 nm; 1.5 db/km at 1300 nm.
7. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.

C. Jacket:

1. Jacket Color: Aqua for 50/125-micrometer cable.
2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-C.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.

2.6 OPTICAL-FIBER CABLE HARDWARE

A. Manufacturers:

1. Belden.
2. TE.
3. Berktek.
4. Approved Equal.

B. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.

1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.

C. Patch Cords: Factory-made, dual fiber cables with duplex LC connectors. Coordinate length prior to purchase.

D. Cable Connecting Hardware: Comply with the Fiber Optic Connector Intermateability Standard (FOCIS) specifications of TIA-604-2-B, TIA-604-3-B, and TIA-604-12. Comply with TIA-568-C.3.

1. Quick-connect duplex, Type LC connectors. Insertion loss not more than 0.75 db.
2. Type SFF connectors may be used in termination racks, panels, and equipment packages.

2.7 PoE EXTENDER CABLES

A. Manufacturers:

1. BerkTek.
2. TE Connectivity.
3. Belden.
4. Approved Equal.

B. Standard Cable: Indoor/Outdoor rated:

1. One pair, minimum 18 AWG.
2. Two 50/125 optical fibers.
3. IEEE 802.3af.
4. IEEE 802.3at.
5. UL 13.

C. Power Supply Module:

1. 12 and/or 54 VDC.
2. 400 Watts.
3. 120V AC input.

D. Power Injector Chassis:

1. 2U:

a. Rear Terminal Block.
b. 6 available slots.

2. 4U:

a. Rear Terminal Block.
b. 12 available slots.

E. Remote PoE Port:

1. PoE or PoE+.
2. 1 Port:

a. 10/100/1000 Mb/s.
b. LC Duplex MM input.
c. Power input.
d. RJ-45 output.

3. 4 Port:

a. MTP MM input.
b. Power Input.
c. RJ-45 output.

2.8 RS-232 CABLE

A. Not Used.

2.9 RS-485 CABLE

A. Not Used.

2.10 ACCESS CONTROL COMPOSITE CABLE

A. Manufacturer:

1. West Penn Wire.
2. Superior Essex.
3. Belden.
4. Approved Equal.

B. 18/4, 22/6, 22/2, 22/4 construction.

C. CMR, CMP rated.

2.11 INDUCTION LOOP UNDER FLOOR WIRE

A. ¾” Wide flat copper cable.

B. Flat wire warning tape.

1. Adhesive backed.

C. Coordinate installation with flooring contractor.

2.12 IDENTIFICATION PRODUCTS

A. Brady Corporation, Kroy LLC, Panduit Corp.

B. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

C. Comply with requirements in Section 270553 "Identification for Communications Systems."

2.13 CABLE MANAGEMENT SYSTEM

A. Brady Worldwide Inc., Chatsworth Products, Inc., Telsoft Solutions.

B. Description: Computer-based cable management system, with integrated database and graphic capabilities.

C. Document physical characteristics by recording the network, TIA details, and connections between equipment and cable.

D. Information shall be presented in database view, schematic plans, or technical drawings.

1. REVIT drawing software shall be used as drawing and schematic plans software.

E. System shall interface with the following testing and recording devices:

1. Direct upload tests from circuit-testing instrument into the personal computer.
2. Direct download circuit labeling into labeling printer.

2.14 SOURCE QUALITY CONTROL

A. Factory test optical-fiber cables on reels according to TIA-568-C.3.

B. Factory test UTP cables according to TIA-568-C.2.

C. Factory test multimode optical fiber cables according to TIA-526.14-B and TIA-568-C.3.

D. Factory sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results. Structural Return Loss shall be less than 20 db.

E. Cable will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements in Section 270529 Hangers and Supports for Communications Systems for installation of supports for cables.

3.2 WIRING METHOD

A. Install wiring in metal pathways and wireways.

1. Minimum conduit size shall be 3/4 inch. Control and data-transmission wiring shall not share conduits with other building wiring systems.
2. Comply with requirements in Section 270533 Conduits and Backboxes for Communications Systems.
3. Comply with requirements in Section 270536 Cable Tray for Communications Systems.

B. Install cable, concealed in accessible ceilings, walls, and floors when possible.

C. Wiring on Racks and within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM's "Cabling Termination Practices" chapter. Cable ties shall not be excessively tightened such that the transmission characteristics of the cable are altered.
2. Install lacing bars and distribution spools.
3. Separate power-limited and non-power-limited conductors as recommended in writing by manufacturer.
4. Install conductors parallel with or at right angles to sides and back of enclosure.
5. Connect conductors associated with intrusion system that are terminated, spliced, or interrupted in any enclosure onto terminal blocks.
6. Mark each terminal according to system's wiring diagrams.
7. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with NECA 1 and NFPA 70.

B. Conductors: Size according to system manufacturer's written instructions unless otherwise indicated.

C. Do not install conductors and cables that are wet, moisture damaged, or mold damaged.

D. Install UTP, optical-fiber, and coaxial cables and connecting materials after spaces are complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

E. General Requirements for Cabling:

1. Comply with TIA-568-C.1.
2. Comply with BICSI ITSIM, Ch. 6, and “Cable Termination Practices."
3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels. Leave a minimum of 6 inches of slack at outlet terminations and coil loosely into box after termination on outlet fitting.
4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
5. Maintain minimum cable bending radius during installation and termination of cables.
6. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
7. Cold-Weather Installation: Bring cable to room temperature before unreeling. Heat lamps shall not be used for heating.
8. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, and “Pulling Cable." Monitor cable pull tensions. Do not exceed manufacturer's rated cable-pulling tension.
9. Riser Cable: Riser cable support intervals shall be in accordance with manufacturer's recommendations.
10. Comply with Section 270529, Article 2.6 Firestopping.

F. UTP Cable Installation: Install using techniques, practices, and methods that are consistent with Category 6 rating of components and that ensure Category 6 performance of completed and linked signal paths, end to end.

1. Comply with TIA-568-C.1.
2. Install 110-style IDC termination hardware unless otherwise indicated.
3. Do not untwist UTP cables more than 1/2 inch from point of termination to maintain cable geometry.

G. Optical-Fiber Cable Installation:

1. Comply with TIA-568-C.0.
2. Cable shall be terminated on connecting hardware that is rack or cabinet mounted.

H. Coaxial-Cable Installation:

1. Install outdoor connections in enclosures complying with NEMA 250, Type 4X. Install corrosion-resistant connectors with properly designed O-rings to keep out moisture.

2. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches.
3. Install indoor cables in pathway.

I. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunication spaces with terminating hardware and interconnection equipment.
2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 48 inches apart. Cable supports shall be fastened to structural members or floor slabs in accordance with Section 270529 Hangers and Supports for Communications Systems.
3. Cable shall not be run in contact with pipes, ducts, or other potentially damaging items. Cables shall not be run through structural members or use structural members, pipes, ducts, or equipment as a support.

J. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Cable slack 72 inches long shall be neatly coiled not less than 12 inches in diameter below each feed point.

K. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-C recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communication cables or cables in nonmetallic pathways and unshielded power conductors and electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.

3. Separation between communication cables in grounded metallic pathways and unshielded power lines or electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.

4. Separation between cables in grounded metallic pathways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.

5. Separation between Cables and Electrical Motors and Transformers, 5 kVA or hp and Larger: A minimum of 48 inches.
6. Separation between Cables and Fluorescent Fixtures: A minimum of 5 inches.

7. Install plenum cable in environmental air spaces, including plenum ceilings.

3.4 POWER AND CONTROL-CIRCUIT CONDUCTORS

A. 120-V Power Wiring: Install according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables" unless otherwise indicated.

B. Minimum Conductor Sizes:

1. Class 1 remote-control and signal circuits, No. 14 AWG.
2. Class 2 low-energy, remote-control and signal circuits, No. 16 AWG.
3. Class 3 low-energy, remote-control, alarm and signal circuits, No. 12 AWG.

3.5 CONNECTIONS

A. Comply with requirements in Section 281300 Access Control for connecting, terminating, and identifying wires and cables.

B. Comply with requirements in Section 282300 Video Surveillance for connecting, terminating, and identifying wires and cables.

3.6 FIRESTOPPING

A. Comply with requirements in Section 270529, Article 2.6 Firestopping.

B. Comply with TIA-569-C, "Firestopping" Annex A.

C. Comply with BICSI TDMM, "Firestopping Systems".

3.7 GROUNDING

A. For communication wiring, comply with J-STD-607-A and with BICSI TDMM's "Grounding, Bonding, and Electrical Protection" chapter.

B. For low-voltage wiring and cabling, comply with requirements in Section 270526 Grounding and Bonding for Communications Systems.

3.8 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 270553 Identification for Communications Systems.

3.9 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Visually inspect UTP and optical-fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations to confirm color coding for pin assignments, and inspect cabling connections to confirm compliance with TIA-568-C.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test UTP cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross connection.

    a. Test instruments shall comply with or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

4. Optical-Fiber Cable Tests:

    a. Test instruments shall comply with or exceed applicable requirements in TIA-568-C.0. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
    b. Link End-to-End Attenuation Tests:

        1) Multimode Link Measurements: Test at 850 or 1300 nm in one direction according to TIA-526-14-B, Method B, One Reference Jumper.
        2) Attenuation test results for links shall be less than 2.0 db. Attenuation test results shall be less than that calculated according to equation in TIA-568-C.0.

END OF SECTION 280513

SECTION 281300 - ACCESS CONTROL

PART 1 GENERAL

1.1 SUMMARY

A. This specification is intended to define the standards and criteria to be used in the installation and documentation of an Access Control System to support the Greenville Transit Activity Center, Greenville, North Carolina. This specification coupled with construction drawings shall form the basis for the system installation.

B. The proposed Access Control System shall offer a highly efficient and automated solution that allows operators to quickly identify an alarm scenario.

C. All interfaces within the Access Control System shall be based on TCP/IP network protocol connectivity over the corporate intranet / internet / LAN/WAN.

D. The access control must be expandable in the following areas:

1. The system shall be designed to allow foreseeable organizational changes and procedural changes beyond current plans.
2. Additional hardware units shall easily be added without any modification to the existing hardware, software and network configuration.
3. All systems shall provide at least 10% spare capacity for future expansion and connection.

E. The Access Control System shall be a multi-tasking and multi-user based head end running on a distributed TCP/IP network.

F. The system shall provide alarm gathering, monitoring, handling reporting, full logging including the performance and activities of the operators within the secured areas of the building. It shall also provide monitoring and control of inputs and outputs both locally and remotely (e.g. in different buildings).

G. The system shall be a flexible and user friendly workstation providing users(s) with a Graphical User Interfaces (GUIs) for alarm monitoring and control. Such GUIs shall be the core of the entire Access Control System that includes a map viewer and a Video Verification module for surveillance and recording video streams.

H. The system shall control access into designated security controlled doors only by personnel with a valid access card and within a valid time schedule. All access cards shall be authenticated against the central and/or local database before granting access.

I. The system shall support credential enrollment via field readers connected to the local access controller.

J. Up to three cards can be assigned to a person.

K. All designated security controlled doors shall be fitted with a suitable card reader.

L. All door access activities shall be logged into the central database. Any unauthorized attempt or invalid card used shall be reported to the Access Control System, including door held and forced opened alarm as priority alarm transactions.

M. With the Video Verification module, live images from the camera installed at the door location shall be displayed at Access Control System GUI during door alarm activation and access request. It shall also be possible to select live view of the camera to view the person’s face before activating (manually unlocking the door via icon control on the BUI) and granting during door access request.

N. The system shall also include a feature to display the last 5 access requests from an specified entrance with last name, first name, database picture, timestamp and event type (authorized, card is unknown, card is blocked, etc.).

O. Reports shall always be readily available and owner shall be able to request for the reports on exactly what information from the report is required with the use of event filters.

P. Unauthorized deviations from this specification may require re-design, re-construction, or re-installation of Access Control System elements at the Contractors' expense. Contractors shall get prior approval to deviate from this specification. Contractors cannot deviate from NEC and NESC.

Q. "Codes" refer to the NFPA 70 (National Electrical Code) and IEEE C2 (National Electric Safety Code). "Standards" refer to ANSI, ASTM, and UL standards. "Methodologies" refers to BISCI.

R. Like standards and codes, this document uses the word "shall" to indicate mandatory requirements and "may" or "should" to indicate optional components. Conflicts within this document are to be resolved by Greenville Transit Security Services prior to application of the specification by a Contractor.

S. Sections Include:

1. Section 280513: Conductors and Cables for Security Systems.
2. Section 282300 Video Surveillance.
3. Section 270533: Conduits and Backboxes for Communications Systems.
4. Section 270536: Cable Tray for Communications Systems.
5. Section 270553: Identification for Communications Systems.

T. CAUTION! Use of this Section without including all of the above-listed items will result in the omission of basic requirements.

1.2 REFERENCES

A. NFPA 70: National Electric Code

B. BHMA – Builders Hardware Manufacturers Association

C. ISO/IEC 7810 – Identification Cards

D. ANSI/TIA-862-A – Building Automation Systems Cabling

E. Standards referenced above may include multiple components which apply to the Greenville Transit Activity Center project. In all cases, the current versions or succeeding documents for the codes, standards, and methodologies listed above shall be used.

F. Should conflicts exist within the standards, the more stringent shall apply.

1.3 DEFINITIONS

A. Access Control System:

1. Access Control System: An integrated solution that consists for hardware and software designed to control entry into selected areas and manage movement of people/vehicles within. The system is designed to increase security by defining access permissions based on area and time for each user and maintaining a log of all events.

B. Specific Elements:

1. Software: Used to adjust all parameters of the system, control hardware display events related to movement of users, alarms, and operation of hardware devices.
2. Electromechanical hardware: Includes electric locks, parking barriers and garage gates, turnstiles.
3. Electronic Hardware:

a. Controllers - Receive settings from software and control the electromechanical hardware of the system.
b. Contactless Readers - Read unique numbers of identification cards/tags and forwards the numbers to controllers.
c. Fingerprint Readers - Scan fingerprint images, compare them with the templates stored in the internal reader database (or on a smart card) and send the verification results to controllers.

4. System Users:

a. Operator - Responsible for administrating the system, creating new users, issuing cards and performing other regular daily tasks.
b. Installers – Responsible for installing, programming, maintaining and troubleshooting the system.
c. Visitors – People that are not employed by the end-user company/organization, but still have rights to access certain areas (contractors, visitors, delivery people, etc.).
d. Vehicles (or other equipment) – Are accounted for and their in/out movements are controlled and tracked by the system, in order to prevent unauthorized vehicles from entering parking areas, or valuable equipment from being taken without authorization.

C. Acronyms And Abbreviations:

1. ADA: Americans with Disabilities Act

2. AMC: Access Modular Controller
3. AS: Application Software
4. ANSI: American National Standards Institute.
5. AWG: American Wire Gauge
6. CCTV: CCTV: Closed Circuit Television surveillance and recording system
7. CPU: Central Processing Unit
8. CF: Compact Flash
9. dB: Decibel
10. EIA: Electronic Industries Alliance
11. EOL: End of Line Resistor
12. ESA: Electronic Security Association
13. FCC: Federal Communications Commission
14. FP: Fingerprint
15. GTAC: Greenville Transit Activity Center
16. GUI: Graphical User Interface
17. Hz: Hertz
18. HTML: Hyper Text Mark-up Language
19. IE: Internet Explorer (Microsoft)
20. IEC: International Electrotechnical Commission
21. IEEE: Institute of Electrical and Electronics Engineers
22. ISO: International Organization for Standardization
23. LAN: Local Area Network
24. LDAP: Lightweight Directory Access Protocol
25. Mbps: Megabits per second
26. MHz: Megahertz
27. NEC: National Electrical Code, NFPA 70
28. NFPA: National Fire Protection Association
29. OLE: Object Linking and Embedding (Microsoft)
30. OLS: Offline Locking System
31. OPC: OLE for Process Control
32. OS Operating System
33. TR: Telecommunications Room
34. UL: Underwriters Laboratory
35. UPS: Uninterruptible Power Supply
36. WAN: Wide Area Network

1.4 QUALITY ASSURANCE

A. All equipment, systems and materials furnished and installed under this section shall be installed in accordance with the applicable standards of:

1. National codes: NEC and NFPA
2. Approvals and Listings: UL
3. Electronic Security Association
4. EIA/TIA Telecommunications Wiring Standards
5. Local Authority Having Jurisdiction
6. Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of a RCDD / RCDD/NTS or Commercial Installer, Level 2.

7. Installation Supervision: Installation shall be under the direct supervision of a Registered Technician, Level 2 Installer, who shall be present at all times when work of this section is performed at project site.
8. Field Inspector: Currently registered by BICSI as a RCDD, or Commercial Installer Level 2 to perform the on-site inspection.

B. Perform work in accordance with the State of North Carolina and local AHJ standards.

C. Maintain one copy of each referenced standard on site.

D. The Contractor shall have extensive experience (3+ years) with the specified manufacturers' hardware and cabling.

E. All installers shall have had experience with the specified manufacturers' hardware and cabling. ESA Installer Level I experience may be limited to class-based training using the manufacturers' hardware and cabling.

F. All installers shall be ESA registered installers. Seventy-five percent or more of the installers shall be ESA Certified Installer Level I. Workers not involved in installing security system elements (e.g. laborers delivering/moving materials, installing grounding, by an electrician, or workers installing pathway elements) do not have to be registered.

G. All team leads shall be ESA registered Technicians. The Contractor shall provide statements in the bid documents of experience for all proposed team leads. The statements shall include industry-specific training and certifications (with dates verifying active status on registrations/certifications), project experience, experience with security systems and experience as a team lead. The Contractor may provide additional material.

H. Only installers trained and certified by the manufacturer shall be allowed to install the products. Installers must possess the highest level of certification available by the manufacturer for the specific solution being installed.

I. The Contractor may provide proof of registration/certification of planned installers in bid documents. If not included in the bid documents, the Contractor shall provide a narrative on the levels of registration/certification of their installers within the bid documents. The Contractor shall provide proof of registration/certification for the final list of installers prior to the start of work.

J. Greenville Transit reserves the right to reject any unregistered or uncertified installers performing work for which they are not registered/certified. The Contractor shall be responsible for any loss of work, delays in schedules, or extra costs as a result of the use of unregistered/uncertified workers. Additional effort on the part of the Contractor to maintain the installation schedule as a result of the above mentioned loss time shall be the Contractor's responsibility and at the Contractor's additional expense.

K. Any exception to this specification must be approved by Greenville Transit Security system owner prior to installation. Any deviation from this specification must be approved by Greenville Transit Security system owner prior to installation. Any questions on interpretation shall be resolved by Greenville Transit Security system owner.

1.5 QUALIFICATIONS

A. The manufacturing company of products specified in this section is required to have a minimum of five years documented experience.

B. The installing company specializing in performing work of this section is required to have a minimum of three years documented experience approved by the manufacturer.

1.6 UNITS OF MEASURE

A. dB: Decibel

B. in: Inch(es)

C. ft: Foot or feet

D. m: Meter

E. nm: Nanometer

1.7 SYSTEM DESCRIPTION

A. The Access Control system shall be of open-architecture, PC-based system based on Windows Operating Systems, such as Windows 7 (64 bit, Enterprise), Windows Server 2008 (R2), Windows 10 (64 bit, Enterprise).

B. The Access control System shall comply to the strict regulation and adapting state-of-the-art security technologies, the highest level of reliability and integrate to networking infrastructures such as the Intranet, Internet, LAN/WAN.

C. The main function of the Access Control System shall be to control and monitor all designated access to the selected doors, areas or buildings.

D. The Access Control System shall provide and require a single security license key for system operation. Without or removing of such key shall disable the operation of the system upon detection.

E. The Access Control system shall be of modular design providing the flexibility to allow the user to add or remove any components and/or controlled functions or in the event when operating requirements change or as system expands.

F. The Access control System provided shall contain all the features and requirements specified, but not limited to, in this document. In particular, the proposed access controller shall be equipped with all common interfaces such as Ethernet and RS-485 for connection to the Access Control System server running the management software.

G. The Access Control System shall allow control of door entry access both by a proximity card reader and from the Access Control System workstation.

H. The proximity card reader shall also incorporate a numeric keypad to be used if Card and/or PIN number access configuration is desired at any locations. Coordinate with Greenville Transit Security system owner.

I. The Access Control System shall support up to four different Wiegand card formats simultaneously. The number of each format supported shall be unlimited.

J. A locally mounted door release push button shall be provided for purpose of exiting at selected doors as defined by the Security system owner or as indicated on the drawings.

K. For highly secured areas as further specified or indicated on the drawings, exit card reader shall be provided to allow an exact tracking of people going in and out of the predefined area.

L. All access doors shall have an emergency break-glass door release installed to unlock the door for exi9t in the event of emergency. In addition, all dedicated doors along the escape route shall automatically open during fire alarm activation.

M. The Access Control System shall also be provided to designated elevator access and vehicle barrier systems.

N. The Access Control System shall monitor and record in a logbook all movements and activities at each control point.

O. The Access Control System shall provide configuration and programming of access groups, where each access group contains a list of control points or access doors to which a card holder has authorized access.

P. The Access Control System shall provide configurable time schedules to have the flexibility for programming automatic locking and unlocking of any access controlled doors, as well as activating and de-activating of card holder settings for restricting any access groups from entering certain areas with the pre-programmed time model.

Q. The time schedule shall include holiday facilities to allow user programming for public holidays and user definable special holidays. All schedules shall be definable by day, hours and minutes.

R. The Access control System shall be designed such that any point of failure within the system shall not affect the normal operation of the other sub-systems. It shall continue to operate even if the connection with the management software is not present.

S. The Access Control System management software provided shall allow card personalization. That is, it shall include a tool for designing badges that supports the importing of bitmaps, text and database fields such as name or badge number for creating of corporate badge designs printable on a standard card printer that come with a Windows compliant printer driver.

T. The system must be expandable and by adding a new component it will not affect the systems normal operation.

1.8 SUBMITTALS

A. Product Data: For each type of hardware and software supplied, provide manufacturers data.

1.9 WARRANTY

A. The Contractor shall adhere to the warranty requirement for all installations. The Contractor shall install all components of the installed manufacturer's system-wide solution to the specifications and requirements needed to extend the longest and most extensive performance warranty available under the installed solution(s).

PART 2 PRODUCTS

2.1 SOFTWARE

A. Manufacturer:

1. Key Scan.
2. No Exceptions.

B. There shall be no limitations on the number of PC workstations, readers, and alarm inputs.

C. The number of cards/users shall be limited only by memory available in hardware.

D. At least 3 active cards per user shall be supported.

E. At least 8 access levels per user shall be supported.

F. Access levels should be assigned to a user, not to a card, in order to help issue a new card in a fast and easy manner, without reassigning access levels.

G. The software shall support at least 4000 holiday dates and have automatic holiday rescheduling feature.

H. The software shall have the ability to perform scheduled automatic database maintenance and backup tasks at user selected intervals and ability to configure the amount of history stored in the active database.

I. The software shall have the ability to produce the following report types: system and alarm event reports, user reports, hardware configuration settings, access level reports, employee time and attendance reports.

J. The reports shall be available in Adobe PDF and MS Excel formats.

K. Report filters must be convenient and user friendly: allow operator preview user photos, content of access levels, hardware settings and time zone configuration.

L. The software shall support an unlimited number of building floor plans.

M. Floor plan viewing interface shall have convenient zoom in/out controls by mouse wheel.

N. The software shall allow operator to conveniently edit floor plans by “dragging and dropping” hardware devices to selected plan areas.

O. The software shall allow assigning custom icons to each floor plan in order to help operator identify floor plans quickly. The software shall have a wide selection of default icons as well.

P. The software shall support “full-screen” mode that would take up 100% of the monitor area and prevent operators from starting or accessing any other programs.

Q. All configuration and user changes shall be sent to controller immediately. The software shall display the progress in percent as the changes are being downloaded. The downloading shall be done in background and not affect the normal use of the software in any way.

R. The floor plans shall display real-time status of system hardware and allow operators to immediately see the effects caused by configuration changes.

S. Dynamic search function shall be present in all windows of the program: search results shall be narrowed automatically as a key phrase is being entered, i.e. after entering characters “xy” the program shall locate and display all records these characters, and after typing in more characters shall refresh the results automatically.

T. The software shall have the ability to automatically display photos and additional information about users as they enter/exit through doors.

U. The software shall be available in the official language(s) of the country where it is being installed. If such language is not included in the standard installation, the software shall support user friendly translation method: simply replacing program text directly in the software (“on the fly”), without the need of sending any files to the manufacture for compiling.

V. The software shall have a modern interface, attractively designed and convenient to use.

W. The software shall be adapted for operators who have not received any special training related to management of integrated security systems. Graphical user interface shall be intuitive. Introducing the system to a new operator shall not take more than 1 hour.

X. In order to reduce the amount of work done by an operator, the software shall incorporate an option to copy objects: users, doors, floor plans, time schedules, access levels and holidays.

Y. The software shall facilitate integration with other systems of the building.

Z. The software shall have the ability to transfer entry and exit events to HR systems with the purpose of work time calculation.

AA. The software shall store information and provide reports about visitors and appointments.

2.2 HARDWARE

A. Manufacturer:

1. Key Scan.
2. No Exceptions.

B. The hardware shall support open architecture. Communication protocols shall be available to system integrators and software development companies in order to protect end-users from being constrained to a single brand of hardware or software.

C. The hardware shall support all industry standard readers that output information in Wiegand or Clock/Data formats (up to 128 bits).

D. There shall be a proximity reader available. The proximity reader shall integrate a contactless proximity card reader and controller in a single body, designed for surface mounting on a wall.

E. There shall be a proximity reader and keypad available. The proximity reader and keypad shall integrate both a card reader and keypad in a single body, designed for surface mounting a wall.

F. Each controller shall have a standard RJ-45 network port for communication with software and other controllers.

G. Each controller shall have a Communications Interlink Module-Link TCP/IP companion module when more than one controller is in use.

H. Controller and shall support standard Ethernet 10/100 BaseT network and TCP/IP communication protocol.

I. All proximity readers shall use a 125 MHz in order to enable fast execution of advanced functions.

J. All system parameters including card numbers, PINs, access levels, time schedules, holidays and operations modes shall be stored in controller and IP reader memory and not affected in case of a power loss.

K. Eight door controller shall enough memory to store at least 45, 000 users.

L. In case communication with the host PC is interrupted the controller must have enough memory to store at least 6000 latest events (Transaction file buffer).

M. Operation of the controller and proximity reader shall be completely independent of the PC or “Master controller”. Should the PC or the communications link fail, the users should not be affected in any way and all functions should continue working.

N. Proximity reader shall have the following features:

1. LED illumination for access granted and denial indications.
2. RFID technology.
3. Door held open alert.
4. Epoxy encased electronics for either interior or exterior use.
5. Read range of 4 to 6 inches.
6. UL294 listed.
7. Part number – K-PROX2.

O. Proximity reader and keypad shall be capable of the following:

1. The same features as the proximity reader.
2. Integral 10 digit and 2 symbol keypad.
3. Part number – K-KPR.

P. Eight door controller shall have the following inputs and outputs:

1. Power output for the reader.
2. Outputs for controlling LEDs and beeper of the reader.
3. Wiegand or Clock/Data input.
4. Exit button input.
5. Door contact input.
6. Auxiliary alarm input.
7. Tamper input.
8. Inputs for monitoring AC power and backup battery state. There should be an option to reconfigure these inputs to function as general purpose inputs.
9. Relay for controlling electric lock.
10. General purpose auxiliary output relay.
11. Ethernet ready.
12. Part number – CA8500.

Q. Relays of controller and proximity readers should support two modes of operation :

1. Dry contact.
2. Powered, whereas power to the lock is provided via relay contacts this way simplifying wiring and eliminating the need for an additional power supply.

R. Controllers and proximity readers shall accept the standard 12 VDC power input in case an existing network infrastructure does not support PoE.

S. Proximity cards shall be similar in size and thickness as standard credit cards or bank ATM cards.

1. Operate at 125 kHz.
2. CE/UL approved.

T. Controllers and proximity readers shall be capable of supplying up to 600mA @12 VDC to peripheral devices: readers, electric locks, sirens, detectors, etc.

U. In case the main PC of the system fails, controllers and proximity readers shall accept a connection from a laptop in order to diagnose the problem, change settings or control peripheral devices.

V. In case of an alarm controllers and IP readers shall initiate communication and provide timely notifications to operators. Hardware that does not initiate communication and needs to be polled frequently will not be acceptable due to producing needless traffic on the network and processing load on the PC.

PART 3 EXECUTION

3.1 EXAMINATION

A. Prior to installation, verify racks, conduits, boxes are installed and clean and dust free before installing equipment.

B. Verify that all equipment to be installed has not been damaged in shipment.

3.2 PREPARATION

A. Prior to installation verify that racks, boxes, etc. are plumb before installing equipment.

B. Product Schedules: Obtain detailed product schedules from manufacturer of access control system or develop product schedules to suit project. Fill in all data available from project plans and specifications and public as Product Schedules for review and approval.

C. Prior to start of project meet with architect and system owner to present product schedules and review, adjust and prepare final setup documents. Use approved final product schedules to set up system software.

3.3 CABLING

A. Comply with NECA 1, “Good Workmanship in Electrical Construction.”

B. Comply with TIA – 569 – C – Commercial Building Standard for Telecommunications Pathways and Spaces.

C. Cable application requirements are minimum requiremet5ns and shall be exceeded if recommended or required by manufacturer of system hardware.

D. Install cables and wiring according to requirements in Section 280513 – Conductors and Cables for Electronic Safety and Security.

E. Wiring Method: Install wiring in raceway and cable tray except within consoles, cabinets, racks, desks, and counters. Conceal raceway and wiring except in unfinished spaces.

F. Install LAN cables using techniques, practices and methods that are consistent with Category 6 rating of components and fiber optic rating of components, and that ensure completed and linked signal paths end to end.

G. Boxes and enclosures continuing security system components or cabling and which are easily accessible to employees or to the public, shall be provided with a lock. Boxes above ceiling level in occupied areas of the building shall not be considered accessible. Junction boxes and small device enclosures below ceiling level and easily accessible to employees or the public shall be covered with a suitable cover plate and secured with tamper proof screws.

H. Install end of line resistors at the field device location and not at the controller or panel location.

I. TIA 232-F Cabling: Install at a maximum distance of 50 feet.

J. TIA 485-A Cabling: Install at a maximum distance of 4000 feet.

K. Card Readers and Keypads:

1. Install number of conductor pairs recommended by manufacturer for the functions specified.
2. Unless manufacturer recommends larger conductors, install No. 22AWG wire if maximum distance from controller to the reader is 250 feet, and install No. 20 AWG wire if maximum distance is 500 feet.
3. For greater distances install extender or repeater modules recommended by manufacturer of the controller.
4. Install minimum No. 18 AWG shielded cable to readers and keypads that draw 50 mA or more.
5. Install No. 16 AWG cable from controller to electrically powered locks. Do not exceed 250 feet.
6. Install minimum No. 18 AWG AC power from wiring from transformer to controller with a maximum distance of 25 feet.

L. Grounding:

1. Comply with Section 270526 – Grounding and Bonding for Communications Systems.
2. Comply with IEEE 1100 – Recommended Practice for Power and Grounding Electronic Equipment.
3. Ground cable shields, drain conductors and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk and other impairments.
4. Bond shields and drain conductors to ground at only one point in each circuit.

3.4 INSTALLATION

A. Push Buttons: Where multiple push buttons are housed within a single switch enclosure, they shall be stacked vertically with each push button switch labeled with ¼ inch high text and symbols as required. Push button switches shall be connected to the controller associated with the portal to which they are applied, and shall operate the appropriate electric strike, electric bolt, or other facility release device.

B. Install raceways, cabling, card readers, keypads, push buttons and biometric readers.

3.5 IDENTIFICATION

A. In addition to requirements in this section, comply with applicable requirements in Section 270553 Identification for Communications Systems and with TIA-606-A.

B. Using appropriate software, develop cable administration drawings for system identification, testing, and management. Use unique alphanumeric designation for each cable, and label cable and jacks, connector and terminals to which it connects with the same designation. Use logical and systematic designations for facility's architectural arrangement. Obtain approval of security system owner for system identification.

C. Label each terminal strip and screw terminal in each cabinet, rack or panel.

1. All wiring conductors connected to terminal strips shall be individually numbered and each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with the name and number of the particular device as shown.
2. Each wire connected to building mounted devices is not required to be numbered at the device if the color of the wire is consistent with the associated wire connected and numbered within the panel or cabinet.

D. At completion, cable and asset management software shall reflect as built conditions.

3.6 SYSTEM SOFTWARE AND HARDWARE

A. Develop, install and test software and hardware and perform database tests for the complete and proper operation of systems involved. Assign software license to Owner.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections:

1. Manufacturer's Field Service: Engage a factory authorized service representative to inspect components, assemblies, and equipment installations, including connections and to assist in testing.

B. Tests and Inspections:

1. LAN Cable Procedures: Inspect for physical damage and test each conductor signal path for continuity and shorts. Use Class 2, bidirectional, Category 6 tester. Test for faulty connectors, splices, and terminations. Test according to TIA-EIA-568 C.0 and C.1.
2. Test each circuit and component of each system. Tests shall include, but are not limited to measurements of power supply output under maximum load, signal loop resistance, and leakage to ground where applicable. System components with battery backup shall be operated on battery power of a period of not less than 10 percent of the calculated battery operation time. Provide special equipment and software if testing requires special or dedicated equipment.

3. Operational Test: After installation of cables and connectors, demonstrate product capability and compliance with requirements. Test each signal path for end to end performance from each end of all pairs installed. Remove temporary connections when test have been satisfactorily completed.
4. Contractor shall notify owner prior to starting testing. Owner or owner's representative shall be present during testing.

C. Devices and circuits will be considered defective if they do not pass test and inspections. Contractor will correct defects and retest at no cost to the owner.

D. Prepare test and inspection reports.

3.8 STARTUP SERVICE

A. Engage a factory authorized service representative to supervise and assist with startup service.

1. Complete installation and startup checks according to approved procedures that were developed in Article 3.2, Preparation.
2. Enroll and prepare badges and access cards for Owner's operators, management and security personnel.

3.9 PROTECTION

A. Maintain strict security during the installation of equipment and software. Rooms housing the control station and workstations that have been powered up shall be locked and secured during periods when a qualified operator in the employ of the contractor is not present. A Central Station burglar alarm shall be employed if installed at this site.

3.10 TRAINING

A. Engage a factory authorized service representative to train Owner's maintenance personnel to adjust, operate and maintain security access system. Two hours of onsite training to be provided.

B. Develop separate training modules for the following:

1. Computer system administration personnel to manage and repair the LAAN and data bases and to update and maintain software.
2. Operators who prepare and input credentials to man the control station and workstations and to enroll personnel.
3. Security personnel.
4. Hardware maintenance personnel.
5. Corporate management.

3.11 WARRANTY

A. Contractor to provide a minimum one year warranty. Manufacturer's Warranty information to be filled out in the Owner's name and address.

END OF SECTION 281300

SECTION 282300 - VIDEO SURVEILLANCE

PART 1 - GENERAL

1.1 The Contractor shall provide, install and program a functionally complete integrated video surveillance system per Manufacturer's guidelines and codes, as described in the following specification.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

A. Section includes a video surveillance system consisting of cameras, network video recorder, data transmission wiring, and a control station with its associated equipment.

B. Video surveillance system shall be integrated with an access control system.

1.4 DEFINITIONS

A. AGC: Automatic gain control.

B. BNC: Bayonet Neill-Concelman - type of connector.

C. CCD: Charge-coupled device.

D. FTP: File transfer protocol.

E. IP: Internet protocol.

F. LAN: Local area network.

G. MPEG: Moving picture experts group.

H. NTSC: National Television System Committee.

I. NVR: Network Video Recorder

J. PC: Personal computer.

K. PoE: Power over Ethernet.

L. PTZ: Pan-tilt-zoom.

M. RAID: Redundant array of independent disks.

N. TCP: Transmission Control Protocol - connects hosts on the Internet.

O. UPS: Uninterruptible power supply.

P. VMR: Video Management Recorder

Q. VMS: Video Management System

R. WAN: Wide area network.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include dimensions and data on features, performance, electrical characteristics, ratings, and finishes.

B. Equipment List: Include every piece of equipment by model number, manufacturer, serial number, location, and date of original installation. Add pretesting record of each piece of equipment, listing name of person testing, date of test, set points of adjustments, name and description of the view of preset positions, description of alarms, and description of unit output responses to an alarm.

1.6 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Warranty: Sample of special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For cameras, power supplies, infrared illuminators, monitors, videotape recorders, digital video recorders, video switches, and control-station components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Lists of spare parts and replacement components recommended to be stored at the site for ready access.

1.8 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 NECA 1.

C. Comply with NFPA 70.

D. Electronic data exchange between video surveillance system with an access-control system shall comply with SIA TVAC.

1.9 PROJECT CONDITIONS

A. Environmental Conditions: Capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:

1. Control Station: Rated for continuous operation in ambient temperatures of 60 to 85 deg F (16 to 29 deg C) and a relative humidity of 20 to 80 percent, noncondensing.
2. Interior, Controlled Environment: System components, except central-station control unit, installed in air-conditioned interior environments shall be rated for continuous operation in ambient temperatures of 36 to 122 deg F dry bulb and 20 to 90 percent relative humidity, noncondensing. Use NEMA 250, Type 1 enclosures.
3. Interior, Uncontrolled Environment: System components installed in non-air-conditioned interior environments shall be rated for continuous operation in ambient temperatures of 0 to 122 deg F dry bulb and 20 to 90 percent relative humidity, noncondensing. Use NEMA 250, Type 3R enclosures.
4. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambient temperatures of 0 to plus 122 deg F dry bulb and 20 to 90 percent relative humidity, condensing. Rate for continuous operation when exposed to rain as specified in NEMA 250, winds up to 85 mph and snow cover up to 24 inches thick. Use NEMA 250, Type 3S enclosures.
5. Hazardous Environment: System components located in areas where fire or explosion hazards may exist because of flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers shall be rated, listed, and installed according to NFPA 70.
6. Corrosive Environment: System components subject to corrosive fumes, vapors, and wind-driven salt spray in coastal zones. Use NEMA 250, Type 4X enclosures.
7. Security Environment: Camera housing for use in high-risk areas where surveillance equipment may be subject to physical violence.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of cameras, equipment related to camera operation, and control-station equipment that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM REQUIREMENTS

A. Video-signal format shall comply with NTSC standard, composite interlaced video. Composite video-signal termination shall be 75 ohms.

B. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor's entry connection to components.

1. Minimum Protection for Power Connections 120 V and More: Auxiliary panel suppressors.
2. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Connections: Comply with requirements as recommended by manufacturer for type of line being protected.

C. Tamper Protection: Tamper switches on enclosures, control units, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled. Control-station, control-unit alarm display shall identify tamper alarms and indicate locations.

2.2 STANDARD CAMERAS

A. Manufacturers:

1. Axis Communications.
2. No Exceptions.

B. Color HDTV Camera:

1. Pickup Device: Progressive Scan CCD.
2. Maximum Video Resolution: Extended D1 (752 x 480).
3. Signal-to-Noise Ratio: 52 dB.
4. With AGC, manually selectable on or off.
5. Sensitivity: Camera shall provide usable images in low-light conditions, delivering a color image at a scene illumination of .5 lux at F1.4.
6. Manually selectable modes for backlight compensation or normal lighting.
7. Intelligent Video Analytics.
8. White Balance: Auto-tracing white balance, with manually settable fixed balance option.
9. Motion Detector: Built-in digital.
10. Power: PoE.

C. Automatic Color Dome HDTV Camera: Assembled and tested as a manufactured unit, containing dome assembly, color camera, motorized pan and tilt, zoom lens, and receiver/driver.

1. Pickup Device: Progressive Scan CCD.
2. Maximum Video Resolution: Extended D1 (752 x 480).
3. Signal-to-Noise Ratio: 52 dB.
4. With AGC, manually selectable on or off.
5. Sensitivity: Camera shall provide usable images in low-light conditions, delivering a color image at a scene illumination of .5 lux at F1.4.
6. Manually selectable modes for backlight compensation or normal lighting.
7. Pan and Tilt: Direct-drive motor, 360-degree rotation angle, and 180-degree tilt angle. Pan-and-tilt speed shall be controlled by operator. Movement from preset positions shall be not less than 300 degrees per second.

8. Preset Positioning: Eight user-definable scenes, each allowing 16-character titles. Controls shall include the following:

    a. In "sequence mode," camera shall continuously sequence through preset positions, with dwell time and sequencing under operator control.
    b. Motion detection shall be available at each camera position.
    c. Up to four preset positions may be selected to be activated by an alarm. Each of the alarm positions may be programmed to output a response signal.

9. Intelligent Video Analytics.
10. White Balance: Auto-tracing white balance, with manually settable fixed balance option.
11. Motion Detector: Built-in digital.
12. Dome shall support multiplexed control communications using coaxial cable recommended by manufacturer.
13. Power: PoE.

D. Camera Part Numbers:

1. P5635-E 60Hz Outdoor HDTV PTZ day/night camera with 30X optical zoom.
2. Q3505-VE day/night dome, wide dynamic range, IK10+vandal 3-9mm 1080p, 2MP, 60FPS.
3. Q3505-V day/night indoor.
4. M3037-PVE outdoor ready 360 degree camera.

2.3 LENSES

A. Manufacturers:

1. Axis Communications.
2. No Exceptions.

B. Description: Optical-quality coated lens, designed specifically for video-surveillance applications and matched to specified camera. Provide color-corrected lenses with color cameras.

1. Auto-Iris Lens: Electrically controlled iris with circuit set to maintain a constant video level in varying lighting conditions.
2. Fixed Lens: With calibrated focus ring.
3. Zoom Lens: Motorized, remote-controlled unit, rated as "quiet operating." Features include the following:

    a. Electrical Leads: Filtered to minimize video signal interference.
    b. Motor Speed: Variable.
    c. Lens shall be available with preset positioning capability to recall the position of specific scenes.

2.4 POWER SUPPLIES

A. Power over Ethernet.

2.5 CAMERA-SUPPORTING EQUIPMENT

A. Manufacturers:

1. Axis Communications.
2. No Exceptions.

B. Minimum Load Rating: Rated for load in excess of the total weight supported times a minimum safety factor of two.

C. Pan Units: Motorized automatic-scanning units arranged to provide remote-controlled manual and automatic camera panning action, and equipped with matching mounting brackets.

1. Scanning Operation: Silent, smooth, and positive.
2. Stops: Adjustable without disassembly, to limit the scanning arc.

D. Pan-and-Tilt Units: Motorized units arranged to provide remote-controlled aiming of cameras with smooth and silent operation, and equipped with matching mounting brackets.

1. Panning Rotation: 0 to 360 degrees, with adjustable stops.
2. Tilt Movement: 90 degrees, plus or minus 5 degrees, with adjustable stops.
3. Speed: 12 degrees per second in both horizontal and vertical planes.
4. Wiring: Factory prewired for camera and zoom lens functions and pan-and-tilt power and control.
5. Built-in encoders or potentiometers for position feedback.
6. Pan-and-tilt unit shall be available with preset positioning capability to recall the position of a specific scene.

E. Mounting Brackets for Fixed Cameras: Type matched to items supported and mounting conditions. Include manual pan-and-tilt adjustment.

1. Corner Bracket:

a. Part number – T91A64.

2. Pole Bracket:

a. Part number – T91A67.

3. Ceiling Mount:

a. Part number – T91863.

4. Pendant Kit:

a. Part number – T94M01D.

F. Protective Housings for Fixed and Movable Cameras: Steel enclosures with internal camera mounting and connecting provisions that are matched to camera/lens combination and mounting and installing arrangement of camera to be housed.

1. Tamper switch on access cover sounds an alarm signal when unit is opened or partially disassembled. Central-control unit shall identify tamper alarms and indicate location in alarm display.
2. Camera Viewing Window: Polycarbonate window, aligned with camera lens.
3. Duplex Receptacle: Internally mounted.
4. Alignment Provisions: Camera mounting shall provide for field aiming of camera and permit removal and reinstallation of camera lens without disturbing camera alignment.
5. Built-in, thermostat-activated heater units. Units shall be automatically controlled so the environmental limits of the camera equipment are not exceeded.
6. Sun shield shall not interfere with normal airflow around the housing.
7. Mounting bracket and hardware for wall or ceiling mounting of the housing. Bracket shall be of same material as the housing; mounting hardware shall be stainless steel.
8. Finish: Housing and mounting bracket shall be factory finished using manufacturer's standard finishing process suitable for the environment.
9. Enclosure Rating:

    a. Interior: IP 51.
    b. Exterior: IP 66.

        1) Exterior housing to be equipped with sunshield, heater and thermostat.

G. Camera License:

1. Ocularis CS.
2. 1 License per camera.
3. 1 year license support per camera.

H. PTZ Controls: Arranged for multiple-camera control, with switches to select camera to be controlled.

1. Pan-and-Tilt Control: Joystick type.
2. Zoom Control: Momentary-contact, "in-out" push button.
3. Automatic-Scan Control: A push button for each camera with pan capability that places camera in automatic-scanning mode.

2.6 VIDEO SERVER

A. Manufacturer:

1. Iomnis.
2. Model number IR20TB791.
3. No Exceptions.

B. Description:

1. 12 x 3 ½” front loading drive bays for storage up to 72TB raw capacity.
2. Two Intel Xeon E5-2620 v3 processors.
3. 24 DIMM slots supporting up to 1.5TB of memory.
4. Redundant power supply units.
5. Hot plug PSUs, HDDs, and fans.

6. 32GB of memory.
7. 1GB Cache RAID controller.
8. 11 2TB 7200RPM 3.5: NL-SAS.
9. PCIe: (3) x 8 Half-Height, (1) x 8 Full Height, (2) x 16 Full-Height.
10. Power Supplies: (2) 495W AC, 86mm 12G (Platinum).
11. Enterprise Remote Card.
12. Video: Integrated Matrox G200eW (1 x VGA).
13. NIC: 4 x 10/100/1000 (RJ-45).
14. Rack Mount 2RU with Sliding Rack Rails.
15. Heat Output: (est) 1500 BTU/Hr.
16. Warranty: 5 Year Onsite Hardware Repair/Replacement.
17. Operating System: Windows Server 2012 R2 Standard.

2.7 DESKTOP CONTROL STATIONS

A. Manufacturers:

1. Axis Communications.
2. No Exceptions.

B. Remote control capable of accessing up to 100 IP cameras.

C. Adjustment Functions; Pan/Tilt, Zoom, Focus, Iris, Gain, Pedestal, Shutte, Detail, White Balance (Auto, R/B Gain), Black Balance (Auto, R/B Pedestal), Switch Scene files.

D. IP Connection 10Base-T, 100Base-TX, RJ-45 x 1.

E. Power Requirements: DC 12V, POE, 120V.

2.8 SIGNAL TRANSMISSION COMPONENTS

A. Cable: 100 ohm 4 pair Category 6 cable. Cable rating to match area of installation, i.e. CMP, CMR, OSP.

2.9 SIGNAGE REQUIREMENTS

A. Signage for video and CCTV locations is required at main entrances to areas with video security, such as building entrances, elevator landings, and bus canopies.

1. Signs size shall be 14” x 10”.
2. Sign Reads: NOTICE FOR YOUR PROTECTION ALL ACTIVITIES ON THESE PREMISES ARE RECORDED BY VIDEO SURVEILLANCE.
3. Signs will be placed so the bottom of the sign is 60” above finished floor. (i.e. just above light switch level).
4. Signs will be placed in locations where they can be readily be seen by someone entering the space. Guidance for sign placement is as follows:

a. Immediately inside or outside the entrance door to the building lobby or other building entrances.
b. Above the elevator call buttons in the elevator lobby.
c. On walls and not on doors.
d. Bus Canopy areas.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine pathway elements intended for cables. Check raceways and other elements for compliance with space allocations, installation tolerance, hazards to camera installation, and other conditions affecting installation.

B. Examine roughing-in for LAN, WAN, and IP network before device installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 WIRING

A. Comply with requirements in Section 270533 Conduits and Backboxes for Communications Systems.

B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

C. Splices, Taps, and Terminations: For power and control wiring, use numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

D. For LAN connection and fiber-optic and copper communication wiring, comply with Section 271519 "Data Communications Horizontal Cabling."

E. Grounding: Provide independent-signal circuit grounding recommended in writing by manufacturer.

3.3 VIDEO SURVEILLANCE SYSTEM INSTALLATION

A. Install cameras and infrared illuminators level and plumb.

B. Install cameras with 96-inch minimum clear space below cameras and their mountings unless noted otherwise on the drawings. Change type of mounting to achieve required clearance.

C. Set pan unit and pan-and-tilt unit stops to suit final camera position and to obtain the field of view required for camera. Connect all controls and alarms, and adjust.

D. Install power supplies and other auxiliary components at control stations unless otherwise indicated.

E. Install tamper switches on components indicated to receive tamper switches, arranged to detect unauthorized entry into system-component enclosures and mounted in self-protected, inconspicuous positions.

F. Avoid ground loops by making ground connections only at the control station.

1. For 12- and 24-V dc cameras, connect the coaxial cable shields only at the monitor end.

G. Identify system components, wiring, cabling, and terminals according to Section 270553 Identification for Communications Systems.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Inspection: Verify that units and controls are properly installed, connected, and labeled, and that interconnecting wires and terminals are identified.
2. Pretesting: Align and adjust system and pretest components, wiring, and functions to verify that they comply with specified requirements. Conduct tests at varying lighting levels, including day and night scenes as applicable. Prepare video-surveillance equipment for acceptance and operational testing as follows:

    a. Prepare equipment list described in "Informational Submittals" Article.
    b. Verify operation of auto-iris lenses.
    c. Set back-focus of fixed focal length lenses. At focus set to infinity, simulate nighttime lighting conditions by using a dark glass filter of a density that produces a clear image. Adjust until image is in focus with and without the filter.
    d. Set back-focus of zoom lenses. At focus set to infinity, simulate nighttime lighting conditions by using a dark glass filter of a density that produces a clear image. Additionally, set zoom to full wide angle and aim camera at an object 50 to 75 feet away. Adjust until image is in focus from full wide angle to full telephoto, with the filter in place.
    e. Set and name all preset positions; consult Owner's personnel.
    f. Set sensitivity of motion detection.
    g. Connect and verify responses to alarms.
    h. Verify operation of control-station equipment.

3. Test Schedule: Schedule tests after pretesting has been successfully completed and system has been in normal functional operation for at least 14 days. Provide a minimum of 10 days' notice of test schedule.
4. Operational Tests: Perform operational system tests to verify that system complies with Specifications. Include all modes of system operation. Test equipment for proper operation in all functional modes.

D. Video surveillance system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.5 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Tasks shall include, but are not limited to, the following:

1. Check cable connections.
2. Check proper operation of cameras and lenses. Verify operation of auto-iris lenses and adjust back-focus as needed.
3. Adjust all preset positions; consult Owner's personnel.
4. Recommend changes to cameras, lenses, and associated equipment to improve Owner's use of video surveillance system.
5. Provide a written report of adjustments and recommendations.

3.6 CLEANING

A. Clean installed items using methods and materials recommended in writing by manufacturer.

B. Clean video-surveillance-system components, including camera-housing windows, lenses, and monitor screens.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain video-surveillance equipment. Two hours of onsite training to be provided.

END OF SECTION 282300

SECTION 283111 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

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. Fire-alarm control unit.
2. Manual fire-alarm boxes.
3. System smoke detectors.
4. Air-sampling smoke detectors.
5. Heat detectors.
6. Notification appliances.
7. Device guards.
8. Remote annunciator.
9. Addressable interface device.
10. Digital alarm communicator transmitter.
11. Network communications.

B. Related Requirements:

1. Section 280513 "Conductors and Cables for Electronic Safety and Security" for cables and conductors for fire-alarm systems.

1.3 DEFINITIONS

A. EMT: Electrical Metallic Tubing.

B. FACP: Fire Alarm Control Panel.

C. HLI: High Level Interface.

D. NICET: National Institute for Certification in Engineering Technologies.

E. PC: Personal computer.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, including furnished options and accessories.

1. Include construction details, material descriptions, dimensions, profiles, and finishes.
2. Include rated capacities, operating characteristics, and electrical characteristics.

B. Shop Drawings: For fire-alarm system.

1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
2. Include plans, elevations, sections, details, and attachments to other work.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
4. Detail assembly and support requirements.
5. Include voltage drop calculations for notification-appliance circuits.
6. Include battery-size calculations.
7. Include input/output matrix.
8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
9. Include performance parameters and installation details for each detector.
10. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
11. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale; coordinate location of duct smoke detectors and access to them.

    a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
    b. Show field wiring required for HVAC unit shutdown on alarm.
    c. Locate detectors according to manufacturer's written recommendations.

12. Include single-line connection diagram.
13. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

C. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
2. Shop Drawings shall be prepared by persons with the following qualifications:

    a. Trained and certified by manufacturer in fire-alarm system design.
    b. NICET-certified, fire-alarm technician; Level III minimum.
    c. Licensed or certified by authorities having jurisdiction (if required).

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Field quality-control reports.

C. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following and deliver copies to authorities having jurisdiction:

a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
c. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.
d. Riser diagram.
e. Device addresses.
f. Record copy of site-specific software.
g. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:

1) Equipment tested.
2) Frequency of testing of installed components.
3) Frequency of inspection of installed components.
4) Requirements and recommendations related to results of maintenance.
5) Manufacturer's user training manuals.

h. Manufacturer's required maintenance related to system warranty requirements.
i. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.

3. Smoke Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than one unit of each type.
4. Detector Bases: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
5. Keys and Tools: One extra set for access to locked or tamper-proofed components.
6. Audible and Visual Notification Appliances: One of each type installed.
7. Fuses: Two of each type installed in the system. Provide in a box or cabinet with compartments marked with fuse types and sizes.

1.8 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 III technician.

C. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

1.9 PROJECT CONDITIONS

A. Use of Devices during Construction: Protect devices during construction unless devices are placed in service to protect the facility during construction.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.

1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.
2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Noncoded, UL-certified and FM Global-placarded addressable system, with multiplexed signal transmission and horn/strobe evacuation.

B. Automatic sensitivity control of certain smoke detectors.

C. All components provided shall be listed for use with the selected system.

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

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. Fire standpipe system.
7. Dry system pressure flow switch.

B. Fire-alarm signal shall initiate the following actions:

1. Continuously operate alarm notification appliances.
2. Identify alarm and specific initiating device at 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. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
6. Close smoke dampers in air ducts of designated air-conditioning duct systems.
7. Recall elevators to primary or alternate recall floors.
8. Activate elevator power shunt trip.
9. Record events in the system memory.
10. Record events by the system printer.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Valve supervisory switch.
2. High- or low-air-pressure switch of a dry-pipe or preaction sprinkler system.
3. Elevator shunt-trip supervision.
4. Loss of communication.

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 communication with any addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
4. Loss of primary power at fire-alarm control unit.
5. Ground or a single break in internal circuits of fire-alarm control unit.
6. Abnormal ac voltage at fire-alarm control unit.
7. Break in standby battery circuitry.
8. Failure of battery charging.
9. Abnormal position of any switch at fire-alarm control unit or annunciator.

E. System Supervisory Signal Actions:

1. Initiate notification appliances.

2. Identify specific device initiating the event at fire-alarm control unit and remote annunciators.
3. Record the event on system printer.
4. After a time delay of 200 seconds, transmit a trouble or supervisory signal to the remote alarm receiving station.
5. Transmit system status to building management system.

2.3 FIRE-ALARM CONTROL UNIT

A. Basis-of-Design Product: Subject to compliance with requirements, provide Gamewell/FCI S3 Series or comparable product by one of the following:

1. Notifier.
2. SimplexGrinnell LP.

B. General Requirements for Fire-Alarm Control Unit:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.

    a. System software and programs shall be held in nonvolatile flash, electrically erasable, programmable, read-only memory, 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.
    c. Provide communication between the FACP and remote circuit interface panels, annunciators, and displays.
    d. The FACP shall be listed for connection to a central-station signaling system service.
    e. Provide nonvolatile memory for system database, logic, and operating system and event history. The system shall require no manual input to initialize in the event of a complete power down condition. The FACP shall provide a minimum 500-event history log.

2. Addressable Initiation Device Circuits: The FACP shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.
3. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.

C. 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, two line(s) of 40 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.

D. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:

1. Pathway Class Designations: NFPA 72, Class A.
2. Pathway Survivability: Level 1.
3. Install no more than 256 addressable devices on each signaling-line circuit.
4. Serial Interfaces:

    a. One dedicated RS 485 port for central-station operation using point ID DACT.
    b. One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).
    c. One USB or RS 232 port for PC configuration.

E. Smoke-Alarm Verification:

1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
2. Activate an approved "alarm-verification" sequence at fire-alarm control unit and detector.
3. Record events by the system printer.
4. Sound general alarm if the alarm is verified.
5. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.
6. Alarm verification shall not include duct smoke detectors.

F. Notification-Appliance Circuit:

1. Audible appliances shall sound in a three-pulse temporal pattern, as defined in NFPA 72.
2. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.

G. Elevator Recall:

1. Elevator recall shall be initiated only by one of the following alarm-initiating devices:

    a. Elevator lobby detectors except the lobby detector on the designated floor.
    b. Smoke detector in elevator machine room.
    c. Smoke detectors in elevator hoistway.

2. Elevator controller shall be programmed to move the cars to the alternate recall floor if lobby detectors located on the designated recall floors are activated.
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.

H. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.

I. 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 signals supervisory and digital alarm communicator transmitters and digital alarm radio 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.

J. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

1. Batteries: Sealed, valve-regulated, recombinant lead acid.

K. 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. Basis-of-Design Product: Subject to compliance with requirements, provide Gamewell/FCI or comparable product by one of the following:

1. Notifier.
2. SimplexGrinnell LP.
3. System Sensor.

B. 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: Factory-fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.

2.5 SYSTEM SMOKE DETECTORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Gamewell/FCI or comparable product by one of the following:

1. Notifier.
2. SimplexGrinnell LP.
3. System Sensor.

B. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be two-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.
7. Remote Control: Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.

    a. Multiple levels of detection sensitivity for each sensor.
    b. Sensitivity levels based on time of day.

C. 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.).

D. 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 for smoke detection in HVAC system ducts.
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: Fully programmable relay rated to interrupt fan motor-control circuit.

2.6 HEAT DETECTORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Gamewell/FCI or comparable product by one of the following:

1. Notifier.
2. SimplexGrinnell LP.
3. System Sensor.

B. General Requirements for Heat Detectors: Comply with UL 521.

1. Temperature sensors shall test for and communicate the sensitivity range of the device.

C. 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.

2.7 NOTIFICATION APPLIANCES

A. Basis-of-Design Product: Subject to compliance with requirements, provide Gamewell/FCI or comparable product by one of the following:

1. SimplexGrinnell LP.
2. System Sensor.

B. 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.

C. 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.

D. Visible Notification Appliances: Xenon strobe lights complying 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.

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 or white (to be confirmed in submittals).

2.8 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.

2.9 ADDRESSABLE INTERFACE DEVICE

A. General:

1. Include address-setting means on the module.
2. Store an internal identifying code for control panel use to identify the module type.
3. Listed for controlling HVAC fan motor controllers.

B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.

C. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall and to circuit-breaker shunt trip for power shutdown.

1. Allow the control panel to switch the relay contacts on command.
2. Have a minimum of two normally open and two normally closed contacts available for field wiring.

D. Control Module:

1. Operate notification devices.
2. Operate solenoids for use in sprinkler service.

2.10 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632.

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.
5. Loss of power.
6. Low battery.
7. Abnormal test signal.
8. Communication bus failure.

E. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.11 NETWORK COMMUNICATIONS (OPTIONAL PENDING AHU APPROVAL)

A. Provide network communications for fire-alarm system according to fire-alarm manufacturer's written requirements.

B. Provide network communications pathway per manufacturer's written requirements and requirements in NFPA 72 and NFPA 70.

C. Provide integration gateway using BACnet or Modbus for connection to building automation system.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.

1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.

B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EQUIPMENT INSTALLATION

A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."

1. Devices placed in service before all other trades have completed cleanup shall be replaced.
2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.

B. Install wall-mounted equipment, with tops of cabinets not more than 78 inches above the finished floor.

C. Manual Fire-Alarm Boxes:

1. Install manual fire-alarm box in the normal path of egress within 60 inches of the exit doorway.
2. Mount manual fire-alarm box on a background of a contrasting color.
3. The operable part of manual fire-alarm box shall be between 42 inches and 48 inches above floor level. All devices shall be mounted at the same height unless otherwise indicated.

D. Smoke- or Heat-Detector Spacing:

1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.

2. Comply with the "Heat-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, 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 Annex Ain NFPA 72.
5. HVAC: Locate detectors not closer than 36 inches 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 and not directly above pendant mounted or indirect lighting.

E. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.

F. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches long shall be supported at both ends.

1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.

G. Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location. Do not install smoke detectors in sprinklered elevator shafts.

H. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.

I. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.

J. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling. Install all devices at the same height unless otherwise indicated.

K. Device Location-Indicating Lights: Locate in public space near the device they monitor.

3.3 PATHWAYS

A. Pathways shall be installed in EMT.

B. Exposed EMT shall be painted red enamel.

3.4 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 Section 087100 "Door Hardware." Connect hardware and devices to fire-alarm system.

1. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

1. Smoke dampers in air ducts of designated HVAC duct systems.
2. Electronically locked doors and access gates.
3. Alarm-initiating connection to elevator recall system and components.
4. Supervisory connections at valve supervisory switches.
5. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
6. Supervisory connections at elevator shunt-trip breaker.
7. Data communication circuits for connection to building management system.

3.5 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Install framed instructions in a location visible from fire-alarm control unit.

3.6 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.7 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by authorities having jurisdiction and Engineer.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

D. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

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 the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
    b. Comply with the "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 the "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" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

E. Fire-alarm system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

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.

3.8 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 24 months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

1. Include visual inspections according to the "Visual Inspection Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
2. Perform tests in the "Test Methods" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Perform tests per the "Testing Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system. Two hours of onsite training to be provided.

END OF SECTION 283111

SECTION 312000 - EARTH MOVING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. This section specifies the requirements for furnishing all equipment, materials, labor, tools, and techniques for earthwork including, but not limited to, the following:

1. Site preparation.
2. Excavation.
3. Underpinning.
4. Filling and backfilling.
5. Grading.
6. Soil Disposal.
7. Clean Up.

1.2 DEFINITIONS:

A. Unsuitable Materials:

1. Fills: Topsoil; frozen materials; construction materials and materials subject to decomposition; clods of clay and stones larger than 3 inches; organic material, including silts, which are unstable; and inorganic materials, including silts, too wet to be stable and any material with a liquid limit and plasticity index exceeding 40 and 15 respectively. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction, as defined by ASTM D 698.
2. Existing Subgrade (Except Footing Subgrade): Same materials as 1.2.A.1, that are not capable of direct support of slabs, pavement, and similar items with possible exception of improvement by compaction, proofrolling, or similar methods.
3. Existing Subgrade (Footings Only): Same as paragraph 1, but no fill or backfill. If materials differ from design requirements, excavate to acceptable strata subject to Resident Engineer's approval.

B. Building Earthwork: Earthwork operations required in area enclosed by a line located 5 feet outside of principal building perimeter. It also includes earthwork required for auxiliary structures and buildings.

C. Trench Earthwork: Trenchwork required for utility lines.

D. Site Earthwork: Earthwork operations required in area outside of a line located 5 feet outside of principal building perimeter and within new construction area with exceptions noted above.

E. Degree of compaction: Degree of compaction is expressed as a percentage of maximum density obtained by laboratory test procedure. This percentage of maximum density is obtained through use of data provided from results of field test procedures presented in ASTM D1556, ASTM D2167, and ASTM D2922.

F. Fill: Satisfactory soil materials used to raise existing grades. In the Construction Documents, the term "fill" means fill or backfill as appropriate.

G. Backfill: Soil materials or controlled low strength material used to fill an excavation.

H. Unauthorized excavation: Removal of materials beyond indicated sub-grade elevations or indicated lines and dimensions without written authorization by the Resident Engineer. No payment will be made for unauthorized excavation or remedial work required to correct unauthorized excavation.

I. Authorized additional excavation: Removal of additional material authorized by the Resident Engineer based on the determination by the Owner's soils testing agency that unsuitable bearing materials are encountered at required sub-grade elevations. Removal of unsuitable material and its replacement as directed will be paid on basis of Conditions of the Contract relative to changes in work.

J. Subgrade: The undisturbed earth or the compacted soil layer immediately below granular sub-base, drainage fill, or topsoil materials.

K. Structure: Buildings, foundations, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

L. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.

M. Drainage course: Layer supporting slab-on-grade used to minimize capillary flow of pore water.

N. Bedding course: Layer placed over the excavated sub-grade in a trench before laying pipe. Bedding course shall extend up to the springline of the pipe.

O. Sub-base Course: Layer placed between the sub-grade and base course for asphalt paving or layer placed between the sub-grade and a concrete pavement or walk.

P. Utilities include on-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

Q. Debris: Debris includes all materials located within the designated work area not covered in the other definitions and shall include but not be limited to items like vehicles, equipment, appliances, building materials or remains thereof, tires, any solid or liquid chemicals or products stored or found in containers or spilled on the ground.

R. Contaminated soils: Soil that contains contaminates as defined and determined by the Resident Engineer or the Owner's testing agency.

1.3 RELATED WORK:

A. Materials testing and inspection during construction: Section 014527, INSPECTION AND TESTING OF EARTHWORK; Utilities, Division 33.

B. Applicable sections: Division 01.

C. Paving sub-grade requirements: Section 321216, ASPHALT PAVING.

1.4 CLASSIFICATION OF EXCAVATION:

A. Unclassified Excavation: Removal and disposal of pavements and other man-made obstructions visible on surface; utilities, and other items including underground structures indicated to be demolished and removed; together with any type of materials regardless of character of material and obstructions encountered.

1.5 SUBMITTALS:

A. Submit in accordance with Section 013300, Submittals..

B. Furnish to Resident Engineer:

1. Contactor shall furnish resumes with all personnel involved in the project including Project Manager, Superintendent, and on-site Engineer. Project Manager and Superintendent should have at least 3 years of experience on projects of similar size.

2. Soil samples.

a. Classification in accordance with ASTM D2487 for each on-site or borrow soil material proposed for fill, backfill, engineered fill, or structural fill.

b. Laboratory compaction curve in accordance with ASTM D 698 for each on site or borrow soil material proposed for fill, backfill, engineered fill, or structural fill.

c. Test reports for compliance with ASTM D 2940 requirements for subbase material.

d. Pre-excavation photographs and videotape in the vicinity of the existing structures to document existing site features, including surfaces finishes, cracks, or other structural blemishes that might be misconstrued as damage caused by earthwork operations.

e. The Contractor shall submit a scale plan daily that defines the location, limits, and depths of the area excavated.

1.6 APPLICABLE PUBLICATIONS:

A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.

B. American Association of State Highway and Transportation Officials (AASHTO):

T99-01(2004)..... Moisture-Density Relations of Soils Using a 2.5 kg (5.5 lb) Rammer and a 305 mm (12 inch) Drop

T180-01(2004)..... Moisture-Density Relations of Soils using a 4.54 kg (10 lb) Rammer and a 457 mm (18 inch) Drop

C. American Society for Testing and Materials (ASTM):

D448-03a..... Standard Classification for Sizes of Aggregate for Road and Bridge Construction

D698-00ae1 ..... Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft. lbf/ft3 (600 kN m/m3))

D1556-00..... Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method

D1557-02e1 ..... Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2700 kN m/m3))

D2167-94 (2001) ..... Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method

D2487-06..... Standard Classification of Soil for Engineering Purposes (Unified Soil Classification System)

D2922-05..... Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

D2940-03..... Standard Specifications for Graded Aggregate Material for Bases or Subbases for Highways or Airports

D. Society of Automotive Engineers (SAE):

J732-92 ..... Specification Definitions - Loaders

J1179-02 Hydraulic Excavator and Backhoe Digging Forces

PART 2 - PRODUCTS

2.1 MATERIALS:

A. General: Provide borrow soil material when sufficient satisfactory soil materials are not available from excavations.

B. Fills: Material in compliance with ASTM D2487 Soil Classification Groups GW, GP, GM, GC, SW, SP, SM, SC, and ML, or any combination of these groups; free of rock or gravel larger than 75 mm (3 inches) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter. Material approved from on site or off site sources having a minimum dry density of 1760 kg/m3 (110 pcf), a maximum Plasticity Index of 15, and a maximum Liquid Limit of 40.

C. Engineered Fill: Naturally or artificially graded mixture of compliance with ASTM D2487 Soil Classification Groups GW, GP, GM, GC, SW, SP, SM, SC, and ML, or any combination of these groups, or as approved by the Engineer or material with at least 90 percent passing a 37.5-mm (1 1/2-inch) sieve and not more than 12 percent passing a 75-µm (No. 200) sieve, per ASTM D2940;.

D. Bedding: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940; except with 100 percent passing a 25 mm (1 inch) sieve and not more than 8 percent passing a 75-µm (No. 200) sieve.

E. Drainage Fill: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D448; coarse-aggregate grading Size 57; with 100 percent passing a 37.5 mm (1 1/2-inch) sieve and 0 to 5 percent passing a 2.36 mm (No. 8) sieve.

F. Granular Fill:

1. Under concrete slab, crushed stone or gravel graded from 25 mm (1 inch) to 4.75 mm (No. 4), per ASTM D 2940.

G. Bedding for sanitary and storm sewer pipe, crushed stone or gravel graded from 13 mm (1/2 inch) to 4.75 mm (No 4), per ASTM D 2940.

PART 3 - EXECUTION

3.1 SITE PREPARATION:

A. Clearing: Clear within limits of earthwork operations as shown. Work includes removal of trees, shrubs, fences, foundations, incidental structures, paving, debris, trash, and other obstructions.

B. Grubbing: Remove stumps and roots 3 inch and larger diameter. Undisturbed sound stumps, roots up to 3 inch diameter, and nonperishable solid objects a minimum of 3 feet below subgrade or finished embankment may be left.

C. Trees and Shrubs: Trees and shrubs, not shown for removal, may be removed from areas within 15 feet of new construction and 7.5 feet of utility lines when removal is approved in advance by Resident Engineer. Trees and shrubs, shown to be transplanted, shall be dug with a ball of earth and burlapped in accordance with latest issue of, "American Standard for Nursery Stock" of the American Association of Nurserymen, Inc. Transplant trees and shrubs to a permanent or temporary position within two hours after digging. Maintain trees and shrubs held in temporary locations by watering as necessary and feeding semiannually with liquid fertilizer with a minimum analysis of 5 percent nitrogen, 10 percent phosphorus, and 5 percent potash. Maintain plants moved to permanent positions as specified for plants in temporary locations until

conclusion of contract. Box, and otherwise protect from damage, existing trees and shrubs which are not shown to be removed in construction area. Immediately repair damage to existing trees and shrubs by trimming, cleaning and painting damaged areas, including roots, in accordance with standard industry horticultural practice for the geographic area and plant species. Do not store building materials closer to trees and shrubs, that are to remain, than farthest extension of their limbs.

D. Stripping Topsoil: Strip topsoil from within limits of earthwork operations as specified. Topsoil shall be a fertile, friable, natural topsoil of loamy character and characteristic of locality. Topsoil shall be capable of growing healthy horticultural crops of grasses. Stockpile topsoil and protect as directed by Resident Engineer. Eliminate foreign materials, such as weeds, roots, stones, subsoil, frozen clods, and similar foreign materials larger than 1/2 cubic foot in volume, from soil as it is stockpiled. Retain topsoil on station. Remove foreign materials larger than 2 inches in any dimension from topsoil used in final grading. Topsoil work, such as stripping, stockpiling, and similar topsoil work shall not, under any circumstances, be carried out when soil is wet so that the composition of the soil will be destroyed.

E. Concrete Slabs and Paving: Score deeply or saw cut to insure a neat, straight cut, sections of existing concrete slabs and paving to be removed where excavation or trenching occurs. Extend pavement section to be removed a minimum of 12 inches on each side of widest part of trench excavation and insure final score lines are approximately parallel unless otherwise indicated.

F. Lines and Grades: Registered Professional Land Surveyor or Registered Civil Engineer, shall establish lines and grades.

1. Grades shall conform to elevations indicated on plans within the tolerances herein specified. Generally grades shall be established to provide a smooth surface, free from irregular surface changes. Grading shall comply with compaction requirements and grade cross sections, lines, and elevations indicated. Where spot grades are indicated the grade shall be established based on interpolation of the elevations between the spot grades while maintaining appropriate transition at structures and paving and uninterrupted drainage flow into inlets.

2. Locations of existing elevations indicated on plans are from a site survey that measured spot elevations and subsequently generated existing contours and spot elevations. Proposed spot elevations and contour lines have been developed utilizing the existing conditions survey and developed contour lines and may be approximate. Contractor is responsible to notify Resident Engineer of any differences between existing elevations shown on plans and those encountered on site by Surveyor/Engineer described above. Notify Resident Engineer of any differences between existing or constructed grades, as compared to those shown on the plans.

3. Subsequent to establishment of lines and grades, Contractor will be responsible for any additional cut and/or fill required to ensure that site is graded to conform to elevations indicated on plans.

4. Finish grading is specified in Section 329000, PLANTING.

G. Disposal: All materials removed from the property shall be disposed of at a legally approved site, for the specific materials, and all removals shall be in accordance with all applicable Federal, State and local regulations. No burning of materials is permitted onsite.

3.2 EXCAVATION:

A. Shoring, Sheeting and Bracing: Shore, brace, or slope, its angle of repose or to an angle considered acceptable by the Resident Engineer, banks of excavations to protect workmen, banks, adjacent paving, structures, and utilities.

1. Design of the temporary support of excavation system is the responsibility of the Contractor.

2. Construction of the support of excavation system shall not interfere with the permanent structure and may begin only after a review by the Resident Engineer.

3. Extend shoring and bracing to a minimum of 5 feet below the bottom of excavation. Shore excavations that are carried below elevations of adjacent existing foundations.

4. If bearing material of any foundation is disturbed by excavating, improper shoring or removal of existing or temporary shoring, placing of backfill, and similar operations, the Contractor shall provide a concrete fill support under disturbed foundations, as directed by Resident Engineer, at no additional cost to the Owner. Do not remove shoring until permanent work in excavation has been inspected and approved by Resident Engineer.

B. Excavation Drainage: Operate pumping equipment, and/or provide other materials, means and equipment as required to keep excavation free of water and subgrade dry, firm, and undisturbed until approval of permanent work has been received from Resident Engineer. Approval by the Resident Engineer is also required before placement of the permanent work on all subgrades.

C. Subgrade Protection: Protect subgrades from softening, undermining, washout, or damage by rain or water accumulation. Reroute surface water runoff from excavated areas and not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches. When subgrade for foundations has been disturbed by water, remove disturbed material to firm undisturbed material after water is brought under control. Replace disturbed subgrade in trenches with concrete or material approved by the Resident Engineer.

D. Proofrolling:

1. After rough grade has been established in cut areas and prior to placement of fill in fill areas under building and pavements, proofroll exposed subgrade with a fully loaded dump truck to check for pockets of soft material.

2. Proofrolling shall consist of at least two complete passes with one pass being in a direction perpendicular to preceding one. Remove any areas that deflect, rut, or pump excessively during proofrolling, or that fail to consolidate after successive passes to suitable soils and replaced with compacted fill. Maintain subgrade until succeeding operation has been accomplished.

E. Building Earthwork:

1. Excavation shall be accomplished as required by drawings and specifications.

2. Excavate foundation excavations to solid undisturbed subgrade.

3. Remove loose or soft materials to a solid bottom.

4. Fill excess cut under footings or foundations with 3000 psi concrete poured separately from the footings.

5. Do not tamp earth for backfilling in footing bottoms, except as specified.

6. Slope grades to direct water away from excavations and to prevent ponding.

F. Trench Earthwork:

1. Utility trenches (except sanitary and storm sewer):
   a. Excavate to a width as necessary for sheeting and bracing and proper performance of the work.
   b. Grade bottom of trenches with bell holes scooped out to provide a uniform bearing.
   c. Support piping on undisturbed earth unless a mechanical support is shown.
   d. Length of open trench in advance of piping laying shall not be greater than is authorized by Resident Engineer.

2. Sanitary and storm sewer trenches:
   a. Trench width below a point 6 inches above top of pipe shall be 24 inches maximum for pipe up to and including 12 inches diameter, and four-thirds diameter of pipe plus 8 inches for pipe larger than 12 inches. Width of trench above that level shall be as necessary for sheeting and bracing and proper performance of the work.
   b. Bed bottom quadrant of pipe on undisturbed soil or granular fill.
      1) Undisturbed: Bell holes shall be no larger than necessary for jointing. Backfill up to a point 12 inches above top of pipe shall be clean earth placed and tamped by hand.
      2) Granular Fill: Depth of fill shall be a minimum of 3 inches plus one sixth of pipe diameter below pipe to 12 inches above top of pipe. Place and tamp fill material by hand.
   c. Place and compact as specified remainder of backfill using acceptable excavated materials. Do not use unsuitable materials.

G. Site Earthwork: Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation. Excavation shall be accomplished as required by drawings and specifications. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. Extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, complying with OSHA requirements, and for inspections. Remove subgrade materials that are determined by Resident Engineer as unsuitable, and replace with acceptable material. When unsuitable material is encountered and removed, contract price and time will be adjusted in accordance with Articles, DIFFERING SITE CONDITIONS, CHANGES and CHANGES-SUPPLEMENT of the GENERAL CONDITIONS as applicable. Adjustments to be based on volume in cut section only.

1. Site Grading:
   a. Provide a smooth transition between adjacent existing grades and new grades.

b. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
c. Slope grades to direct water away from buildings and to prevent ponds from forming where not designed. Finish subgrades to required elevations within the following tolerances:
   1) Lawn or Unpaved Areas: Plus or minus 1 inch.
   2) Walks: Plus or minus 1 inch.
   3) Pavements: Plus or minus 1/2 inch.
d. Grading Inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10 foot straightedge.

3.3 FILLING AND BACKFILLING:

A. General: Do not fill or backfill until all debris, water, unsatisfactory soil materials, obstructions, and deleterious materials have been removed from excavation. For fill and backfill, use excavated materials and borrow meeting the criteria specified herein, as applicable. Borrow will be supplied at no additional cost to the Owner. Do not use unsuitable excavated materials. Do not backfill until foundation walls have been completed above grade and adequately braced, waterproofing or dampproofing applied, foundation drainage, and pipes coming in contact with backfill have been installed and work inspected and approved by Resident Engineer.

B. Placing: Place materials in horizontal layers not exceeding 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers and then compacted. Place backfill and fill materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure. Place no material on surfaces that are muddy, frozen, or contain frost.

C. Compaction: Compact with approved tamping rollers, sheepsfoot rollers, pneumatic tired rollers, steel wheeled rollers, vibrator compactors, or other approved equipment (hand or mechanized) well suited to soil being compacted. Do not operate mechanized vibratory compaction equipment within 10 feet of new or existing building walls without prior approval of Resident Engineer. Moisten or aerate material as necessary to provide moisture content that will readily facilitate obtaining specified compaction with equipment used. Compact soil to not less than the following percentages of maximum dry density, according to ASTM D698 or ASTM D1557 as specified below:

1. Fills, Embankments, and Backfill
   a. Under proposed structures, building slabs, steps, and paved areas, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill material in accordance with ASTM D698 to 95 percent.
   b. Curbs, curbs and gutters, 95 percent.
   c. Under Sidewalks, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill material in accordance with ASTM D698 to 95 percent.
   d. Landscaped areas, top 16 inches, 85 percent.
   e. Landscaped areas, below 16 inches of finished grade, 90 percent.

2. Natural Ground (Cut or Existing)
   a. Under building slabs, steps and paved areas, top 6 inches, 95 percent.
   b. Curbs, curbs and gutters, top 6 inches, 95 percent.

c. Under sidewalks, top 6 inches, 95 percent.

3.4 GRADING:

A. General: Uniformly grade the areas within the limits of this section, including adjacent transition areas. Smooth the finished surface within specified tolerance. Provide uniform levels or slopes between points where elevations are indicated, or between such points and existing finished grades. Provide a smooth transition between abrupt changes in slope.

B. Cut rough or sloping rock to level beds for foundations. In pipe spaces or other unfinished areas, fill low spots and level off with coarse sand or fine gravel.

C. Slope backfill outside building away from building walls for a minimum distance of 6 feet.

D. Finish grade earth floors in pipe basements as shown to a level, uniform slope and leave clean.

E. Finished grade shall be at least 6 inches below bottom line of window or other building wall openings unless greater depth is shown.

F. Place crushed stone or gravel fill under concrete slabs on grade, tamped, and leveled. Thickness of fill shall be 6 inches unless otherwise shown.

G. Finish subgrade in a condition acceptable to Resident Engineer at least one day in advance of paving operations. Maintain finished subgrade in a smooth and compacted condition until succeeding operation has been accomplished. Scarify, compact, and grade subgrade prior to further construction when approved compacted subgrade is disturbed by Contractor's subsequent operations or adverse weather.

H. Grading for Paved Areas: Provide final grades for both subgrade and base course to +/- 6 mm (0.25 inches) of indicated grades.

3.5 Disposal of unsuitable and excess excavated material:

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off site.

B. Place excess excavated materials suitable for fill and/or backfill on site where directed.

C. Remove from site and dispose of any excess excavated materials after all fill and backfill operations have been completed.

3.6 CLEAN UP:

A. Upon completion of earthwork operations, clean areas within contract limits, remove tools, and equipment. Provide site clear, clean, free of debris, and suitable for subsequent construction operations.

END OF SECTION 312000

SECTION 321216 - ASPHALT PAVING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. This work shall cover the composition, mixing, construction upon the prepared subgrade, and the protection of hot asphalt concrete pavement. The hot asphalt concrete pavement shall consist of an aggregate or asphalt base course and asphalt surface course constructed in conformity with the lines, grades, thickness, and cross sections as shown. Each course shall be constructed to the depth, section, or elevation required by the drawings and shall be rolled, finished, and approved before the placement of the next course.

1.2 RELATED WORK

A. Laboratory and field testing requirements: Section 014537, INSPECTION AND TESTING OF ASPHALTIC CONCRETE.

B. Subgrade Preparation: Paragraph 3.3 and Section 312000, EARTH MOVING.

C. Pavement Markings: Section 321723, PAVEMENT MARKINGS.

1.3 INSPECTION OF PLANT AND EQUIPMENT

A. The Engineer shall have access at all times to all parts of the material producing plants for checking the mixing operations and materials and the adequacy of the equipment in use.

1.4 ALIGNMENT AND GRADE CONTROL

A. The Contractor’s Registered Professional Land Surveyor shall establish and control the pavement (aggregate or asphalt base course and asphalt surface course) alignments, grades, elevations, and cross sections as shown on the Drawings.

1.5 SUBMITTALS

A. In accordance with Section 013300, SUBMITTALS, furnish the following:

1. Data and Test Reports:
    a. Aggregate Base Course: Sources, gradation, liquid limit, plasticity index, percentage of wear, and other tests required by State Highway Department.
    b. Asphalt Base/Surface Course: Aggregate source, gradation, soundness loss, percentage of wear, and other tests required by State Highway Department.
    c. Job-mix formula.

2. Certifications:
    a. Asphalt prime and tack coat material certificate of conformance to State Highway Department requirements.
    b. Asphalt cement certificate of conformance to State Highway Department requirements.
    c. Job-mix certification - Submit plant mix certification that mix equals or exceeds the State Highway Specification.
3. Provide MSDS (Material Safety Data Sheets) for all chemicals used on ground.

PART 2 - PRODUCTS

2.1 GENERAL

A. Aggregate base and asphalt concrete materials shall conform to the requirements of the appropriate sections of the latest version of the NC Department of Transportation Standard Specifications for Roads and Structures, including amendments, addenda and errata.

2.2 AGGREGATES

A. Provide aggregates consisting of crushed stone, gravel, sand, or other sound, durable mineral materials having hard, strong, durable particles free of adherent coatings.

B. Subbase aggregate (where required) maximum size: 38mm(1-1/2").

C. Base aggregate maximum size:
    1. Base course over 152mm(6") thick: 38mm(1-1/2").
    2. Other base courses: 19mm(3/4").

D. Asphaltic base course:
    1. Maximum particle size not to exceed 25.4mm(1”).
    2. Where conflicts arise between this specification and the requirements in the latest version of the State Highway Specifications, the State Specifications shall control.

E. Aggregates for asphaltic concrete paving: Provide a mixture of sand, mineral aggregate, and liquid asphalt mixed in such proportions that the percentage by weight will be within:

Sieve Sizes	Percentage Passing
19mm(3/4")	100
9.5mm(3/8")	67 to 85
6.4mm(1/4")	50 to 65
2.4mm(No. 8 mesh)	37 to 50
600µm(No. 30 mesh)	15 to 25
75µm(No. 200 mesh)	3 to 8

plus 50/60 penetration liquid asphalt at 5 percent to 6-1/2 percent of the combined dry aggregates.

2.3 ASPHALTS

A. Comply with provisions of Asphalt Institute Specification SS2:

1. Asphalt cement: Penetration grade 50/60
2. Prime coat: Cut-back type, grade MC-250
3. Tack coat: Uniformly emulsified, grade SS-1H

2.4 SEALER

A. Provide a sealer consisting of suitable fibrated chemical type asphalt base binders and fillers having a container consistency suitable for troweling after thorough stirring, and containing no clay or other deleterious substance.

B. Where conflicts arise between this specification and the requirements in the latest version of the State Highway Specifications, the State Specifications shall control.

PART 3 - EXECUTION

3.1 GENERAL

A. The Asphalt Concrete Paving equipment, weather limitations, job-mix formula, mixing, construction methods, compaction, finishing, tolerance, and protection shall conform to the requirements of the appropriate sections of the State Highway Specifications for the type of material specified.

3.2 MIXING ASPHALTIC CONCRETE MATERIALS

A. Provide hot plant-mixed asphaltic concrete paving materials.

1. Temperature leaving the plant: 143 degrees C(290 degrees F) minimum, 160 degrees C(320 degrees F) maximum.

2. Temperature at time of placing: 138 degrees C(280 degrees F) minimum.

3.3 SUBGRADE

A. Shape to line and grade and compact with self-propelled rollers.

B. All depressions that develop under rolling shall be filled with acceptable material and the area re-rolled.

C. Soft areas shall be removed and filled with acceptable materials and the area re-rolled.

D. Should the subgrade become rutted or displaced prior to the placing of the subbase, it shall be reworked to bring to line and grade.

E. Proof-roll the subgrade with maximum 50 ton gross weight dump truck as directed by Engineer. If pumping, pushing, or other movement is observed, rework the area to provide a stable and compacted subgrade.

3.4 BASE COURSES

A. Subbase (when required)

1. Spread and compact to the thickness shown on the drawings.

2. Rolling shall begin at the sides and continue toward the center and shall continue until there is no movement ahead of the roller.

3. After completion of the subbase rolling there shall be no hauling over the subbase other than the delivery of material for the top course.

B. Base

1. Spread and compact to the thickness shown on the drawings.

2. Rolling shall begin at the sides and continue toward the center and shall continue until there is no movement ahead of the roller.

3. After completion of the base rolling there shall be no hauling over the base other than the delivery of material for the top course.

C. Thickness tolerance: Provide the compacted thicknesses shown on the Drawings within a tolerance of minus 0.0mm (0.0") to plus 12.7mm (0.5").

D. Smoothness tolerance: Provide the lines and grades shown on the Drawings within a tolerance of 5mm in 3m (3/16 inch in ten feet).

E. Moisture content: Use only the amount of moisture needed to achieve the specified compaction.

3.5 PLACEMENT OF ASPHALTIC CONCRETE PAVING

A. Remove all loose materials from the compacted base.

B. Apply the specified prime coat, and tack coat where required, and allow to dry in accordance with the manufacturer's recommendations as approved by the Architect or Engineer.

C. Receipt of asphaltic concrete materials:

1. Do not accept material unless it is covered with a tarpaulin until unloaded, and unless the material has a temperature of not less than 130 degrees C(280 degrees F).

2. Do not commence placement of asphaltic concrete materials when the atmospheric temperature is below 10 degrees C (50 degrees F), not during fog, rain, or other unsuitable conditions.

D. Spreading:

1. Spread material in a manner that requires the least handling.

2. Where thickness of finished paving will be 76mm (3") or less, spread in one layer.

E. Rolling:

1. After the material has been spread to the proper depth, roll until the surface is hard, smooth, unyielding, and true to the thickness and elevations shown own the drawings.

2. Roll in at least two directions until no roller marks are visible.

3. Finished paving smoothness tolerance:

a. No depressions which will retain standing water.
b. No deviation greater than 3mm in 1.8m (1/8" in six feet).

3.6 APPLICATION OF SEAL COAT

A. Prepare the surfaces, mix the seal coat material, and apply in accordance with the manufacturer's recommendations as approved by the Architect or Engineer.

B. Apply one coat of the specified sealer.

C. Achieve a finished surface seal which, when dry and thoroughly set, is smooth, tough, resilient, of uniform black color, and free from coarse textured areas, lap marks, ridges, and other surface irregularities.

3.7 PROTECTION

A. Protect the asphaltic concrete paved areas from traffic until the sealer is set and cured and does not pick up under foot or wheeled traffic.

3.8 FINAL CLEAN-UP

A. Remove all debris, rubbish, and excess material from the work area.

END OF SECTION 321216

SECTION 321313 - CONCRETE FOR EXTERIOR IMPROVEMENTS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. This section shall cover site work concrete constructed upon the prepared subgrade and in conformance with the lines, grades, thickness, and cross sections shown. Construction shall include the following:

B. Curb, gutter, and combination curb and gutter, wheel stop.

C. Pedestrian Pavement: Walks, grade slabs, wheelchair curb ramps, steps.

D. Vehicular Pavement: Service courts, driveways.

E. Equipment Pads: Oxygen storage, transformers.

1.2 RELATED WORK

A. Laboratory and Field Testing Requirements: Section 014533, INSPECTION AND TESTING OF CAST IN PLACE CONCRETE.

B. Subgrade Preparation: Section 312000, EARTH MOVING.

C. Concrete Materials, Quality, Mixing, Design and Other Requirements: Section 033000, CAST-IN-PLACE-CONCRETE.

1.3 DESIGN REQUIREMENTS

A. Design all elements with the latest published version of applicable codes.

1.4 WEATHER LIMITATIONS

A. Placement of concrete shall be as specified under Article 3.8, COLD WEATHER and Article 3.7, HOT WEATHER of Section 033000, CAST-IN-PLACE CONCRETE.

1.5 SUBMITTALS

A. In accordance with Section 013323, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:

1. Manufacturers' Certificates and Data certifying that the following materials conform to the requirements specified.

    a. Expansion joint filler

b. Hot poured sealing compound
c. Reinforcement
d. Curing materials

2. Data and Test Reports:

a. Job-mix formula.
b. Source, gradation, liquid limit, plasticity index, percentage of wear, and other tests as specified and in referenced publications.

1.6 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Refer to the latest edition of all referenced Standards and codes.

B. American Association of State Highway and Transportation Officials (AASHTO):

M031MM031-07-UL ..... Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement (ASTM A615/A615M-09)
M055MM055-09-UL ..... Steel Welded Wire Reinforcement, Plain, for Concrete (ASTM A185)
M147-65-UL ..... Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses (R 2004)
M148-05-UL ..... Liquid Membrane-Forming Compounds for Curing Concrete (ASTM C309)
M171-05-UL ..... Sheet Materials for Curing Concrete (ASTM C171)
M182-05-UL ..... Burlap Cloth Made from Jute or Kenaf and Cotton Mats
M213-01-UL ..... Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Type) (ASTM D1751)
M233-86-UL ..... Boiled Linseed Oil Mixer for Treatment of Portland Cement Concrete
T099-09-UL ..... Moisture-Density Relations of Soils Using a 2.5 kg. (5.5 lb) Rammer and a 305 mm (12 in.) Drop
T180-09-UL ..... Moisture-Density Relations of Soils Using a 4.54 kg (10 lb.) Rammer and a 457 mm (18 in.) Drop

C. American Society for Testing and Materials (ASTM):

C94/C94M-09..... Ready-Mixed Concrete
C143/C143M-09..... Slump of Hydraulic Cement Concrete

PART 2 - PRODUCTS

2.1 GENERAL

A. Concrete shall be Type C, air-entrained as specified in Section 033000, CAST-IN-PLACE CONCRETE, with the following exceptions:

TYPE	MAXIMUM SLUMP*
Curb & Gutter	75 mm (3")
Pedestrian Pavement	75 mm (3")
Vehicular Pavement	50 mm (2") (Machine Finished) 100 mm (4") (Hand Finished)
Equipment Pad	75 to 100 mm (3" to 4")
* For concrete to be vibrated: Slump as determined by ASTM C143. Tolerances as established by ASTM C94.	

2.2 REINFORCEMENT

A. The type, amount, and locations of steel reinforcement shall be as shown on the drawings and in the specifications.

B. Welded wire-fabric shall conform to AASHTO M55.

C. Dowels shall be plain steel bars conforming to AASHTO M31. Tie bars shall be deformed steel bars conforming to AASHTO M31.

2.3 FORMS

A. Use metal or wood forms that are straight and suitable in cross-section, depth, and strength to resist springing during depositing and consolidating the concrete, for the work involved.

B. Do not use forms if they vary from a straight line more than 1/8 inch in any ten foot long section, in either a horizontal or vertical direction.

C. Wood forms should be at least 2 inches thick (nominal). Wood forms shall also be free from warp, twist, loose knots, splits, or other defects. Use approved flexible or curved forms for forming radii.

2.4 CONCRETE CURING MATERIALS

A. Concrete curing materials shall conform to one of the following:

1. Burlap conforming to AASHTO M182 having a weight of 233 grams (seven ounces) or more per square meter (yard) when dry.

2. Impervious Sheeting conforming to AASHTO M171.

3. Liquid Membrane Curing Compound conforming to AASHTO M148 (ASTM C309), Type 1 and shall be free of paraffin or petroleum.

2.5 EXPANSION JOINT FILLERS

A. Material shall conform to AASHTO M213.

PART 3 - EXECUTION

3.1 SUBGRADE PENETRATION

A. Prepare, construct, and finish the subgrade as specified in Section 312000, EARTH MOVING.

B. Maintain the subgrade in a smooth, compacted condition, in conformance with the required section and established grade until the succeeding operation has been accomplished.

3.2 SETTING FORMS

A. Base Support:

1. Compact the base material under the forms true to grade so that, when set, they will be uniformly supported for their entire length at the grade as shown.

2. Correct imperfections or variations in the base material grade by cutting or filling and compacting.

B. Form Setting:

1. Set forms sufficiently in advance of the placing of the concrete to permit the performance and approval of all operations required with and adjacent to the form lines.

2. Set forms to true line and grade and use stakes, clamps, spreaders, and braces to hold them rigidly in place so that the forms and joints are free from play or movement in any direction.

3. Forms shall conform to line and grade with an allowable tolerance of 3 mm (1/8 inch) when checked with a straightedge and shall not deviate from true line by more than 6 mm (1/4 inch) at any point.

4. Do not remove forms until removal will not result in damaged concrete or at such time to facilitate finishing.

5. Clean and oil forms each time they are used.

C. The Contractor’s Registered Professional Land Surveyor, specified in Section 007200, GENERAL CONDITIONS, shall establish and control the alignment and the grade elevations of the forms or concrete slipforming machine operations.

1. Make necessary corrections to forms immediately before placing concrete.

2. When any form has been disturbed or any subgrade or subbase has become unstable, reset and recheck the form before placing concrete.

3.3 EQUIPMENT

A. The Resident Engineer shall approve equipment and tools necessary for handling materials and performing all parts of the work prior to commencement of work.

B. Maintain equipment and tools in satisfactory working condition at all times.

3.4 PLACING REINFORCEMENT

A. Reinforcement shall be free from dirt, oil, rust, scale or other substances that prevent the bonding of the concrete to the reinforcement.

B. Before the concrete is placed, the Resident Engineer shall approve the reinforcement, which shall be accurately and securely fastened in place with suitable supports and ties. The type, amount, and position of the reinforcement shall be as shown.

3.5 PLACING CONCRETE - GENERAL

A. Obtain approval of the Resident Engineer before placing concrete.

B. Remove debris and other foreign material from between the forms before placing concrete. Obtain approval of the Resident Engineer before placing concrete.

C. Before the concrete is placed, uniformly moisten the subgrade, base, or subbase appropriately, avoiding puddles of water.

D. Convey concrete from mixer to final place of deposit by a method which will prevent segregation or loss of ingredients. Deposit concrete so that it requires as little handling as possible.

E. While being placed, spade or vibrate and compact the concrete with suitable tools to prevent the formation of voids or honeycomb pockets. Vibrate concrete well against forms and along joints. Over-vibration or manipulation causing segregation will not be permitted. Place concrete continuously between joints without bulkheads.

F. Install a construction joint whenever the placing of concrete is suspended for more than 30 minutes and at the end of each day's work.

G. Workmen or construction equipment coated with foreign material shall not be permitted to walk or operate in the concrete during placement and finishing operations.

3.6 PLACING CONCRETE FOR CURB AND GUTTER, PEDESTRIAN PAVEMENT, AND EQUIPMENT PADS

A. Place concrete in the forms in one layer of such thickness that, when compacted and finished, it will conform to the cross section as shown.

B. Deposit concrete as near to joints as possible without disturbing them but do not dump onto a joint assembly.

C. After the concrete has been placed in the forms, use a strike-off guided by the side forms to bring the surface to the proper section to be compacted.

D. Consolidate the concrete thoroughly by tamping and spading, or with approved mechanical finishing equipment.

E. Finish the surface to grade with a wood or metal float.

F. All Concrete pads and pavements shall be constructed with sufficient slope to drain properly.

G. Curb-forming machines for constructing curbs and gutter will be approved based on trial use on the job. If the equipment produces unsatisfactory results, discontinue use of the equipment at any time during construction and accomplish the work by hand method construction as specified. Remove unsatisfactory work and reconstruct the full length between regularly scheduled joints. Dispose of removed portions off the property.

3.7 PLACING CONCRETE FOR VEHICULAR PAVEMENT

A. Deposit concrete into the forms as close as possible to its final position.

B. Place concrete rapidly and continuously between construction joints.

C. Strike off concrete and thoroughly consolidate by a finishing machine, vibrating screed, or by hand-finishing.

D. Finish the surface to the elevation and crown as shown.

E. Deposit concrete as near the joints as possible without disturbing them but do not dump onto a joint assembly. Do not place adjacent lanes without approval by the Resident Engineer.

3.8 CONCRETE FINISHING - GENERAL

A. The sequence of operations, unless otherwise indicated, shall be as follows:

1. Consolidating, floating, straight-edging, troweling, texturing, and edging of joints.
2. Maintain finishing equipment and tools in a clean and approved condition.

3.9 CONCRETE FINISHING CURB AND GUTTER

A. Round the edges of the gutter and top of the curb with an edging tool to a radius of 6mm (1/4 inch) or as otherwise detailed.

B. Float the surfaces and finish with a smooth wood or metal float until true to grade and section and uniform in textures.

C. Finish the surfaces, while still wet, with a bristle type brush with longitudinal strokes.

D. Immediately after removing the front curb form, rub the face of the curb with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. Brush the surface, while still wet, in the same manner as the gutter and curb top.

E. Except at grade changes or curves, finished surfaces shall not vary more than 3 mm (1/8 inch) for gutter and 6 mm (1/4 inch) for top and face of curb, when tested with a 3000 mm (10 foot) straightedge.

F. Remove and reconstruct irregularities exceeding the above for the full length between regularly scheduled joints.

G. Correct any depressions which will not drain.

H. Visible surfaces and edges of finished curb and gutter shall be free of blemishes, form marks, and tool marks, and shall be uniform in color, shape, and appearance.

3.10 CONCRETE FINISHING PEDESTRIAN PAVEMENT

A. Walks, Grade Slabs, Wheelchair Curb Ramps:

1. Finish the surfaces to grade and cross section with a metal float, trowled smooth and finished with a broom moistened with clear water.
2. Brooming shall be transverse to the line of traffic.
3. Finish all slab edges, including those at formed joints, carefully with an edger having a radius as shown on the Drawings.
4. Unless otherwise indicated, edge the transverse joints before brooming. The brooming shall eliminate the flat surface left by the surface face of the edger. Execute the brooming so that the corrugation, thus produced, will be uniform in appearance and not more than 2 mm (1/16 inch) in depth.
5. The completed surface shall be uniform in color and free of surface blemishes, form marks, and tool marks. The finished surface of the pavement shall not vary more than 5 mm (3/16 inch) when tested with a 3000 mm (10 foot) straightedge.
6. The thickness of the pavement shall not vary more than 6 mm (1/4 inch).
7. Remove and reconstruct irregularities exceeding the above for the full length between regularly scheduled joints.

B. Steps: The method of finishing the steps and the sidewalls is similar to above except as herein noted.

1. Remove the riser forms one at a time, starting with the top riser.

2. After removing the riser form, rub the face of the riser with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. Use an outside edger to round the corner of the tread; use an inside edger to finish the corner at the bottom of the riser.

3. Give the risers and sidewall a final brush finish. The treads shall have a final finish with a stiff brush to provide a non-slip surface.

4. The texture of the completed steps shall present a neat and uniform appearance and shall not deviate from a straightedge test more than 5 mm (3/16 inch).

3.11 CONCRETE FINISHING FOR VEHICULAR PAVEMENT

A. Accomplish longitudinal floating with a longitudinal float not less than 10 feet long and 6 inches wide, properly stiffened to prevent flexing and warping. Operate the float from foot bridges in a sawing motion parallel to the direction in which the pavement is being laid from one side of the pavement to the other, and advancing not more than half the length of the float.

B. After the longitudinal floating is completed, but while the concrete is still plastic, eliminate minor irregularities in the pavement surfaces by means of metal floats, 5 feet in length, and straightedges, 10 feet in length. Make the final finish with the straightedges, which shall be used to float the entire pavement surface.

C. Test the surface for trueness with a 10 foot straightedge held in successive positions parallel and at right angles to the direction in which the pavement is being laid and the entire area covered as necessary to detect variations. Advance the straightedge along the pavement in successive stages of not more than one half the length of the straightedge. Correct all irregularities and refinish the surface.

D. The finished surface of the pavement shall not vary more than 1/4 inch in both longitudinal and transverse directions when tested with a 10 foot straightedge.

E. The thickness of the pavement shall not vary more than 6 mm (1/4 inch).

F. When most of the water glaze or sheen has disappeared and before the concrete becomes nonplastic, give the surface of the pavement a broomed finish with an approved fiber broom not less than 450 mm (18 inches) wide. Pull the broom gently over the surface of the pavement from edge to edge. Brooming shall be transverse to the line of traffic and so executed that the corrugations thus produced will be uniform in character and width, and not more than 3 mm (1/8 inch) in depth. Carefully finish the edge of the pavement along forms and at the joints with an edging tool. The brooming shall eliminate the flat surface left by the surface face of the edger.

G. The finish surfaces of new and existing abutting pavements shall coincide at their juncture.

3.12 CONCRETE FINISHING EQUIPMENT PADS

A. After the surface has been struck off and screeded to the proper elevation, give it a smooth dense float finish, free from depressions or irregularities.

B. Carefully finish all slab edges with an edger having a radius as shown in the Drawings.

C. After removing the forms, rub the faces of the pad with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. The finish surface of the pad shall not vary more than 3 mm (1/8 inch) when tested with a 3000 mm (10 foot) straightedge.

D. Correct irregularities exceeding the above.

3.13 JOINTS - GENERAL

A. Place joints, where shown, conforming to the details as shown, and perpendicular to the finished grade of the concrete surface.

B. Joints shall be straight and continuous from edge to edge of the pavement.

3.14 CONTRACTION JOINTS

A. Cut joints to depth as shown with a grooving tool or jointer of a radius as shown or by sawing with a blade producing the required width and depth.

B. Construct joints in curbs and gutters by inserting 3 mm (1/8 inch) steel plates conforming to the cross sections of the curb and gutter.

C. Plates shall remain in place until concrete has set sufficiently to hold its shape and shall then be removed.

D. Finish edges of all joints with an edging tool having the radius as shown.

E. Score pedestrian pavement with a standard grooving tool or jointer.

3.15 EXPANSION JOINTS

A. Use a preformed expansion joint filler material of the thickness as shown to form expansion joints.

B. Material shall extend the full depth of concrete, cut and shaped to the cross section as shown, except that top edges of joint filler shall be below the finished concrete surface where shown to allow for sealing.

C. Anchor with approved devices to prevent displacing during placing and finishing operations.

D. Round the edges of joints with an edging tool.

E. Form expansion joints as follows:

1. Without dowels, about structures and features that project through, into, or against any site work concrete construction.

2. Using joint filler of the type, thickness, and width as shown.

3. Installed in such a manner as to form a complete, uniform separation between the structure and the site work concrete item.

3.16 CONSTRUCTION JOINTS

A. Locate longitudinal and transverse construction joints between slabs of vehicular pavement as shown.

B. Place transverse construction joints of the type shown, where indicated and whenever the placing of concrete is suspended for more than 30 minutes.

C. Use a butt-type joint with dowels in curb and gutter if the joint occurs at the location of a planned joint.

D. Use keyed joints with tiebars if the joint occurs in the middle third of the normal curb and gutter joint interval.

3.17 FORM REMOVAL

A. Forms shall remain in place at least 12 hours after the concrete has been placed. Remove forms without injuring the concrete.

B. Do not use bars or heavy tools against the concrete in removing the forms. Promptly repair any concrete found defective after form removal.

3.18 CURING OF CONCRETE

A. Cure concrete by one of the following methods appropriate to the weather conditions and local construction practices, against loss of moisture, and rapid temperature changes for at least seven days from the beginning of the curing operation. Protect unhardened concrete from rain and flowing water. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready to install before actual concrete placement begins. Provide protection as necessary to prevent cracking of the pavement due to temperature changes during the curing period. If any selected method of curing does not afford the proper curing and protection against concrete cracking, remove and replace the damaged pavement and employ another method of curing as directed by the Resident Engineer.

B. Burlap Mat: Provide a minimum of two layers kept saturated with water for the curing period. Mats shall overlap each other at least 150 mm (6 inches).

C. Impervious Sheeting: Use waterproof paper, polyethylene-coated burlap, or polyethylene sheeting. Polyethylene shall be at lease 0.1 mm (4 mils) in thickness. Wet the entire exposed concrete surface with a fine spray of water and then cover with the sheeting material. Sheets shall overlap each other at least 300 mm (12 inches). Securely anchor sheeting.

D. Liquid Membrane Curing:

1. Apply pigmented membrane-forming curing compound in two coats at right angles to each other at a rate of 5 m2/L (200 square feet per gallon) for both coats.
2. Do not allow the concrete to dry before the application of the membrane.
3. Cure joints designated to be sealed by inserting moistened paper or fiber rope or covering with waterproof paper prior to application of the curing compound, in a manner to prevent the curing compound entering the joint.
4. Immediately re-spray any area covered with curing compound and damaged during the curing period.

3.19 CLEANING

A. After completion of the curing period:

1. Remove the curing material (other than liquid membrane).
2. Sweep the concrete clean.
3. After removal of all foreign matter from the joints, seal joints as herein specified.
4. Clean the entire concrete of all debris and construction equipment as soon as curing and sealing of joints has been completed.

3.20 PROTECTION

A. The contractor shall protect the concrete against all damage prior to final acceptance by the Government. Remove concrete containing excessive cracking, fractures, spalling, or other defects and reconstruct the entire section between regularly scheduled joints, when directed by the Resident Engineer, and at no additional cost to the Government. Exclude traffic from vehicular pavement until the concrete is at least seven days old, or for a longer period of time if so directed by the Resident Engineer.

3.21 FINAL CLEAN-UP

A. Remove all debris, rubbish and excess material from the Station.

END OF SECTION 321313

SECTION 321416 - BRICK PAVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specifications sections, apply to work of this section.

B. The following related items of work are included under other sections:

1. Earthmoving: Section 312000

2. Concrete: Section 033000

3. Masonry: Section 042000

1.2 SUMMARY

A. The work under this Section shall include all labor, materials, equipment, and all else necessary for full compliance with the applicable drawings, specifications, and other contract requirements or as directed by the Construction Manager for the installation of brick pavement and brick veneer.

1.3 QUALITY ASSURANCE

A. Standards

1. ASTM C-150 Specification for Portland Cement

2. ASTM C-144 Sand for Concrete Work

3. ASTM D-3381 Asphalt Cement

4. ASTM C902, Class SX, Type 1, Application PX. Brick Pavement

1.4 SUBMITTALS

A. Submit sample for approval by the OWNER prior to installation. Samples shall be as follows:

B. Bricks:

1. Quantity: 6 pavers

2. Sizes: See plans.

3. Edge: See plans.

4. Color: Submit samples for selection.

5. Pattern: Running Bond

C. Sand: Samples shall weigh 1 kg (2 lb) and be packaged in plastic bags. Samples shall be typical of the lot of material to be delivered to the site and provide an accurate indication of color and texture of the material.

1.5 MOCK UP

A. Install a 4’ x 4’ sample of brick paved area on the job site. Location to be determined by the Project Consultant.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the project site in such quantities and at such times to assure continuity of installation.

B. Store materials at the project site in a clean dry location to prevent damage.

1.7 JOB CONDITION

A. Verify dimension, including finish grade elevations in the field before commencing with the installation of brick pavers.

B. Coordinate work with other trades as to the sequencing of installation operations.

PART 2 - PRODUCTS

A. Concrete base shall be as specified under Section 321313 Concrete For Exterior Improvements

B. Sand Setting Bed shall be in accordance with ASTM C14, "Aggregate for Masonry Mortar", and be clean, washed sharp sand compacted to the depths as shown on the drawings.

C. Mortar Setting Bed and Mortar Joints shall be in accordance with ASTM C270 Type M mortar, “Specification for Mortar Unit Masonry”

D. Brick Paver shall be as specified in Division 042000 and shall match wall brick.

PART 3 - EXECUTION

3.1 INSPECTION

A. Prior to the installation of the brick paving system, the paving contractor shall check and verify that the base material has been properly prepared and that the specified elevation, grade and slope for drainage comply with the project specifications.

3.2 SETTING BED

A. Weather Limitations: Setting bed shall be constructed only when the sub grade and base course are dry and the weather is not foggy, rainy, or below 10 degrees F.

B. To install the setting bed over the surface of the concrete base, place depth control bars directly over the concrete base. If grades must be adjusted, set wood chocks under the depth control bars to proper grade. Set two bars parallel to each other approximately eleven feet (11 ft.) apart to serve as guide for striking board (12’ x 6” x 2”). The depth of control bars must be set carefully to bring the paver, when laid, to the proper grade.

C. Place some mortar material between the parallel depth control bars. Pull this bed with the striking board over these bars several times. After each pass, low porous spots must be showered with fresh mortar material to produce a smooth, firm and even setting bed. As soon as this initial panel is completed, advance the first bar to the next position in readiness for striking the next panel. Carefully fill up any depression that remain after removing the depth control bars and wood chocks.

D. Bed shall be spread in a continuous workmanlike manner. Bed depth greater than 1-1/8 will not be accepted. Contractor shall remove concrete required to maintain specified bed thickness. Minimum concrete replacement repair thickness shall be two inches (2”).

3.3 PLACING PAVERS ON SAND SETTING BED

A. Provide edge restraints as indicated - install edge restraints prior to placing unit pavers.

B. Lay Filter Geotextile (if applicable) along edges where indicated in the drawings. Place geotextile over the compacted base course overlapping ends and edges at least 12-inches.

C. Spread the sand evenly over the base course and screed to ½ - 1 inches thickness. The screeded sand should not be disturbed. Sufficient sand shall be placed to ensure that no delay occurs in laying pavers. The screeded bedding sand shall not be subjected to any traffic by either mechanical or pedestrian use.

D. Ensure that pavers are free of foreign material before installation. The installer shall take the pavers from the pallet by row consisting of 18 pavers. Each row shall be installed together to ensure proper color mix.

E. Lay the pavers in the pattern(s) as shown on the drawings. Full pavers are to be laid first. The pavers should be laid hand tight. Maintain straight pattern lines and adjust as necessary.

F. Joints between the pavers shall be between 1/16 inch and 1/8 inch (2 to 3 mm) wide.

G. Fill gaps at the edges of the paved area with cut pavers or edge units. Cut pavers to be placed along the edge using a masonry saw and in such a manner that no segment is smaller than one quarter of a full paver.

H. Use a low amplitude, high frequency plate vibrator capable of 3000 to 5000 lbs. centrifugal compaction force to vibrate the pavers into the sand. Vibrate the pavers, sweeping dry sand into the joints and vibrating until they are full. This will require at least two or three passes with the vibrator. Do not vibrate within three feet of the unrestrained edges of the paving units. (A plate vibrator is not recommended for straight edge pavers, instead use a hand tamp and board method for compaction)

I. All work to within three feet of the laying face must be left fully compacted with sand-filled joints at the completion of each day.

J. Sweep off excess sand when the job is complete. Contractor shall return to the site one month after installation is complete to inspect sand in joints. Contractor is responsible for adding additional sand to fill joints where necessary.

K. The final surface elevations shall not deviate more than 3/8 inch under a 10 foot long straightedge.

L. The surface elevation of pavers shall be 1/8 to 1/4 inch above adjacent drainage inlets, concrete collars or channels.

M. Handtight joints shall read from 0” to maximum 3/16”. Sweep a dry mixture of joint filler into joints until joints are completely filled. Fog lightly with water.

3.4 PLACING PAVERS ON A MORTAR SETTING BED

A. Mix mortar according to ASTM C-270 or to latex-modified mortar manufacturer’s recommendations.

B. Place wet mortar setting bed to thickness indicated on drawings, but no greater than ¾”.

C. Before mortar setting bed has set, install brick pavers in the pattern(s) as indicated on the drawings.

D. Fill in all mortar joints and tool to concave appearance when thumbprint hard.

3.5 CLEANING RIGID BRICK PAVING

A. Do not clean pavers until mortar is cured.

B. Clean soiled surfaces with cleaning solution approved by paving brick manufacturer.

C. Protect adjacent construction and landscaping from cleaning agents.

D. Rinse all surfaces with potable water. Pressure not to exceed 120 lbs. per square inch.

3.6 TOLERANCES

A. The final surface elevation shall be flush with adjacent construction.

B. Maximum variation in level shall be within ± 3/8” in 10 feet.

3.7 TRAFFIC CONTROL

A. The General Contractor shall provide suitable traffic and pedestrian control, as general conditions demand, during the paver installation until all work is completed. Newly installed pavers must be protected at all times by panels of plywood supplied by General Contractor. These panels must be used in areas which will be subjected to the continued movement of material and equipment. These precautions must be taken in order to avoid depressions and protect brick alignment. Traffic of other trades, while installation is in progress will not be approved and damaged work will be removed and replaced as directed by the Landscape Architect, and is the responsibility of the General Contractor.

END OF SECTION 024119

SECTION 321723 - PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. This work shall consist of furnishing and applying paint on pavement surfaces, in the form of traffic lanes, parking bays, areas restricted to handicapped persons, crosswalks, and other detail pavement markings, in accordance with the details as shown or as prescribed by the Resident Engineer. Conform to the Manual on Uniform Traffic Control Devices for Streets and Highways, published by the U.S. Department of Transportation, Federal Highway Administration, for details not shown.

1.2 SUBMITTALS

A. In accordance with Section 013323, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish Manufacturer's Certificates and Data certifying that the following materials conform to the requirements specified.

B. Paint.

1.3 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. Federal Specifications (Fed. Spec.):

TT-P-1952D .....Paint, Traffic Black, and Airfield Marking, Waterborne

C. Master Painters Institute (MPI):

Approved Product List - 2010

PART 2 - PRODUCTS

2.1 PAINT

A. Paint for marking pavement (parking lot and zone marking) shall conform to MPI No. 97, color as shown. Paint for obliterating existing markings shall conform to Fed. Spec. TT-P-1952D. Paint shall be in containers of at least 18 L (5 gallons). A certificate shall accompany each batch of paint stating compliance with the applicable publication.

2.2 PAINT APPLICATOR

A. Apply all marking by approved mechanical equipment. The equipment shall provide constant agitation of paint and travel at controlled speeds. Synchronize one or more paint "guns" to automatically begin and cut off paint flow in the case of skip lines. The equipment shall have manual control to apply continuous lines of varying length and marking widths as shown. Provide pneumatic spray guns for hand application of paint in areas where a mobile paint applicator cannot be used. An experienced technician that is thoroughly familiar with equipment, materials, and marking layouts shall control all painting equipment and operations.

2.3 SANDBLASTING EQUIPMENT

A. Sandblasting equipment shall include an air compressor, hoses, and nozzles of proper size and capacity as required for cleaning surfaces to be painted. The compressor shall furnish not less than 0.08 m^3/s (150 cfm) of air at a pressure of not less than 625 kPa (90 psi) at each nozzle used.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

A. Allow new pavement surfaces to cure for a period of not less than 14 days before application of marking materials.

B. Thoroughly clean all surfaces to be marked before application of paint. Remove dust, dirt, and other granular surface deposits by sweeping, blowing with compressed air, rinsing with water, or a combination of these methods. Completely remove rubber deposits, existing paint markings, and other coatings adhering to the pavement with scrapers, wire brushings, sandblasting, mechanical abrasion, or approved chemicals as directed by the Resident Engineer. The application of paint conforming to Fed. Spec. TT-P-1952D is an option to removal of existing paint markings on asphalt pavement. Apply the black paint in as many coats as necessary to completely obliterate the existing markings. Where oil or grease are present on old pavements to be marked, scrub affected areas with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinse thoroughly after each application. After cleaning, seal oil-soaked areas with cut shellac to prevent bleeding through the new paint. Pavement marking shall follow as closely as practicable after the surface has been cleaned and dried, but do not begin any marking until the Resident Engineer has inspected the surface and gives permission to proceed. The Contractor shall establish control points for marking and provide templates to control paint application by type and color at necessary intervals. The Contractor is responsible to preserve and apply marking in conformance with the established control points.

3.2 APPLICATION

A. Apply uniformly painted pavement marking of required color(s), length, and width with true, sharp edges and ends on properly cured, prepared, and dried surfaces in conformance with the details as shown and established control points. The length and width of lines shall conform within a tolerance of plus or minus 75 mm (3 inches) and plus or minus 3 mm (1/8 inch), respectively, in the case of skip markings. The length of intervals shall not exceed the line length tolerance. Temperature of the surface to be painted and the atmosphere shall be above 10□C (50□F) and less than 35□C (95□F). Apply the paint at a wet film thickness of 0.4 mm (0.015 inch). Apply paint in one coat. At the direction of the Resident Engineer, markings showing light spots may receive additional coats. The maximum drying time requirements of the paint specifications will be strictly enforced, to prevent undue softening of asphalt, and pick-up, displacement, or discoloration by tires of traffic. If there is a deficiency in drying of the marking, discontinue paint operations until cause of the slow drying is determined and corrected. Remove and replace marking that is applied at less than minimum material rates; deviates from true alignment; exceeds stipulated length and width tolerances; or shows light spots, smears, or other deficiencies or irregularities. Use carefully controlled sand blasting, approved grinding equipment, or other approved method to remove marking so that the surface to which the marking was applied will not be damaged.

3.3 PROTECTION

A. Conduct operations in such a manner that necessary traffic can move without hindrance. Protect the newly painted markings so that, insofar as possible, the tires of passing vehicles will not pick up paint. Place warning signs at the beginning of the wet line, and at points well in advance of the marking equipment for alerting approaching traffic from both directions. Place small flags or other similarly effective small objects near freshly applied markings at frequent intervals to reduce crossing by traffic. Efface and replace damaged portions of markings at no additional cost to the Government.

3.4 DETAIL PAVEMENT MARKING

A. Use Detail Pavement Markings, exclusive of actual traffic lane marking, at exit and entrance islands and turnouts, on curbs, at crosswalks, at parking bays, and at such other locations as shown. Show the International Handicapped Symbol at indicated parking spaces. Color shall be as shown. Apply paint for the symbol using a suitable template that will provide a pavement marking with true, sharp edges and ends. Place detail pavement markings of the color(s), width(s) and length(s), and design pattern at the locations shown.

3.5 TEMPORARY PAVEMENT MARKING

A. When shown or directed by the Resident Engineer, apply Temporary Pavement Markings of the color(s), width(s) and length(s) shown or directed. After the temporary marking has served its purpose and when so ordered by the Resident Engineer, remove temporary marking by carefully controlled sandblasting, approved grinding equipment, or other approved method so that the surface to which the marking was applied will not be damaged. As an option, an approved preformed pressure sensitive, adhesive tape type of temporary pavement marking of the required color(s), width(s) and length(s) may be furnished and used in lieu of temporary painted marking. The Contractor shall be fully responsible for the continued durability and effectiveness of such marking during the period for which its use is required. Remove any unsatisfactory tape type marking and replace with painted markings at no additional cost to the Government.

3.6 FINAL CLEAN-UP

A. Remove all debris, rubbish and excess material from the Station.

END OF SECTION 321723

SECTION 329000 - PLANTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work in this section consists of furnishing and installing plant, soils, edging turf, grasses and landscape materials required as specified in locations shown.

1.2 RELATED WORK

A. Topsoil Testing: Section 014527, INSPECTION AND TESTING OF EARTHWORK

B. Section 015700, CONSTRUCTION POLLUTION CONTROLS.

C. Stripping Topsoil, Stock Piling and Topsoil Materials: Section 312000, EARTH MOVING.

1.3 DEFINITIONS

A. Backfill: The earth used to replace earth in an excavation.

B. Balled and Burlapped Stock: ANSI Z60.1. Plants dug with firm, natural balls of earth in which they were grown, with ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball.

C. Balled and Potted Stock: ANSI Z60.1. Plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required.

D. Bare-Root Stock: Plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than minimum root spread according to ANSI Z60.1 for type and size of plant required.

E. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.

F. Fabric Bag-Grown Stock: Healthy, vigorous, well-rooted plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by ANSI Z60.1 for type and size of plant.

G. Finish Grade: Elevation of finished surface of planting soil.

H. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

I. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

J. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

K. Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, turf and grasses, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.

L. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.

M. 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.

N. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

1.4 DELIVERY, STORAGE AND HANDLING

A. Retain terms that remain after this Section has been edited for a Project.

B. Notify the Contracting Officer’s Representative of the delivery schedule in advance so the plant material may be inspected upon arrival at the job site. Remove unacceptable plant and landscape materials from the job site immediately.

C. Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws, as applicable. Keep seed and other packaged materials in dry storage away from contaminants.

D. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants. Keep bulk materials in dry storage away from contaminants.

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 fertilizers, lime and soil amendments with appropriate certificates.

E. Deliver bare-root stock plants freshly dug. 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.

F. 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.

G. Handle planting stock by root ball.

H. The use of equipment such as "tree spades" is permitted provided the plant balls are sized in accordance with ANSI Z60.1 and tops are protected from damage.

I. Store bulbs, corms, and tubers in a dry place at 60 to 65 deg F (16 to 18 deg C) until planting.

J. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than 6 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 dry condition in water for two hours. Reject dried-out plants.
   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.

K. Harvest, deliver, store, and handle sod according to requirements in TPI's "Guideline Specifications to Turfgrass Sodding". Deliver sod in time for planting within 24 hours of harvesting. Protect sod from breakage, seed contamination and drying.

L. Deliver sprigs in air tight bags to keep from drying out. Sprigs delivered unwrapped, shall be kept moist in burlap or other accepted material until planting.

M. Deliver plugs within 24 hours of harvesting, keep moist until planting.

N. All pesticides and herbicides shall be properly labeled and registered with the U.S. Department of Agriculture. Deliver materials in original, unopened containers showing, certified analysis, name and address of manufacturer, product label, manufacturer’s application instructions specific to the project and indication of conformance with state and federal laws, as applicable.

1.5 PROJECT CONDITIONS

A. 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. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion. Plant during one of the following periods:
   1. October 1 – April 30

C. 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 according to manufacturer's written instructions and warranty requirements.

D. 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.

E. Plant trees, shrubs, and other plants after finish grades and irrigation system components are established, but not before irrigation system components are installed, tested and approved, unless otherwise indicated.
   1. When planting trees, shrubs, and other plants, protect irrigation system components and promptly repair damage caused by planting operations.

1.6 QUALITY ASSURANCE

A. Products Criteria:
   1. When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.
   2. A nameplate bearing manufacturer's name or trademark, including model number, shall be securely affixed in a conspicuous place on equipment. In addition, the model number shall be either cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.

B. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of plants.
   1. Installer shall be actively registered with the North Carolina Landscape Contractors Registration Board with 5 years experience in landscape installation.
   2. Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

      a. Pesticide Applicator: Licensed in state of project, commercial.

C. A qualified Arborist shall be licensed and required to submit one copy of license to the Contracting Officer’s Representative.

D. Include an independent or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

E. For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; deleterious material; pH; and mineral and plant-nutrient content of the soil.
   1. Testing methods and written recommendations shall comply with USDA's Handbook No. 60, “Diagnosis and Improvement of Saline and Alkali Soils”.
   2. The soil-testing laboratory shall oversee soil sampling; with depth, location, and number of samples to be taken per instructions from Contracting Officer’s Representative. A minimum of 3 representative samples shall be taken from varied locations for each soil to be used or amended for planting purposes.
   3. Report suitability of tested soil for plant growth.

      a. Based upon the test results, state recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1000 sq. ft. (92.9 sq. m) or volume per cu. yd (0.76 cu. m) for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.

      b. Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problem materials are present, provide additional recommendations for corrective action.

F. Provide quality, size, genus, species, variety and sources of plants indicated, complying with applicable requirements in ANSI Z60.1.

G. Measure according to ANSI Z60.1. Do not prune to obtain required sizes.
   1. Measure trees and shrubs 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 (150 mm) above the root flare for trees up to 4 inch (100 mm) caliper size, and 12 inches (300 mm) above the root flare for larger sizes.
   2. Measure other plants with stems, petioles, and foliage in their normal position.

H. Contracting Officer’s Representative 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. Contracting Officer’s Representative retains right to observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.
   1. Notify Contracting Officer’s Representative of plant material sources seven days in advance of delivery to site.

I. Include product label and manufacturer's literature and data for pesticides and herbicides.

J. Conduct a pre-installation conference at Project site.

1.7 SUBMITTALS

A. Submit product data for each type of product indicated, including soils:
   1. Include quantities, sizes, quality, and sources for plant materials.
   2. Include EPA approved product label, MSDS (Material Safety Data Sheet) and manufacturer's application instructions specific to the Project.
   3. Include color photographs in digital format of each required species and size of plant material as it will be furnished to the Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. For species where more than 20 plants are required, include a minimum of 3 photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.

B. Submit samples and manufacturer’s literature for each of the following for approval before work is started.
   1. Trees and Shrubs: 3 samples of each variety and size delivered to the site for review. Maintain approved samples on-site as a standard for comparison.
   2. Organic and Compost Mulch: 1 quart (1-liter) volume of each organic and compost mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.
   3. Weed Control Barrier: 12 by 12 inches (300 by 300 mm).
   4. Submit edging materials and accessories in manufacturer's standard size, to verify color selected.
   5. Erosion Control Materials: 12 by 12 inches (300 by 300 mm).
   6. Root Barrier: Width of panel by 12 inches (300 mm).
   7. Landscape Membranes: 12 by 12 inches (300 by 300 mm).
   8. Tree Wrap: Width of panel by 12 inches (300 mm).

C. Qualification data for qualified 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.

D. Prior to delivery, provide notarized certificates attesting that each type of manufactured product, from the manufacturer, meet the requirements specified and shall be submitted to the Contracting Officer’s Representative for approval:
   1. Plant Materials (Department of Agriculture certification by State Nursery Inspector declaring material to be free from insects and disease).
   2. Seed and Turf Materials notarized certificate of product analysis.
   3. Manufacturer's certified analysis of standard products.
   4. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.

E. Material Test Reports: For existing native surface topsoil and imported or manufactured topsoil.

F. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before start of required maintenance periods.

1.8 PLANT AND TURF ESTABLISHMENT PERIOD

A. The establishment period for plants and turf shall begin immediately after installation, with the approval of the Contracting Officer's Representative, and continue until the date that the Government accepts the project or phase for beneficial use and occupancy. During the Establishment Period the Contractor shall maintain the plants and turf as required in Part 3.

1.9 PLANT AND TURF MAINTENANCE SERVICE

A. Provide initial maintenance service for trees, shrubs, ground cover and other plants by skilled employees of landscape Installer. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established and acceptance is documented by the Contracting Officer's Representative.

1.10 APPLICABLE PUBLICATIONS

A. The publications listed below, form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.

B. American National Standards Institute (ANSI):

Z60.1-04 .....Nursery Stock

C. Association of Official Seed Analysts (AOSA): Rules for Testing Seed.

D. American Society For Testing And Materials (ASTM):

B221-08 .....Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

C33/C33M-11 .....Concrete Aggregates

C136-06 .....Sieve Analysis of Fine and Coarse Aggregates

C516-08 .....Vermiculite Loose Fill Thermal Insulation

C549-06 .....Perlite Loose Fill Insulation

C602-07 .....Agricultural Liming Materials

D977-05 .....Emulsified Asphalt (AASTHO M140)

D5268-07 .....Topsoil Used for Landscaping Purposes

E. Hortus Third: A Concise Dictionary of Plants Cultivated in the United States and Canada.

F. Turfgrass Producers International (TPI): Guideline Specifications to Turfgrass Sodding.

G. United States Department of Agriculture (USDA): Handbook No. 60 Diagnosis and Improvement of Saline and Alkali Soils; Federal Seed Act Regulations.

1.11 WARRANTY

A. The Contractor shall remedy any defect due to faulty material or workmanship and pay for any damage to other work resulting therefrom within a period of one year from final acceptance, unless noted otherwise below. Further, the Contractor will provide all manufacturer's and supplier's written guarantees and warranties covering materials and equipment furnished under this Contract.

1. Plant and Turf Warranty Periods will begin from the date of Government acceptance of the project or phase for beneficial use and occupancy.

    a. Trees, Shrubs, Vines, and Ornamental Grasses: 12 months.

    b. Ground Covers, Biennials, Perennials, Turf, and Other Plants: 12 months.

    c. Annuals: 3 months.

2. The Contractor shall have completed, located, and installed all plants and turf according to the plans and specifications. All plants and turf are expected to be living and in a healthy condition at the time of final inspection.
3. The Contractor will replace any dead plant material and any areas void of turf immediately, unless required to plant in the succeeding planting season. Provide extended warranty for period equal to original warranty period for replacement plant materials. Replacement plant and turf warranty will begin on the day the work is completed.
4. Replacement of relocated plants, that the Contractor did not supply, is not required unless plant failure is due to improper handling and care during transplanting. Loss through Contractor negligence requires replacement in plant type and size.
5. The Government will reinspect all plants and turf at the end of the Warranty Period. The Contractor will replace any dead, missing, or defective plant material and turf immediately. The Warranty Period will end on the date of this inspection provided the Contractor has complied with the warranty work required by this specification. The Contractor shall also comply with the following requirements:

    a. Replace plants that are more than 25 percent dead, missing or defective plant material prior to final inspection.

    b. A limit of one replacement of each plant will be required except for losses or replacements due to failure to comply with requirements.

    c. Mulch and weed plant beds and saucers. Just prior to final inspection, treat these areas to a second application of approved pre-emergent herbicide.

    d. Complete remedial measures directed by the Contracting Officer’s Representative to ensure plant and turf survival.

    e. Repair damage caused while making plant or turf replacements.

B. 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, or incidents that are beyond Contractor's control.

      b. Structural failures including plantings falling or blowing over.

      c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

A. Plant and turf materials: ANSI Z60.1; will conform to the varieties specified and be true to botanical name as listed in Hortus Third; nursery-grown plants and turf material true to genus, species, variety, cultivar, stem form, shearing, and other features indicated on Drawings; healthy, normal and unbroken root systems developed by transplanting or root pruning; well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf; free of disease, pests, eggs, larvae, and defects such as knots, sun scald, windburn, injuries, abrasions, and disfigurement.
   1. Trees-deciduous and evergreen: Single trunked with a single leader, unless otherwise indicated; symmetrically developed deciduous trees and shrubs of uniform habit of growth; straight boles or stems; free from objectionable disfigurements; evergreen trees and shrubs with well developed symmetrical tops, with typical spread of branches for each particular species or variety. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch (19 mm) in diameter; or with stem girdling roots will be rejected.
   2. Ground cover and vine plants: Provide the number and length of runners for the size specified on the Drawings, together with the proper age for the grade of plants specified. Provide vines and ground cover plants well established in removable containers, integral containers, or formed homogeneous soil sections. Plants shall have been grown under climatic conditions similar to those in the locality of the project. Spray all plants budding into leaf or having soft growth with an anti desiccant at the nursery before digging.
   3. The minimum acceptable sizes of all plants, measured before pruning with branches in normal position, shall conform to the measurements designated. Plants larger in size than specified may be used with the approval of the Contracting Officer’s Representative, with no change in the contract price. When larger plants are used, increase the ball of earth or spread of roots in accordance with ANSI Z60.1.
   4. Provide nursery grown plant material conforming to the requirements and recommendations of ANSI Z60.1. Dig and prepare plants for shipment in a manner that will not cause damage to branches, shape, and future development after planting.
   5. Balled and burlapped (B&B) plant ball sizes and ratios will conform to ANSI Z60.1, consisting of firm, natural balls of soil wrapped firmly with burlap or strong cloth and tied.

6. Bare root (BR) plants shall have the root system substantially intact, but with the earth carefully removed. Cover roots with a thick coating of mud by "puddling" after the plants are dug.
7. Container grown plants shall have sufficient root growth to hold the earth intact when removed from containers, but shall not be root bound.
8. Make substitutions only when a plant (or alternates as specified) is not obtainable and the Contracting Officer's Representative authorizes a change order providing for use of the nearest equivalent obtainable size or variety of plant with the same essential characteristics and an equitable adjustment of the contract price.
9. Existing plants to be relocated, ball sizes shall conform to requirements for collected plants in ANSI Z60.1, and plants shall be dug, handled, and replanted in accordance with applicable sections of these specifications.
10. 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.
11. Plants shall be grown at a latitude not more than 200 miles north or south of the project latitude unless the provenance of the plant can be documented to be compatible with the latitude and cold hardiness zone of the plant location.

B. Label at least one plant of each variety, size, and caliper with a securely attached, waterproof and weather-resistant label bearing legible the correct designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant as indicated in the Plant Schedule or Plant Legend shown on the Drawings. Labels shall be securely attached and not be removed.

2.2 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:
1. Class: T, with a minimum of 99 percent passing through No. 8 (2.36 mm) sieve and a minimum of 75 percent passing through No. 60 (0.25 mm) sieve.
2. Class: O, with a minimum of 95 percent passing through No. 8 (2.36 mm) sieve and a minimum of 55 percent passing through No. 60 (0.25 mm) sieve.
3. Provide lime in form of ground dolomitic limestone.

B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent sulfur, with a minimum of 99 percent passing through No. 6 (3.35 mm) sieve and a maximum of 10 percent passing through No. 40 (0.425 mm) sieve.

C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.

D. Aluminum Sulfate: Commercial grade, unadulterated.

E. Perlite: ASTM C549, horticultural perlite, soil amendment grade.

F. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through No. 50 (0.30 mm) sieve.

G. Coarse Sand shall be concrete sand, ASTM C33 Fine Aggregate, clean, sharp free of limestone, shale and slate particles, and toxic materials.

H. Vermiculite: ASTM C516, horticultural grade and free of any toxic materials.

I. Diatomaceous Earth: Calcined, 90 percent silica, with approximately 140 percent water absorption capacity by weight.

J. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

2.3 ORGANIC SOIL AMENDMENTS

A. Organic matter: Commercially prepared compost. Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1 inch (25 mm) sieve; soluble salt content of 5 to 10 decisiemens/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.

B. Peat: A natural product of peat moss derived from a fresh-water site, except as otherwise specified. Peat shall be shredded and granulated to pass through a 1/2 inch (13 mm) mesh screen with a pH range of 3.4 to 4.8 and conditioned in storage piles for at least 6 months after excavation.

C. Wood derivatives: Decomposed, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil, or toxic materials.
   1. In lieu of decomposed wood derivatives, mix partially decomposed wood derivatives with ammonium nitrate at a minimum rate of.15 lb/cu. ft. (2.4 kg/cu. m) of loose sawdust or ground bark, or with ammonium sulfate at a minimum rate of 0.25 lb/cu. ft. (4 kg/cu. m) of loose sawdust or ground bark.

D. 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 PLANT AND TURF FERTILIZERS

A. Soil Test: Evaluate existing soil conditions and requirements prior to fertilizer selection and application to minimize the use of all fertilizers and chemical products. Obtain approval of Contracting Officer’s Representative for allowable products, product alternatives, scheduling and application procedures. Evaluate existing weather and site conditions prior to application. Apply products during favorable weather and site conditions according to manufacturer's written instructions and warranty requirements. Fertilizers to be registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer applicable to specific areas as required for Project conditions and application. Provide commercial grade plant and turf fertilizers, free flowing, uniform in composition and conforms to applicable state and federal regulations.

B. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
   1. Composition shall be nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

C. Slow-Release Fertilizer: Granular or pellet fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
   1. Composition shall be nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

D. Plant Tablets: Tightly compressed chip type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.
   1. Size: 5-gram tablets.
   2. Nutrient Composition shall be 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.

2.5 PLANTING SOILS

A. Planting Soil: ASTM D5268 topsoil, with pH range of 5.5 to 7, a minimum of 2 percent organic material content; free of stones 1 inch (25 mm) or larger in any dimension and other extraneous materials harmful to plant growth. Mix ASTM D5268 topsoil with the following soil amendments and fertilizers as recommended by the soils analysis.

B. Existing Planting Soil: Existing, native surface topsoil formed under natural conditions retained during excavation process and stockpiled on-site. Verify suitability of native surface topsoil to produce viable planting soil. Clean soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.
   1. Supplement with planting soil when quantities are insufficient.
   2. Mix existing, native surface topsoil with the following soil amendments and fertilizers as recommended by the soils analysis.

C. Imported Planting Soil: Imported topsoil or manufactured topsoil from off-site sources can be used if sufficient topsoil is not available on site to meet the depth as specified herein. The Contractor shall furnish imported topsoil. At least 10 days prior to topsoil delivery, notify the Contracting Officer’s Representative of the source(s) from which topsoil is to be furnished. Obtain imported topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches (100 mm) deep; do not obtain from agricultural land, bogs, or marshes.

2.6 BIOSTIMULANTS

A. Biostimulants: Contain soil conditioners, VAM fungi, and endomycorrhizal and ectomycorrhizal fungi spores and soil bacteria appropriate for existing soil conditions.

2.7 LANDSCAPE MEMBRANES

A. Nonwoven Geotextile Filter Fabric: Polypropylene or polyester fabric, 3 oz./sq. yd. (101 g/sq. m) minimum, composed of fibers formed into a stable network so that fibers retain their relative position. Fabric shall be inert to biological degradation and resist naturally-encountered chemicals, alkalis, and acids.

B. Composite Fabric shall be woven, needle-punched polypropylene substrate bonded to a nonwoven polypropylene fabric, 4.8 oz./sq. yd. (162 g/sq. m).

2.8 MULCH

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.

B. Straw for lawn seed bed mulch: Stalks from oats, wheat, rye, barley, or rice that are free from noxious weeds, mold or other objectionable material. Straw shall be in an air dry condition and suitable for placing with blower equipment.

C. Wood cellulose fiber for use with hydraulic application of grass seed and fertilizer: Consist of specially prepared wood cellulose fiber, processed to contain no growth or germination inhibiting factors, and dyed an appropriate color to facilitate visual metering of the application of materials. On an air dry weight basis, the wood cellulose fiber shall contain a maximum of 12 percent moisture, plus or minus 3 percent at the time of manufacture. The pH range shall be from 3.5 to 5.0. The wood cellulose fiber shall be manufactured so that:
   1. After addition and agitation in slurry tanks with fertilizers, grass seeds, water, and other approved additives, the fibers in the material will become uniformly suspended to form an homogeneous slurry.
   2. When hydraulically sprayed on the ground, the material will form a blotter like cover impregnated uniformly with grass seed.
   3. The cover will allow the absorption of moisture and allow rainfall or applied water to percolate to the underlying soil.
   4. Size Range shall be // 3 inches (76 mm) maximum, 1/2 inch (13 mm) minimum // Insert size range //.
   5. Color shall be natural.

D. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1 inch (25 mm) sieve; soluble salt content of 2 to 5 decisiemens/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.

2.9 TACKIFIERS AND ADHESIVES

A. Nonasphalt tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.

B. Asphalt emulsion: ASTM D977, Grade SS-1; nontoxic and free of plant-growth or germination inhibitors.

2.10 EROSION CONTROL

A. Erosion control blankets: Biodegradable wood excelsior, straw, or coconut fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended biodegradable staples, 6 inches (150 mm) long.

B. Erosion control fiber mesh: Biodegradable burlap or spun-coir mesh, a minimum of 0.92 lb/sq. yd. (0.5 kg/sq. m), with 50 to 65 percent open area. Include manufacturer's recommended biodegradable staples, 6 inches (150 mm) long.

C. Erosion control mats: Cellular, non-biodegradable slope stabilization mats designed to isolate and contain small areas of soil over steeply sloped surface, of 3 inch (75 mm) nominal mat thickness. Include manufacturer's recommended biodegradable anchorage system for slope conditions.

2.11 EDGING

A. Steel edging: Standard commercial steel edging, rolled edge, fabricated in sections of standard lengths, with loops stamped from or welded to face of sections to receive stakes.
   1. Edging Size: 3/16 inch (4.8 mm) wide by 4 inches (100 mm) deep.
   2. Stakes: Tapered steel, a minimum of 12 inches (300 mm) long.
   3. Accessories: Standard tapered ends, corners, and splicers.
   4. Finish: Standard paint.
   5. Paint color: Brown.

2.12 WATER

A. Water shall not contain elements toxic to plant life. Water to be obtained from quick coupling valves installed with the irrigation system.

2.13 ANTIDESICCANT

A. Antidesiccant: An emulsion specifically manufactured for agricultural use that will provide a protective film over plant surfaces permeable enough to permit transpiration.

2.14 TURF SELECTIONS

A. Grasses for Warm Regions shall be:
   1. Bermudagrass (Cynodon dactylon)
   2. Carpetgrass (Axonopus affinis)
   3. Centipedegrass (Eremochloa ophiuroides)
   4. St. Augustinegrass (Stenotaphrum secundatum)
   5. Zoysia: Manilagrass (Zoysia matrella)

2.15 SEED

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with "AOSA, Rules for Testing Seed" for purity and germination tolerances. Seed shall be labeled in conformance with U. S. Department of Agriculture rules and regulations under the Federal Seed Act and applicable state seed laws. Wet, moldy, or otherwise damaged seed will not be acceptable.

B. Seed Species: Not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5 percent weed seed.

C. Full Sun: Tifway (T419)Bermudagrass

2.16 SOD

A. Sod: Certified Number 1 Quality/Premium, including limitations on thatch, weeds, diseases, nematodes, and insects, complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding". Furnish viable sod of uniform density, color, and texture, strongly rooted, and capable of vigorous growth and development when planted.

B. Sod Species: The grass sod shall be Tifway (419) Bermuda grass and shall come from a field that is very sandy with a maximum of 10% silt and clay combined. Sod from a field of heavy soil will not be accepted. The sod shall be free from foreign grasses, other Bermuda strains, weeds and noxious nematodes. The sod shall be mowed to a uniform height of ¾ inch for a minimum of two weeks prior to harvest. The sod shall be cut with a soil layer of approximately 1/4 inch. The sod shall be harvested, delivered and transplanted within a period of 48 hours.

2.17 PESTICIDES

A. Consider IPM (Integrated Pest Management) practices to minimize the use of all pesticides and chemical products. Obtain approval of Chief Engineer for allowable products, product alternatives, scheduling and application procedures. Evaluate existing weather and site conditions prior to application. Apply products during favorable weather and site conditions according to manufacturer's written instructions and warranty requirements. Pesticides to be registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended 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.

B. Pre-Emergent Herbicide (Selective and Non-Selective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive plants for compliance with requirements and conditions affecting installation and performance.
   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. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
   3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
   4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.
   5. Special conditions may exist that warrant a variance in the specified planting dates or conditions. Submit a written request to the Contracting Officer's Representative stating the special conditions and proposal variance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Contracting Officer's Representative and replace with new planting soil.

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 approval by the Contracting Officer's Representative of layout before excavating or planting. The Contracting Officer's Representative may approve adjustments to plant material locations to meet field conditions.

D. 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.

E. 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.

3.3 PLANTING AREA ESTABLISHMENT

A. Loosen subgrade of planting areas to a minimum depth of 6 inches (150 mm). Remove stones larger than 1 inch (25 mm) in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
   1. Apply fertilizer directly to subgrade before loosening.
   2. Spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil.

B. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.

C. Mix lime with dry soil before mixing fertilizer.
   1. Spread planting soil to a depth of 6 inches (150 mm) but not less than required to meet finish grades after natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.

D. Spread approximately one-half the thickness of planting soil over loosened subgrade. Mix thoroughly into top 4 inches (100 mm) of subgrade. Spread remainder of planting soil.

E. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

F. Before planting, obtain Contracting Officer’s Representative acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 EXCAVATION FOR TREES AND SHRUBS

A. Planting Pits and Trenches: Excavate circular planting pits with sides sloping inward at a 45 degree angle. Excavations with vertical sides are not acceptable. 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.
   1. Excavate approximately 3 times as wide as ball diameter for stock.
   2. Excavate at least 12 inches (300 mm) wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
   3. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
   4. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
   5. Maintain required angles of repose of adjacent materials as shown on the Drawings. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
   6. Maintain supervision of excavations during working hours.
   7. Keep excavations covered or otherwise protected when unattended by Installer's personnel.
   8. Use topsoil to form earth saucers or water basins for watering around plants. Basins to be 2 inches (50 mm) high for shrubs and 4 inches (100 mm) high for trees.

B. Subsoil and topsoil removed from excavations may be used as planting soil.

C. Notify Contracting Officer's Representative if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.

D. Notify Contracting Officer's Representative if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.

E. Fill excavations with water and allow water to percolate away before positioning trees and shrubs.

3.5 TREE, SHRUB, AND VINE PLANTING

A. Prior to planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.

B. Girdling roots, kinked roots or injured roots will not be accepted. Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.

C. Set balled and burlapped stock plumb and in center of planting pit or trench with root flare 1 inch (25 mm) above adjacent finish grades.
   1. Use planting 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 full, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
   4. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside soil-covered roots about 1 inch (25 mm) from root tips; do not place tablets in bottom of the hole or touching the roots.
   5. Continue backfilling process. Water again after placing and tamping final layer of soil.

D. Set stock plumb and in center of planting pit or trench with root flare 1 inch (25 mm) above adjacent finish grades.
   1. Use planting soil for backfill.
   2. Carefully remove root ball without damaging root ball or plant. 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 full, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
   4. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside soil-covered roots about 1 inch (25 mm) from root tips; do not place tablets in bottom of the hole or touching the roots.
   5. Continue backfilling process. Water again after placing and tamping final layer of soil.

E. Set and support bare-root stock in center of planting pit or trench with root flare 1 inch (25 mm) above adjacent finish grade.
   1. Use planting soil for backfill.
   2. Spread roots without tangling or turning toward surface, and carefully work backfill around roots by hand. Puddle with water until backfill layers are completely saturated. Plumb before backfilling, and maintain plumb while working backfill around roots and placing layers above roots.
   3. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside soil-covered roots about 1 inch (25 mm) from root tips; do not place tablets in bottom of the hole or touching the roots.
   4. Continue backfilling process. Water again after placing and tamping final layer of soil.

F. 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 the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

3.6 MECHANIZED TREE SPADE PLANTING

A. Trees may be planted with an approved mechanized tree spade at the designated locations. Do not use tree spade to move trees larger than the maximum size allowed for a similar field-grown, balled-and-burlapped root-ball diameter according to ANSI Z60.1, or larger than the manufacturer's maximum size recommendation for the tree spade being used, whichever is smaller.

B. When extracting the tree, center the trunk within the tree spade and move tree with a solid ball of earth.

C. Cut exposed roots cleanly during transplanting operations.

D. Use the same tree spade to excavate the planting hole as was used to extract and transport the tree.

E. Where possible, orient the tree in the 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 according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Contracting Officer’s Representative, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.

C. Do not apply pruning paint to wounds.

3.8 ROOT-BARRIER INSTALLATION

A. Install root barrier where trees are planted within 60 inches (1500 mm) of paving or other hardscape elements, such as walls, curbs, and walkways unless otherwise shown on Drawings.

B. Align root barrier with bottom edge angled at 20 degrees away from the paving or other hardscape element and run it linearly along and adjacent to the paving or other hardscape elements to be protected from invasive roots.

C. Install root barrier continuously for a distance of 60 inches (1500 mm) in each direction from the tree trunk, for a total distance of 10 feet (3 m) per tree. If trees are spaced closer, use a single continuous piece of root barrier.
   1. Position top of root barrier flush per manufacturer's recommendations.
   2. Overlap root barrier a minimum of 12 inches (300 mm) 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.

3.9 GROUND COVER AND PLANT INSTALLATION

A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated in even rows with triangular spacing.

B. Use planting soil 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 will minimally disturb the root system but to a depth not less than two nodes.

E. Work soil around roots to eliminate air pockets and leave a 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.

H. Plant ground cover in areas to receive erosion control materials through the material after erosion control materials are in place.

3.10 MULCH INSTALLATION

A. Install weed-control barriers before mulching according to manufacturer's written instructions. Completely cover area to be mulched, overlapping edges a minimum of 12 inches (300 mm) and secure seams with galvanized pins.

B. Mulch backfilled surfaces of planting areas and other areas indicated. Keep mulch out of plant crowns and off buildings, pavements, utility standards/pedestals, and other structures.

3.11 EDGING INSTALLATION

A. Install steel edging where indicated according to manufacturer's written instructions. Anchor with steel stakes spaced approximately 30 inches (760 mm) apart, driven below top elevation of edging.

B. Unless bordered by concrete curb or sidewalk, provide metallic edging around all shrub beds.

3.12 PLANT MAINTENANCE

A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring plant saucers, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease.

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 IPM (Integrated Pest Management) practices whenever possible to minimize the use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

3.13 TURF AREA PREPARATION AND GRADING

A. For newly graded subgrades loosen subgrade to a minimum depth of 6 inches (150 mm). Remove stones larger than 1 inch (25 mm) in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
   1. Apply soil amendments directly to subgrade before loosening, at rates recommended by the soils analysis.
   2. Spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil.
   3. Spread planting soil to a depth of 6 inches (150 mm) but not less than required to meet finish grades after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.

B. Spread approximately 1/2 the thickness of planting soil over loosened subgrade. Mix thoroughly into top 4 inches (100 mm) of subgrade. Spread remainder of planting soil.

C. Reduce elevation of planting soil to allow for soil thickness of sod.

D. Finish grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch (13 mm) of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future.

3.14 PREPARATION FOR EROSION-CONTROL MATERIALS.

A. Prepare area as specified in "Turf Area Preparation and Grading" Article.

B. For erosion control mats, install planting soil in two lifts, with second lift equal to thickness of erosion control mats. Install erosion control mat and fasten with biodegradable materials as recommended by material manufacturer.

C. Fill cells of erosion control mat with planting soil and compact before planting.

D. For erosion control blanket or mesh, install from top of slope, working downward, and as recommended by material manufacturer for site conditions. Fasten with biodegradable materials as recommended by material manufacturer.

E. Moisten prepared area before planting if surface is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

3.15 SEEDING

A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph (8 km/h). Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
   1. Do not use wet seed or seed that is moldy or otherwise damaged.
   2. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.

B. Sow seed at a total rate of 5 to 8 lb/1000 sq. ft.

C. Rake seed lightly into top 1/8 inch (3 mm) of soil, roll lightly, and water with fine spray.

D. Protect seeded areas with slopes exceeding 1:4 with erosion-control blankets 1:6 with erosion-control fiber mesh installed and fastened with biodegradable materials according to manufacturer's written instructions.

E. Protect seeded areas with erosion control mats where shown on Drawings; install and anchor with biodegradable materials according to manufacturer's written instructions.

F. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre (42 kg/92.9 sq. m) to form a continuous blanket over seeded areas. Spread by hand, blower, or other suitable equipment.
   1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.
   2. Bond straw mulch by spraying with asphalt emulsion at a rate of 10 to 13 gal./1000 sq. ft. (38 to 49 L/92.9 sq. m). Take precautions to prevent damage or staining of structures or other plantings adjacent to mulched areas. Immediately clean damaged or stained areas.

G. Protect seeded areas from hot, dry weather or drying winds by applying compost mulch within 24 hours after completing seeding operations. Soak areas, scatter mulch uniformly to a thickness of 3/16 inch (4.8 mm), and roll surface smooth.

3.16 HYDROSEEDING

A. For hydroseeding, mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.
   1. Mix slurry with fiber-mulch manufacturer's recommended tackifier.
   2. Apply slurry uniformly to all areas to be seeded in a one-step process. Apply slurry at a rate so that mulch component is deposited at not less than 1500-lb/acre (15.6-kg/92.9 sq. m) dry weight, and seed component is deposited at not less than the specified seed-sowing rate.
   3. Apply slurry uniformly to all areas to be seeded in a two-step process. Apply first slurry coat at a rate so that mulch component is deposited at not less than 500-lb/acre (5.2-kg/92.9 sq. m) dry weight, and seed component is deposited at not less than the specified seed-sowing rate. Apply slurry cover coat of fiber mulch (hydromulching) at a rate of 1000 lb/acre (10.4 kg/92.9 sq. m).

3.17 SODDING

A. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.

B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to subgrade or sod during installation. Tamp and roll lightly to ensure contact with subgrade, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.
   1. Lay sod across angle of slopes exceeding 1:3.
   2. Anchor sod on slopes exceeding 1:6 with biodegradable staples spaced as recommended by sod manufacturer but not less than 2 anchors per sod strip to prevent slippage.

C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently until sod is established.

3.18 TURF MAINTENANCE

A. Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
   1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
   2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
   3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use IPM (Integrated Pest Management) practices whenever possible to minimize the use of pesticides and reduce hazards.

B. Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches (100 mm).
   1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
   2. Water turf with fine spray at a minimum rate of 1 inch (25 mm) per week unless rainfall precipitation is adequate.

C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 1/3 of grass height. Remove no more than 1/3 of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:
   1. Mow to a height of 1-1/2 to 2 inches (38 to 50 mm).

3.19 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by Contracting Officer's Representative:
   1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. (0.92 sq. m) and bare spots not exceeding 5 by 5 inches (125 by 125 mm) .
   2. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.
   3. Satisfactory Plugged Turf: At end of maintenance period, the required number of plugs has been established as well-rooted, viable patches of grass, and areas between plugs are free of weeds and other undesirable vegetation.
   4. Satisfactory Sprigged Turf: At end of maintenance period, the required number of sprigs has been established as well-rooted, viable plants, and areas between sprigs are free of weeds and other undesirable vegetation.

B. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory.

3.20 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Contracting Officer's Representative before each application is performed.

B. Pre-Emergent Herbicides (Selective and Non-Selective): Applied to tree, shrub, and ground-cover areas in accordance with manufacturer's written recommendations. Do not apply to seeded areas.

C. Post-Emergent Herbicides (Selective and Non-Selective): Applied only as necessary to treat already-germinated weeds and in accordance with manufacturer's written recommendations.

3.21 CLEANUP AND PROTECTION

A. During planting, keep adjacent paving and construction clean and work area in an orderly condition.

B. 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.

C. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

D. Erect temporary fencing or barricades and warning signs, as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

E. After installation and before Project Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

F. Remove nondegradable erosion control measures after grass establishment period.

G. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

END OF SECTION 024119

SECTION 331000 - WATER UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. Underground water distribution system complete, ready for operation, including all appurtenant structures, and connections to both new building service lines and to existing water supply.

1.2 RELATED WORK:

A. Maintenance of Existing Utilities: Division 01.

B. Excavation, trench widths, pipe bedding, backfill, shoring, sheeting, bracing: Section 312000, EARTH MOVING.

C. Concrete: Section 033000, CAST-IN-PLACE CONCRETE.

D. Protection of materials and equipment: Division 22

E. Fire protection system connection and supervisory switch for post indicator valve: Division 21.

F. Fire protection system connection: Division 21

1.3 DEFINITIONS:

A. Water Distribution: Pipelines and appurtenances which are part of the distribution system. The distribution system comprises the network of piping located throughout building areas and other areas of water use, including hydrants, valves, and other appurtenances used to supply water for domestic and fire-fighting/fire protection purposes.

B. Water Service Line: Pipe line connecting building piping to water distribution lines.

1.4 QUALITY ASSURANCE:

A. Products Criteria:

1. Multiple Units: When two or more units of the same type or class of materials or equipment are required, these units shall be product of one manufacturer.

2. Nameplate: Nameplate bearing manufacturer's name or identifiable trademark securely affixed in a conspicuous place on equipment or name or trademark cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.

B. Comply with the rules and regulations of the Public Utility having jurisdiction over the connection to Public Water lines and the extension, and/or modifications to Public Utility systems.

C. Comply with all rules and regulations of Federal, State, and Local having jurisdiction over the design, construction, and operation of potable water systems. All work shall be in accordance NCDENR Public Water Supply's rules and regulations and with Greenville Utilities Commission's Manual for the Design and Construction of Water and Wastewater Extensions.

D. All material surfaces in contact with potable water shall comply with NSF 61.

1.5 SUBMITTALS:

A. Submit in accordance with Section 013323, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturers' Literature and Data (Submit all items as one package):

1. Piping.
    a. (Ductile Iron Pipe and Polyvinyl Chloride (PVC) shall be in accordance with AWWA C600 and C605 respectively; and shall be provided to Resident Engineer for approval.)
2. Gaskets.
3. Valves.
4. Fire hydrants.
5. Street washer.
6. Meter.
7. Vaults, frames and covers.
8. Steps.
9. Post indicator.
10. Valve boxes.
11. Corporation and curb stops.
12. Curb stop boxes.
13. Joint restraint.
14. Disinfection products.
15. 15. Link/sleeve seals.

C. Testing Certifications:

1. Certification of Backflow Devices.
2. Hydrostatic Testing.
3. Certification of Disinfection, including free chlorine residuals, and bacteriological examinations.

1.6 APPLICABLE PUBLICATIONS:

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American National Standards Institute (ANSI/ASME):

B16.1-98	Cast Iron Pipe Flanges and Flanged Fittings
B16.18	Cast Bronze Solder Joint Pressure Fittings
B16.26-88	Cast Copper Alloy Fittings for Flared Copper Tubes
B40.100-98	Pressure Gauges and Gauge Attachments

C. American Society for Testing and Materials (ASTM):

A123-97	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
A148M-03	Standard Specifications for Steel Castings
A242-00	Standard Specifications for High Strength Low Alloy Structural Steel AASHTO No. M161
A307-02	Standard Specifications for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
A536-04	Standard Specifications for Ductile Iron Castings
B61-02	Steam or Valve Bronze Castings
B62-02	Composition Bronze or Ounce Metal Castings
B88-02	Seamless Copper Water Tube
B828	Standard Practice: Soldering and Brazing Copper Tube and fittings
C32-04	Sewer and Manhole Brick (Made from Clay or Shale)
C139-03	Concrete Masonry Units for Construction of Catch Basins and Manholes
D1784-03	Standard Specifications for Rigid PVC Compounds and CPVC Compounds
D1869-00	Standard Specifications for Rubber Rings for Asbestos Cement Pipe
D2464-99	Standard Specifications for Threaded PVC Pipe Fittings, Schedule 80
D2467-02	Standard Specifications for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
D3139-98	Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
F477-02e1	Elastomeric Seals (Gaskets) for Joining Plastic Pipe
C32-04	Standard Specifications for Sewer Manhole Brick

D. American Water Works Association (AWWA):

B300-04	Hypochlorites
B301-04	Liquid Chlorine
C104-04	Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water
C105-99	Polyethylene Encasement for Gray and Ductile C.I. Piping for Water and Other Liquids
C110-03	Ductile-Iron and Gray-Iron Fittings, 80 mm (3 Inches) Through 1200 mm (48 Inches) for Water and Other Liquids
C111-01	Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings
C115-99	Flanged Ductile-Iron and Gray-Iron Pipe with Threaded Flanges

C150-02 ..... American National Standard for Thickness Design of Ductile Iron Pipe
C151-96 ..... Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids
C153-00 ..... Ductile-Iron Compact Fittings, 80 mm (3 inches) Through 300 mm (12 Inches) for Water and Other Liquids
C500-02 ..... Gate Valves for Water and Sewerage Systems
C502a-95 ..... Dry-Barrel Fire Hydrants
C503-97 ..... Wet-Barrel Fire Hydrants
C508-01 ..... Swing Check Valves for Waterworks Service, 2 Inches (50 mm) Through 24 Inches (600mm) NPS
C509-01 ..... Resilient Seated Gate Valve for Water and Sewage System
C510-97 ..... Double Check Valve Back-Flow Prevention Assembly
C511-97 ..... Reduced Pressure Principle Back-Flow Prevention Assembly
C550-01 ..... Protective Epoxy Interior Coatings for Valves and Hydrants
C600-01 ..... Installation for Ductile-Iron Water Mains and Their Appurtenances
C605-94 ..... Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water
C651-92 ..... Disinfecting Water Mains
C800-01 ..... Underground Service Line Valves and Fittings
C900-97 ..... Polyvinyl Chloride (PVC) Pressure Pipe, 4 Inches Thru 12 Inches, for Water
C905-97 ..... Polyvinyl Chloride (PVC) Pressure Pipe 14 Inches Thru 36 Inches

E. National Fire Protection Association (NFPA):

24-95 ..... Installation of Private Fire Service Mains and Their Appurtenances
291-01 ..... Fire Flow Testing and Marking of Hydrants
1141-98 ..... Fire Protection in Planned Building Groups

F. NSF International:

14-03 ..... Plastics Piping Components and Related Materials
61-02 ..... Drinking Water System Components-Health Effects (Sections 1-9)

G. American Welding Society (AWS):

A5.8-04 ..... Brazing Filler Metal

H. Foundation for Cross-Connection Control and Hydraulic Research-2005

I. Copper Development Association’s Copper Tube Handbook-2005

PART 2 - PRODUCTS

2.1 DUCTILE IRON PIPE AND FITTINGS:

A. Ductile iron pipe, direct buried:

1. Provide ductile iron pipe conforming to the requirements of AWWA C151. The minimum thickness Class of pipe shall be Class 50. ~~With~~ standard thickness cement mortar lining interior, and interior asphaltic seal coat and exterior asphaltic coating, in accordance with AWWA and ANSI Standards.

2. Below Grade: Supply pipe in lengths not in excess of a nominal 6 m (20 feet) with rubber ring type push-on joints, mechanical joint or approved restrained joint. Provide flange joint pipe where shown on the drawings. Provide mechanical and restrained joint pipe with sufficient quantities of accessories as required for each joint.

3. ~~When a~~ Polyethylene encasement over pipe, fittings, and valves is a requirement, the material, installation and workmanship shall conform to applicable sections of AWWA C105. Make provisions to keep the polyethylene from direct exposure to sunlight prior to installation. Backfill following installation without delay to avoid exposure to sunlight.

B. Ductile Iron Pipe Above Grade or in Below Ground Concrete Pits:

1. Flanged ductile iron pipe, AWWA C115, with factory applied screwed long hub flanges except as otherwise specified hereinafter. Face and drill flanges after being screwed on the pipe, with flanges true to 90 degrees with the pipe axis and flush with end of pipe, ANSI B16.1, 850 kPa (125 psi) or 1725 kPa (250 psi) standard, for the purpose intended.

2. Wall Sleeve Castings: Size and types shown on the drawings and be hot dipped galvanized. Seal strips, where required shall be Link Seal as manufactured by Thunderline Corp., Wayne, Michigan or equal.

3. Pipe Thickness Class: Minimum of Class 53 as defined in AWWA C150 for all sizes of flanged pipe.

4. Rubber Ring Gaskets: Full face type, AWWA C111, 2 mm (1/16 inch) rubber ring gaskets and of approved composition suitable for the required service.

5. Pipe and fittings exposed to view in the finished work are to be painted in accordance with Section 099100, PAINTING. Pipe shall not receive the standard tar or asphalt coat on the outside surfaces but shall be shop primed on the outside with one coat of Kop-Coat No. 621 Rust Inhibitive Primer or equal. Paint color shall match the wall color.

6. Bolts and Nuts on Flanged Fittings: Grade B, ASTM A307. Low alloy, high strength steel in accordance with AWWA C111. Assemble stainless steel bolts and nuts using anti-seize compound to prevent galling.

C. All Pipe Fittings: Ductile iron with a minimum pressure rating of 2400 kPa (350 psi). Fittings shall meet the requirements of ANSI and AWWA specifications as applicable. Rubber gasket joints shall conform to AWWA C111 for mechanical and push-on type joints. Ball joints shall conform to AWWA C151 with a separately cast ductile iron bell conforming to ASTM A148. Flanged fittings shall conform to AWWA C115 and be furnished flat faced and drilled to 850 kPa (125 psi) or 1725 kPa (250 psi) template in accordance with ANSI B16.1 with full faced

gaskets.

D. Provide cement mortar lining and bituminous seal coat on the inside of the pipe and fittings in accordance with AWWA C104. Provide standard asphaltic coating on the exterior.

E. Provide a factory hydrostatic test of not less than 3.5 MPa (500 psi) for all pipe in accordance with AWWA C151.

F. Provide ~~non-~~detectable adhesive backed identification tape on top and sides of all buried ductile iron pipe, extended from joint to joint along the length of the pipe and have black lettering identifying the pipe service at no more than 300 mm (12 inch) intervals. According to service, the tape background color shall be as follows: potable water-blue.

2.2 POLYVINYL CHLORIDE PIPE AND FITTINGS:

A. Class-Rated Polyvinyl Chloride (PVC) Pipe:

1. PVC pipe and accessories 100 mm to 356 mm (4 inches–14 inches) in diameter, AWWA C900 “Polyvinyl Chloride (PVC) Pressure Pipe”, Class 200, DR 14, cast iron outside diameters, unless otherwise shown or specified.

2. PVC Pipe and Accessories Smaller than 100 mm (4 inches): Schedule 80, meeting the requirements of ASTM D-1785, Type 1, Grade 1. All exposed piping shall be CPVC meeting requirements of ASTM F441.

B. Joints:

1. Pipe 75 mm (3 inches) and Greater in Diameter: Push-on type with factory installed solid cross section elastomeric ring meeting the requirements of ASTM F-477.

2. Pipe Less Than 75 mm (3 inches) in Diameter: Threaded (ASTM D-2464) or solvent welded (ASTM 2467). Use Teflon tape or liquid Teflon thread lubricant approved for use on plastic on all threaded joints.

C. Fittings:

1. Class-Rated Pipe 75 mm (3 inches) in Diameter and Greater: Ductile iron with mechanical joints conforming to the requirements of AWWA C153.

2. For Schedule 80 Pipe less than 75 mm (3 inches) in Diameter: Threaded or solvent weld. Threaded PVC fittings shall conform to ASTM D2464. CPVC fittings shall conform to ASTM F437 for threaded fittings and ASTM F439 for solvent weld fittings.

2.3 COPPER PIPE AND TUBING:

A. Copper Piping: ASTM B88, Type K, ~~or Type L~~ with flared fittings in accordance with AWWA C800, with sweat cast brass fittings per ANSI B16.18. Use brazing alloy, AWS A5.8, Classification BCuP.

2.4 VALVES:

A. Asbestos packing is not allowed.

B. Gate:

1. Gate Valves (4" and Larger): Gate valves shall conform to the requirements of the latest revision of AWWA Specification C 509/C-515 for resilient seated gate valves. The valve body shall be ASTM A 126 Class B cast iron or ductile iron and shall conform to ASTM A395 or ASTM A536. In addition, ductile iron shall contain no more than 0.08 percent phosphorous. All interior valve parts and surfaces shall be of corrosion resistant materials or have an epoxy coating sufficient to prevent corrosion. Such coating shall be recognized by the AWWA for potable water use. Exterior valve parts and surfaces shall be epoxy coated or have the Standard AWWA coating. The valves shall open counterclockwise and have non rising stem operation with 2 inch square operating nuts. The maximum number of turns required to fully open or close the valve shall equal three times the pipe diameter plus two. The stem shall be of corrosion resistant material and have "O" ring seals. Valves shall provide zero leakage at a working pressure of 200 psi in either direction of line flow. Valves shall have flange connections conforming to ANSI B16.1 Class 125 or mechanical joints conforming to AWWA C 111.

2. Valves shall be manufactured by Clow, American Flow Control, or Mueller.

C. ~~S~~tops and saddles shall conform to AWWA C800.

D. Curb Stop: Smaller than 75 mm (3 inches). One-inch (1") corporation stops shall be bronze body with (AWWA) CC tapered threaded inlet and compression connection outlet. Stops shall be Ford FB1000-4, A Y McDonald 4701B-22, Mueller P-25008, or approved equal.

E. Angle Ball Valve Meter Stop: One inch angle ball valve meter stops shall be bronze body with compression seal inlet connection and threaded outlet for meter connection. Stops shall be Ford BA43-444W, A Y McDonald 4602B-22, Mueller P-24258, or approved equal.

2.5 VALVE BOX:

A. Cast iron extension box with slide-type adjustment and flared base. Minimum thickness of metal shall be 5 mm (3/16 inch). Box shall be adapted, without full extension, to depth of cover required over pipe at valve location. Cast the word "WATER" in cover. Provide 1 "T" handle socket wrenches of 16 mm (5/8 inch) round stock long enough to extend 600 mm (2 feet) above top of deepest valve box. Valve boxes and extensions shall be either of the following: Charlotte Pipe and Foundry: UTL 274 (valve boxes) and UTL 28l (extensions) or Tyler Pipe: 6855 Series (valve box and extensions). Lid shall be 5 1/4” Drop Lid having a minimum of 1 1/2” deep skirt. Valve boxes shall be installed in accordance with the GUC Standard Details.

2.6 POST INDICATOR VALVE:

A. Valve: Valve shall conform to the specifications listed in Section 2.4 for gate valves. The Post Indicator shall conform to NFPA 24, and shall be fully compatible with the valve and all the supervisory switches.

2.7 FIRE HYDRANTS:

A. Size of main valve opening of each hydrant shall be 5 ¼ inches in diameter. Hose thread, size of fire apparatus connection, and shape, size and direction of rotation of operating head of hydrant shall be identical with present local fire department and/or water department standards (Section 7.4.11 of GUC Manual).

B. Hydrant shall be type AWWA C502, heavy construction, of proper length to connect pipe without extra fittings, and shall be the traffic type with safety flange on barrel and safety couplings on the valve stem with the following features:

1. Interior removable without digging up hydrant; can be packed under pressure; 150 mm (6 inch) bell connection; one steamer nozzle and two hose nozzles with nozzle caps securely chained to barrel; suitable drainage device; single rubber or leather-faced valve in base; nozzles, stuffing boxes, wedge nuts, seat rings, clamp plates, etc. Threaded joints or spindles shall be bronze. Upper and lower barrels shall be of equal diameters. Upper barrel shall be of sufficient length to permit setting hydrant with barrel flange not more than 50 mm (2 inches) above finished grade. All fire hydrants shall have 150 mm (6 inch) bottom connection. Steamer nozzle shall be equipped with a factory fitted Storz connection and cap.
2. Provide fire hydrants with finish paint identical to the existing fire hydrants.
3. Hydrants shall be American Flow Control B-84-B-5, Clow Medallion or Mueller A-423.

C. Provide 2 wrenches with handles not less than 350 mm (14 inches) long.

2.8 PIPE SLEEVES:

A. Ductile iron.

2.9 BACKFLOW PREVENTER:

A. Potable Water and Irrigation Water Service: Reduced Pressure Principle Type AWWA C511, except pressure drop at rated flow shall not exceed 100 kPa (15 psi). Gate valves installed on the assembly shall be resilient seated valve conforming to AWWA C509.

B. Fire Service: Reduced Pressure Principle Detector Assembly ASSE Listed 1047, and supplied with full port OS & Y gate valves. The main body and access covers shall be epoxy coated ductile iron (ASTM A 536 Grade 4), the seat ring and check valve shall be NORYL™, the stem shall be stainless steel (ASTM A 276) and the seat disc elastomers shall be EPDM. The first and second checks shall be accessible for maintenance without removing the relief valve or the entire device from the line.

C. In cold climate areas, backflow assemblies and devices shall be protected from freezing by a method acceptable to local jurisdiction.

D. Backflow preventers shall be approved by the Foundation for Cross-Connection Control and Hydraulic Research per current edition of the Manual of Cross-Connection Control.

E. Backflow preventer shall not be located in any area containing fumes that are toxic, poisonous or corrosive.

F. Direct connections between potable water piping and sewer connected wastes shall not exist under any condition with or without backflow protection.

G. Backflow preventer shall be accessed and have clearance for the required testing, maintenance and repair. Access and clearance shall require a minimum of one (1) foot (305 mm) between the lowest portion of the assembly and grade, floor or platform. Installations elevated more than five (5) feet (1524 mm) above the floor or grade shall be provided with a permanent platform capable of supporting a tester or maintenance person.

2.10 WATER METER:

A. Furnished by Water Service Utility and installed by Contractor.

2.11 VAULTS METER:

A. Meter vault shall be precast concrete as shown on plans and details.

B. Access hatch shall be double leaf aluminum access hatch as shown on plans and details.

2.12 FLEXIBLE EXPANSION JOINTS: (Provide for Domestic and Fire Service)

A. Ductile iron with ball joints rated for 1725 kPa (250 PSI) working pressure conforming to ANSI/AWWA A21.53/C153, capable of deflecting a minimum of 30 degrees and expanding simultaneously to the amount shown on the drawings. Flexible expansion joint shall have the expansion capability designed as an integral part of the ductile iron ball castings. Pressure containing parts shall be lined with a minimum of 375 μm (15 mils) of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C213 and shall be factory holiday tested with a 1500 volt spark test. Flexible expansion joint shall have flanged connections conforming to ANSI/AWWA A21.11/C110. Bolts and nuts high strength steel with synthetic gaskets that comply with AWWA C110.

2.13 POTABLE WATER:

A. Water used for filling, flushing, and disinfection of water mains and appurtenances shall conform to Safe Drinking Water Act.

2.14 DISINFECTION CHLORINE:

A. Liquid chlorine shall conform to AWWA B301 and AWWA C651.

B. Sodium hypochlorite shall conform to AWWA B300 with 5 percent to 15 percent available chlorine.

C. Calcium hypochlorite shall conform to AWWA B300 supplied in granular form or 5.g tablets, and shall contain 65 percent chlorine by weight.

2.15 WARNING TAPE

A. Standard, 4-Mil polyethylene 76 mm (3 inch) wide tape, detectable type, blue with black letters, and imprinted with “CAUTION BURIED WATER LINE BELOW”. Warning tape shall comply with Section 7.2.5 of the GUC Manual.

2.16 VALVE TAMPER SWITCH

A. Valve Supervisory Switch: UL 753, electrical, single-pole, double-throw switch with normally closed contacts. Include design that signals controlled valve is in other than fully open position.

2.17 HEATED ENCLOSURE

A. The enclosure manufacturer shall be a company specializing in the manufacture of such enclosures with at least five (5) years of successful field experience and being lab certified as meeting A.S.S.E 1060 requirements. The enclosure shall be manufactured of Mill finish aluminum, ASTM B209. Insulation shall be polyisocyanurate foam: spray applied, frothed in place or board stock laminated between two (2) layers of fiberglass mat.

B. Heating Equipment shall be furnished and designed by the manufacturer of the enclosure to maintain and interior temperature of +40 degrees F with an exterior outside temperature of -30 degrees F and a wind velocity of 15 MPH. The factory assembled heating equipment shall be UL, ETL, or CSA certified. Electric power source for heat and accessories shall be G.F.I. protected, with 18" clearance from receptacle base to grade.

C. Mounting Hardware shall be furnished and shall be stainless steel. All assembly fasteners shall be stainless steel or aluminum. Anchor hardware shall be adjustable up to 1.5" vertically to accommodate uneven concrete slabs.

PART 3 - EXECUTION

3.1 BUILDING SERVICE LINES:

A. Install water service lines to point of connection within approximately 1500 mm (5 feet) outside of buildings to which such service is to be connected and make connections thereto. If building services have not been installed provide temporary caps.

3.2 REGRADING:

A. Raise or lower existing valve and curb stop boxes and fire hydrants to finish grade in areas being graded.

3.3 PIPE LAYING, GENERAL:

A. Care shall be taken in loading, transporting, and unloading to prevent injury to the pipe or coatings. Pipe or fittings shall not be dropped. All pipe or fittings shall be examined before laying, and no piece shall be installed which is found to be defective. Any damage to the pipe coatings shall be repaired as directed by the Resident Engineer.

B. All pipe and fittings shall be subjected to a careful inspection just prior to being laid or installed. If any defective piping is discovered after it has been laid, it shall be removed and replaced with a sound pipe in a satisfactory manner at no additional expense to the Government. All pipe and fittings shall be thoroughly cleaned before laying, shall be kept clean until they are used in the work, and when installed or laid, shall conform to the lines and grades required.

C. All buried piping shall be installed to the lines and grades as shown on the drawings. All underground piping shall slope uniformly between joints where elevations are shown.

D. Contractor shall exercise extreme care when installing piping to shore up and protect from damage all existing underground water line and power lines, and all existing structures.

E. Do not lay pipe on unstable material, in wet trench, or when trench or weather conditions are unsuitable.

F. Do not lay pipe in same trench with other pipes or utilities unless shown otherwise on drawings.

G. Hold pipe securely in place while joint is being made.

H. Do not walk on pipes in trenches until covered by layers of earth well tamped in place to a depth of 300 mm (12 inches) over pipe.

I. Full length of each section of pipe shall rest solidly upon pipe bed with recesses excavated to accommodate bells or joints. Do not lay pipes on wood blocking.

J. Tees, plugs, caps, bends and hydrants on pipe installed underground shall be anchored. See section 3.7 “PIPE SUPPORTS”.

K. Close pipe openings with caps or plugs during installation. Tightly cover and protect equipment against dirt, water and chemical, or mechanical injury. At completion of all work, thoroughly clean exposed materials and equipment.

L. Good alignment shall be preserved in laying. The deflection at joints shall not exceed that recommended by the manufacturer.

M. Warning tape shall be continuously placed 300 mm (12 inches) below finished grade.

3.4 DUCTILE IRON PIPE:

A. Installing Pipe: Lay pipe in accordance with AWWA C600 with polyethylene encasement if required in accordance with AWWA C105. Provide a firm even bearing throughout the length of the pipe by tamping selected material at the sides of the pipe up to the spring line.

B. All pipe shall be sound and clean before laying. When laying is not in progress, the open ends of the pipe shall be closed by watertight plug or other approved means.

C. When cutting pipe is required, the cutting shall be done by machine, leaving a smooth cut at right angles to the axis of the pipe. Bevel cut ends of pipe to be used with push-on bell to conform to the manufactured spigot end. Cement lining shall be undamaged.

D. Jointing Ductile-Iron Pipe:

1. Push-on joints shall be made in strict accordance with the manufacturer’s instruction. Pipe shall be laid with bell ends looking ahead. A rubber gasket shall be inserted in the groove of the bell end of the pipe, and the joint surfaces cleaned and lubricated. The plain end of the pipe is to be aligned with the bell of the pipe to which it is joined, and pushed home with approved means.

2. Mechanical Joints at Valves, Fittings: Install in strict accordance with AWWA C111. To assemble the joints in the field, thoroughly clean the joint surfaces and rubber gaskets with soapy water before tightening the bolts. Bolts shall be tightened to the specified torque.

3. Ball Joints: Install in strict accordance with the manufacturer’s instructions. Where ball joint assemblies occur at the face of structures, the socket end shall be at the structure and ball end assembled to the socket.

4. Flanged joints shall be in accordance with AWWA C115. Flanged joints shall be fitted so that the contact faces bear uniformly on the gasket and then are made up with relatively uniform bolt stress.

3.5 PVC PIPE:

A. PVC piping shall be installed in strict accordance with the manufacturer's instructions and AWWA 605. Place selected material and thoroughly compacted to one foot above the top of the pipe and thereafter back filled as specified in Section 312000, EARTH MOVING.

B. Copper Tracer Wire: Copper tracer wire consisting of No. 14 AWG solid, single conductor, insulated copper wire shall be installed in the trench with all piping to permit location of the pipe with electronic detectors. The wire shall not be spiraled around the pipe nor taped to the pipe. Wire connections are to be made by stripping the insulation from the wire and soldering with rosin core solder. Solder joints shall be wrapped with rubber tape and electrical tape. At least every 300 m (1000 feet), provide a 2.3 kg (5 pound) magnesium anode attached to the main tracer wire by solder. The solder joint shall be wrapped with rubber tape and with electrical tape. An anode shall be attached at the end of each line.

C. Magnetic markers may be used in lieu of copper tracer wire to aid in future pipe locating. Generally, install markers on 6 m (20 foot) centers. If pipe is in a congested piping area, install on 3 m (10 foot) centers. Prepare as-built drawing indicating exact location of magnetic markers.

3.6 COPPER PIPE:

A. Copper piping shall be installed in accordance with the Copper Development Association's Copper Tube Handbook and manufacturer's recommendations. Copper piping shall be bedded in 150 mm (6 inches) of sand and then back filled as specified in Section 312000, EARTH MOVING.

3.7 PIPE SUPPORTS:

A. Supports:

1. All piping shall be properly and adequately supported. Hangers, supports, base elbows and tees, and concrete piers and pads shall be provided as indicated on the drawings. If the method of support is not indicated on the drawings, exposed piping shall be supported by hangers wherever the structure is suitable and adequate to carry the superimposed load. Supports shall be placed approximately 2.4 m (8 feet) on centers and at each fitting.

2. Hangers shall be heavy malleable iron of the adjustable swivel type, split ring type, or the adjustable-swivel, pipe-roll type for horizontal piping and adjustable, wrought iron, clamp type for vertical piping. Flat steel strap or chain hangers are not acceptable unless indicated on the drawings.

3. Hangers shall be attached to the structure, where possible, by beam clamps and approved concrete inserts set in the forms before concrete is poured. Where this method is impractical, anchor bolts with expanding lead shields, rawl drives, or malleable iron expansion shields will be permitted.

4. Where hangers cannot be used, the Contractor shall provide pipe saddle supports with pipe column and floor flange.

3.8 RESTRAINED JOINTS:
(Also refer to Section 7.2.6 of the GUC Manual)

A. Sections of piping requiring restrained joints shall be constructed using pipe and fittings with restrained "locked-type" joints and the joints shall be capable of holding against withdrawal for line pressures 50 percent above the normal working pressure but not less than 1375 kPa (200 psi). The pipe and fittings shall be restrained push-on joints or restrained mechanical joints.

B. The minimum number of restrained joints required for resisting force at fittings and changes in direction of pipe shall be determined from the length of retained pipe on each side of fittings and changes in direction necessary to develop adequate resisting friction with the soil. Restrained pipe length shall be as specified in Section 3.4.6.9.1 of the GUC Manual.

C. Restraining devices for use on mechanical joint ductile iron pipe shall be Uni-Flange Series 1300-C, Star Pipe Products, Allgrip Series 3600, Romac Industries, Inc. GripRing or approved equal..

D. Restraint devices for use on ductile iron and C-900 PVC "push-on" joints shall be Uni-Flange Block Buster Series 1390-C, Star Pipe Products Allgrip series 3600 and Pipe Restrainers Series 1200S, or approved equal.

E. Restraint devices for use on mechanical joint to C-900 PVC shall be Uni-Flange Series 1500, Star Pipe Products, Allgrip Series 3600, Romac Industries, Inc GripRing or approved equal. These devices shall have the stated pressure rating with a minimum safety factor of 2:1. Glands shall be listed with Underwriters Laboratories and/or approved by Factory Mutual.

F. Thrust blocks shall not be permitted.

G. Where ductile iron pipe manufactured with restrained joints is utilized, all restrained joints shall be fully extended and engaged prior to back filling the trench and pressurizing the pipe.

H. PVC pipe bell and spigot joints shall be restrained with the Uni-Flange Corp. Series 1390-C ~~1350~~ Restrainer or approved equal. The restraining device and Tee head bolts shall be manufactured of high strength ductile iron meeting ASTM A536. Clamping bolts and nuts shall be manufactured of corrosion resistant high strength, low alloy steel meeting the requirements of ASTM A242.

I. Ductile iron mechanical joint fittings used with PVC pipe shall be restrained with UNI-Flange Corp. Series 1300-C Restrainer, or approved equal. The restraining device and Tee head bolts shall be manufactured of high strength ductile iron meeting ASTM A-536. Clamping bolts and nuts shall be manufactured of corrosion resistant high strength, low alloy steel meeting the requirements of ASTM A242.

3.9 PIPE SEPARATION:

A. Horizontal Separation-Water Mains and Sewers:

1. Water mains shall be located at least 3 m (10 feet) horizontally from any proposed drain, storm sewer, sanitary or sewer service connection.

2. Water mains may be located closer than 3 m (10 feet) to a sewer line when:
    a. Local conditions prevent a lateral separation of 3 m (10 feet); and
    b. The water main invert is at least 450 mm (18 inches) above the crown of the sewer; and
    c. The water main is either in a separate trench or in the same trench on an undisturbed earth shelf located one side of the sewer.
3. When it is impossible to meet (1) or (2) above, both the water main and drain or sewer shall be constructed of mechanical joint ductile iron pipe. Ductile iron pipe shall comply with the requirements listed in this specification section. The drain or sewer shall be pressure tested to the maximum expected surcharge head before back filling.

B. Vertical Separation-Water Mains and Sewers:

1. A water main shall be separated from a sewer so that its invert is a minimum of 450 mm (18 inches) above the crown of the drain or sewer whenever water mains cross storm sewers, sanitary sewers or sewer service connections. The vertical separation shall be maintained for that portion of the wear main located within 10 feet horizontally of any sewer or drain crossed. A length of water main pipe shall be centered over the sewer to be crossed with joints equidistant from the sewer or drain.
2. Both the water main and sewer shall be constructed of slip-on or mechanical joint ductile iron pipe or PVC pipe equivalent to water main standards of construction when:
    a. It is impossible to obtain the proper vertical separations described in (1) above; or
    b. The water main passes under a sewer or drain.
3. A vertical separation of 450 mm (18 inches) between the invert of the sewer or drain and the crown of the water main shall be maintained where a water main crosses under a sewer. Support the sewer or drain lines to prevent settling and breaking the water main.
4. Construction shall extend on each side of the crossing until the perpendicular distance from the water main to the sewer or drain line is at least 3 m (10 feet).

3.10 SETTING OF VALVES AND BOXES:

A. Provide a surface concrete pad 450 by 450 by 150 mm (24 by 24 by 6 inches) to protect valve box when valve is not located below pavement.

B. Clean valve and curb stops interior before installation.

C. Set valve and curb stop box cover flush with finished grade.

D. Valves shall be installed plumb and level and in accordance with manufacturer’s recommendations.

3.11 SETTING OF FIRE HYDRANTS:

A. Set center of each hydrant not less than 5 feet nor more than 6 feet back of edge of road or face of curb. Fire apparatus connection shall face road with center of nozzle 18 inches to 24 inches above finished grade. Set barrel flange not more than 50 mm (2 inches) above finished grade.

B. Set each hydrant on a slab of stone or concrete not less than 100 mm (4 inches) thick and 375 mm (15 inches) square. The service line to the hydrant, between the tee and the shoe of the hydrant, shall be fully restrained.

C. Set bases in not less than 0.4 cubic meter (1/2 cubic yard) of crushed rock or gravel placed entirely below hydrant drainage device.

D. Clean interiors of hydrants of all foreign matter before installation.

3.12 PIPE SLEEVES:

A. Install where water lines pass through retaining walls, building foundations and floors. Seal with modular mechanical type link seal. Install piping so that no joint occurs within a sleeve. Split sleeves may be installed where existing lines pass through new construction.

3.13 DISINFECTION OF NEW WATER SYSTEMS:

A. Before being placed into service, and before certification of completion by the Engineer, all new water systems, or extensions to existing systems or valved section of such extensions, or any replacement in the existing water system, or any exposed section of the existing system shall be disinfected as follows:

B. DISINFECTION OF NEW SYSTEMS

1. All interior surfaces of new potable water supply systems, including wells, filters, storage tanks and distribution lines shall be thoroughly disinfected by means of hypochlorite or chlorine solutions, after which bacteriological test samples shall be collected.

2. After disinfection the water supply shall not be placed into service until bacteriological test results of representative water samples analyzed in an approved laboratory are found to be satisfactory.

C. DISINFECTION OF STORAGE TANKS AND DISTRIBUTION SYSTEMS

1. Water distribution systems, including storage tanks and water mains, after flushing to remove sediment and other foreign matter, and after testing for leaks, shall be disinfected by the addition and thorough dispersion of a chlorine solution in concentrations sufficient to produce a chlorine residual of at least 100 milligrams per liter (or ppm) in the water throughout the distribution system, including all water mains and storage tanks.

2. The chlorine solution shall remain in contact with interior surfaces of the water system for a period of 24 hours. Then the water system shall be flushed with fresh water from an approved water source until the chlorine solution is dispelled.

3. Representative samples of the water shall then be collected. If bacteriological tests of the samples indicate that the water quality is satisfactory, the water mains and storage tanks may be placed in service.

4. In unusual situations where large volume tanks are involved and where there is not sufficient water available to fill the tank or there is not available a suitable drainage area for the chlorinated water, an alternate disinfection procedure for tanks may be proposed. Such proposal must be submitted in writing completely describing the proposed disinfection procedure and substantiating the need for an alternate procedure in the particular circumstance. Such alternate procedure must be approved before being implemented. The conclusion of the department shall be final."

5. The Contractor shall be required to make arrangements for having tests conducted. All expenses incurred in making tests shall be borne by the Contractor and should be included in his bid.

D. TESTING NEW WATER LINES: The following test sequence shall be included in all water system extension specifications unless otherwise directed by the Commission.

1. Perform pretest inspection.
2. Clean the main.
3. Perform the hydrostatic tests.
4. Apply the proper dosage of chlorine.
5. Allow chlorine solution to remain in the water main a minimum of 24 hours.
6. Flush the main.
7. Assist the Commission in taking bacteriological samples.

E. Pretest Inspection: Prior to the commencement of hydrostatic testing and chlorination, the Commission shall be contacted to request scheduling of inspection and testing. A Commission's Representative shall visually inspect the installation prior to testing to insure that all fire hydrants, valves and other appurtenances are properly located, operable, and installed at the proper grade. All defects disclosed by the inspection shall be corrected prior to testing.

F. Cleaning Of The Main:

1. Cleaning of Water Mains 4” and Smaller in Diameter: Mains smaller than 4” in diameter shall be cleaned by flushing. Flushing velocity shall be adequate to remove all debris and other undesirable material and a minimum of 2-1/2 feet per second.

2. Cleaning of Water Mains 4” and Larger in Diameter: Mains shall be flushed only in the presence of a Commission's Representative. No valves or hydrants owned by the Greenville Utilities Commission shall be operated without the express permission of the Commission.

3. Cleaning shall be accomplished by passing through the pipe a polyethylene “pig” of the appropriate size and density (as manufactured by Poly-Pig or approved equal). Pig(s) shall be furnished by the Contractor. The procedure shall be as follows:

G. The Contractor shall prepare the main for the installation and removal of pig(s) as required:

1. In general, this will consist of furnishing all equipment, material, and labor to satisfactorily install and remove the pig(s).

2. Prior to scheduling a preconstruction conference, the Contractor shall submit a “pigging” plan to the Commission for approval.
3. Where expulsion of the pig is required through a dead end main, Contractor shall prevent the backflow of purged water into the main after expulsion of the pig. For pipe 12” or less in diameter, purged water can be prevented from reentering into the pipe by the temporary installation of pipe and fittings as required to provide a riser with an above ground discharge. On larger pipe, additional excavation of the trench may serve the same purpose.
4. After expulsion of the pig, completion of flushing, and at the direction of the Commission, the Contractor shall complete work at openings by plugging, blocking, backfilling and completion of all appurtenant work necessary to secure the system.
5. Under the supervision of the Inspector, pig(s) shall be propelled via water pressure through the main(s) from the point of insertion to the point of expulsion. Where mains are in the form of a loop, the Contractor shall “pig” the complete system.
6. As an alternate to “pigging”, dead end pipe of less than 100 feet in length which are difficult to “pig” may be cleaned by flushing. Flushing shall be accomplished in the same manner as that required for pipes less than four inches in diameter in accordance with Section 3.5.4.1 of the GUC Design Manual.

H. Hydrostatic Test: Unless otherwise permitted, testing shall be performed between each main line valve in accordance with AWWA C600. The Commission will, except when certain circumstances dictate otherwise, permit the lengths of test sections to be a maximum of 1500 feet in subdivisions or other areas where the new main has closely spaced valves. Testing shall be done only in the presence of a Commission's Representative unless directed otherwise by the Commission. Testing shall be performed using a suitable pump and an accurate gauge graduated in 1.0 psi increments. The section of the main to be tested shall be subjected to a test pressure of 150 psi for a period of two (2) hours. The leakage of the test section shall be accurately determined and compared to the schedule shown below. All visible leaks shall be repaired regardless of the amount of leakage.

PIPE SIZE (inches)	ALLOWABLE LEAKAGE (Gallons per hour per 1000 feet of pipe)
2	0.16
4	0.33
6	0.50
8	0.66
10	0.83
12	0.99
14	1.29
16	1.47
18	1.66
20	1.84

If the leakage is greater than the allowable leakage as given by the above table, the Contractor shall replace any defective materials and perform all necessary work to insure that the installation is acceptable and a retest shall be performed subsequent to any repair work performed. Remedial repair work and retesting shall be repeated until the leakage occurring during the test period is less than or equal to the allowable leakage.

I. Chlorination:

1. Chlorination shall be performed only in the presence of Commission's Representative and shall be performed only after the line is complete and has tested satisfactorily for leakage.
2. Chlorination taps will be made within five (5) pipe diameters of the water main control valve at the upstream end of the line and at all extremities of the line.
3. Sufficient chlorine solution shall be applied to bring the concentration within the main to a minimum of 100 ppm free chlorine residual.
4. The chlorine solution shall be introduced to the main at a constant rate while regulating the flow of water through the main being chlorinated such that the required concentration of chlorine is achieved throughout.
5. All valves within the section of main being chlorinated shall be operated once during the contact period.
6. The chlorine solution shall remain in the lines for no less than twenty four (24) hours, longer if so directed by the Commission.
7. Services shall be chlorinated at the same time and by the same method utilized for the main.
8. Extreme care shall be taken to prevent contamination of existing water mains during the test period. If, in the opinion of the Commission, an existing main is contaminated, the section of main subjected to the possible contamination shall be flushed and chlorinated in accordance with the requirements for new mains.
9. The Commission will advise the Contractor when a suitable period of time has elapsed for chlorine contact. The main shall be flushed thereafter in the presence and under the direction of the Commission's Representative. The flushing of the main shall be considered complete when the chlorine concentration with the main is less than or equal to the lesser of the following values:

   One (1) part per million (ppm) free chlorine.
10. The free chlorine concentration within the existing main to which the extension has been connected.
11. The Developer shall be responsible for insuring that high strength chlorine solution is contained on site and not allowed to make its way to any watercourse, stream, creek, lake, or other body of water.

J. Bacteriological Testing:

1. After completion of chlorination and flushing, the Contractor shall assist the Commission as necessary in obtaining sufficient bacteriological samples for complete testing.
2. The Commission shall determine the location of samples and the number of samples necessary to provide a test group which is representative of the section of main being tested.

3. A failure of any sample of a test group shall constitute failure of the entire test group from which the sample was taken. Such failure shall require two (2) successive passing test groups to substantiate that the main has been satisfactorily chlorinated. The second of the two successive test groups of samples will not be collected before nor unless the first group has passed.
4. The Contractor may, at his option, rechlorinate and retest the section of water main upon failure of the test group.
5. If two (2) successive bacteriological test groups fail, the section of main from which the group is taken shall be rechlorinated and retested until the main is shown to be properly chlorinated in accordance with the above requirements.

3.14 BACKFLOW PREVENTOR TESTING:

A. All backflow preventers shall be tested and certified for proper operation prior to being placed in operation.

B. Original copies of the certification shall be submitted to the Resident Engineer and Greenville Utilities Commission.

END OF SECTION 331000

SECTION 333000 - SANITARY SEWERAGE UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Outside, underground sanitary sewer system, complete, ready for operation, including all gravity flow lines, manholes, cleanouts, frames, covers, structures, appurtenances, and connections to new building and structure, service lines, existing sanitary sewer lines, and existing sanitary structures, and all other incidentals.

1.2 RELATED WORK

A. Maintenance of Existing Utilities: Division 01.

B. Excavation, Trench Widths, Pipe Bedding, Backfill, Shoring, Sheeting, Bracing: Section 312000, EARTH MOVING.

C. Concrete Work Reinforcing, Placement and Finishing; Section 033000, CAST-IN-PLACE CONCRETE.

D. Protection of Materials and Equipment: Division 21.

1.3 QUALITY ASSURANCE

A. Products Criteria:

1. Multiple Units: When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.

2. Nameplates: Nameplate bearing manufacturer's name, or identifiable trademark, including model number, securely affixed in a conspicuous place on equipment, or name or trademark, including model number cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.

B. Comply with the rules and regulations of the Public Utility having jurisdiction over the connection to Public Sanitary Sewer lines and the extension, and/or modifications to Public Utility Systems.

1.4 SUBMITTALS

A. Submit in accordance with Section 013323, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturers' Literature and Data: Submit the following as one package:

1. Pipe, Fittings, and, Appurtenances.

2. Jointing Material.

1.5 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American Society for Testing and Materials (ASTM):

A48/A48M-03 ..... Gray Iron Castings
A536-84(2004) ..... Ductile Iron Castings
A615/A615M-06 ..... Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
A625/A625M-03 ..... Tin Mill Products, Black Plate, Single Reduced
A746-03 ..... Ductile Iron Gravity Sewer Pipe
C12-06 ..... Installing Vitrified Clay Pipe Lines
C76-05b/C76M-05b ..... Reinforced Concrete Culvert, Storm Drain and Sewer Pipe
C139-05 ..... Concrete Masonry Units for Construction of Catch Basins and Manholes
C150-05 ..... Portland Cement
C425-04 ..... Compression Joints for Vitrified Clay Pipe and Fittings
C478-06a/C478M-06a ..... Precast Reinforced Concrete Manhole Sections
C700-05 ..... Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated
C828-03 ..... Low-Pressure Air Test of Vitrified Clay Pipe Lines
C857-95(2001) ..... Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
D698-00ae1 ..... Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3))
D2321-05 ..... Underground Installation of Thermoplastic Pipes for Sewers and Other Gravity-Flow Applications
D2412-02 ..... Determination of External Loading Characteristics of Plastic Pipe by Parallel- Plate Loading
D2992-01 ..... Practice for Obtaining Hydrostatic or Pressure Design Basis for Fiberglass (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe and Fittings
D3034-04a ..... Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
D3212-96a (2003) e1 ..... Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
D3261-03 ..... Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
D3350-05 ..... Polyethylene Plastics Pipe and Fittings Materials
D4101-05a. ..... Polypropylene Injection and Extrusion Materials
F477-02e1 ..... Elastomeric Seals (Gaskets) for Joining Plastic Pipe
F679-06 ..... Poly (vinyl chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
F714-05 ..... Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
F794-03 ..... Poly (Vinyl Chloride)(PVC) Ribbed Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter

F894-05 ..... Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe

F949-03 ..... Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with Smooth Interior and Fittings

C. American Water Works Association (AWWA):

C105/A21.5-05 ..... Polyethylene Encasement for Ductile Iron Pipe Systems

C110/A21.10-03 ..... Ductile-Iron and Gray-Iron Fittings for Water

C111/A21.11-00 ..... Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings

C115-99 ..... Flanged Ductile-Iron Pipe with Threaded Flanges

C116-03 ..... Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile Iron Pipe and Gray Iron Fittings for Water Supply Service

C151-/A21.51-02 ..... Ductile-Iron Pipe, Centrifugally Cast for Water

C153-00 ..... Ductile-Iron Compact Fittings for Water Services

C508-01 ..... Swing Check Valves for Waterworks, 2 inches (50 mm) Through 24 inches (600 mm) NPS

C509-01 ..... Resilient Seated Gate Valves for Water-Supply Service

C515-01 ..... Reduced-Wall, Resilient-Seated Gate Valves For Water Supply Service

C512-04 ..... Air Release, Air/Vacuum, and Combination Air Valves for Waterworks Service

C550-05 ..... Protective Epoxy Interior Coatings for Valves and Hydrants

C600-05 ..... Installation for Ductile-Iron Water Mains and Their Appurtenances

C605-94 ..... Underground Installation of Polyvinyl (PVC) Pressure Pipe and Fittings for Water

C900-97 ..... Polyvinyl Chloride (PVC) Pressure Pipe, 100 mm (4 inches) Through 300 mm (12 inches) for Water Distribution

C905-97 ..... Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 350 mm through 1,200 mm (14 Inches through 48 Inches), for Water Transmission and Distribution

C906-99 ..... Polyethylene (PE) Pressure Pipes and Fittings, 100 mm through 1575 mm (4 Inches through 63 Inches), for Water Distribution

D. American Association of State Highway and Transportation Officials (AASHTO):

M198-05 ..... Joints for Concrete Pipe, Manholes, and Precast Box Sections using Preformed Flexible Joint Sealants

E. Uni-Bell PVC Pipe Association:

Uni-B-6-98 ..... Recommended Practice Low Pressure Air Testing of Installed Sewer Pipe

F. Greenville Utilities Commission's Manual for the Design and Construction of Water and Wastewater Extensions

PART 2 - PRODUCTS

2.1 PIPING

A. Gravity Flow Lines (Pipe and Fittings):

1. Polyvinyl Chloride (PVC):

a. Pipe and Fittings, 100 to 375 mm (4 to 15 inches) in diameter, shall conform to ASTM D3034, Type PSM, SDR 26. Pipe and fittings shall have elastomeric gasket joints providing a watertight seal when tested in accordance with ASTM D3212. Gaskets shall conform to ASTM F477. Solvent welded joints shall not be permitted.

2. Ductile Iron Pipe (DIP) for Sanitary Sewer: Shall conform to ASTM A746, thickness Class 51 unless otherwise shown or specified. Joints on pipe and fittings shall be push-on style and conform to AWWA C110 and AWWA C111, rated for 1.03 MPa (150 psi). Exterior coating shall be approximately 0.025 mm (1 mil) asphaltic coating as specified in ASTM A746. Interior lining shall be a catalyzed coal tar epoxy, having a minimum thickness of 0.60 mm (24 mils), a permeability rating of 0.13 perms, direct impact rating of 11.3 Nm (100 in-lbs), an abrasion resistance of 20 liters of sand per mil, and dielectric strength of 250 volts per mil. Pipe and fittings shall be polyethylene encased with 0.20 mm (8 mil) polyethylene sheeting per AWWA C105. Color of polyethylene encasement shall be green.

2.2 JOINTING MATERIAL

A. Gravity Flow Lines:

1. Ductile Iron Pipe: Push-on or mechanical joints, AWWA C111, AWWA C110. Flange joints shall comply with AWWA C115. Flange joints shall only be used in vaults or above-grade.

2. Polyvinyl Chloride (PVC) Pipe (Gravity Use): Joints, ASTM D3212. Elastomeric gasket, ASTM F477.

2.3 CONCRETE

A. Concrete shall have a minimum compressive strength of 20 MPa (3000 psi) at 28 days. The cement shall be Type III conforming to ASTM C150. Concrete shall conform with the provisions of Division 03 of these specifications.

2.4 REINFORCING STEEL

A. Reinforcing steel shall be deformed bars, ASTM A615, Grade 40 unless otherwise noted.

2.5 OIL AND GREASE INTERCEPTOR AND GREASE REMOVAL PIT

A. Shall be constructed of reinforced precast concrete of the shape and configuration indicated on

the plans. Precast vaults shall be constructed in accordance with ASTM C857 and be rated for HS20-44 loading. The concrete shall have a minimum compressive strength of 35 MPa (5,000 psi) at 28 days, and reinforcement shall comply with ASTM A615, Grade 60. Access to the trap shall be through 600 mm (24 inches) diameter manhole frame and cover or through hinged aluminum access manways.

B. Baffles shall be constructed of precast concrete.

C. Grease Interceptor shall be in accordance with Standard Drawing No. S-14 in the GUC Manual.

2.6 CLEANOUT FRAMES AND COVERS

A. Frames and covers shall be gray iron casting conforming to ASTM C48. The frame and cover shall be rated for HS20-44 wheel loading, have a studded pattern on its cover, vent holes, and lifting slots. The cover shall fit firmly on the frame without movement when subject to vehicular traffic. The word “SEWER” shall be cast on the cover.

2.7 WARNING TAPE

A. Standard, .1mm (4Mil) polyethylene 76 mm (3 inch) wide tape detectable type, green with black letters and imprinted with “CAUTION BURIED SEWER LINE BELOW”.”

PART 3 - EXECUTION

3.1 BUILDING SERVICE LINES

A. Install sanitary sewer service lines to point of connection within approximately 1500 mm (5 feet) outside of buildings where service is required and make connections. Coordinate the invert and location of the service line with the Contractor installing the building lines.

B. Connections of service line to building piping shall be made after the new sanitary sewer system has been constructed, tested, and accepted for operation by the Resident Engineer. The Contractor shall install all temporary caps or plugs required for testing.

C. When building services have not been installed at the time when the sanitary sewer system is complete, provide temporary plugs or caps at the ends of all service lines. Mark the location and depth of the service lines with continuous warning tape placed 300 mm (12 inches) above service lines.

3.2 ABANDONED MANHOLES STRUCTURES AND PIPING

A. Manholes and Structures Outside of Building Areas: Remove frame and cover, cut and remove the top of an elevation of 600 mm (2 feet) below finished grade. Fill the remaining portion with compacted gravel or crushed rock or concrete.

B. Manholes and Structures with Building Areas: Remove the entire structure and the base.

C. Piping under and within 1500 mm (5 feet) of building areas shall be completely removed.

D. Piping outside of building areas shall be completely removed.

E. The Contractor shall comply with all OSHA confined space requirements while working within existing manholes and structures.

F. When the limit of the abandonment terminates in an existing manhole to remain, the flow line in the bench of the manhole to the abandoned line shall be filled with concrete and shaped to maintain the flowline of the lines to remain.

3.3 REGRADING

A. Raise or lower existing manholes and structures frames and covers, cleanout frames and covers and valve boxes in regraded areas to finish grade. Carefully remove, clean and salvage cast iron frames and covers. Adjust the elevation of the top of the manhole or structure as detailed on the drawings. Adjust the elevation of the cleanout pipe riser, and reinstall the cap or plug. Reset cast iron frame and cover, grouting below and around the frame. Install concrete collar around reset frame and cover as specified for new construction.

B. During periods when work is progressing on adjusting manholes or structures cover elevations, the Contractor shall install a temporary cover above the bench of the structure or manhole. The temporary cover shall be installed above the high flow elevation within the structure, and shall prevent debris from entering the wastewater stream.

C. The Contractor shall comply with all OSHA confined space requirements when working within existing structures.

3.4 CONNECTIONS TO EXISTING PUBLIC UTILITY COMPANY MANHOLES

A. Comply with all rules and regulations of the public utility.

B. The connection to the existing utility shall comply with the standard details and specifications of the public utility company, except as specifically modified on the plans and specifications.

3.5 PIPE SEPARATION:

A. Horizontal Separation - Water Mains and Sewers:

1. Existing and proposed water mains shall be at least 3 meters (10 feet) horizontally from any proposed gravity flow and pressure (force main) sanitary sewer or sewer service connection.

2. Gravity flow mains and pressure (force) mains may be located closer than 3 meters (10 feet) but not closer than 1.8 m (6 feet) to a water main when:

   a. Local conditions prevent a lateral separation of ten feet; and

b. The water main invert is at least 450 mm (18 inches) above the crown of the gravity sewer or 600 mm (24 inches) above the crown of the pressure (force) main; and

c. The water main is in a separate trench separated by undisturbed earth.

3. When it is impossible to meet (1) or (2) above, both the water main and sanitary sewer main shall be constructed of push-on or mechanical joint ductile iron pipe. The pipe for the sanitary sewer main shall comply with the specifications for pressure (force) mains, and the water main material shall comply with Section 331000, WATER UTILITIES. The sewer shall be pressure tested as specified for pressure (force) mains before backfilling.

B. Vertical Separation - Water Mains and Sewers at Crossings:

1. Water mains shall be separated from sewer mains so that the invert of the water main is a minimum of 18 inches above the crown of gravity flow sewer or 1200 mm (48 inches) above the crown of pressure (force) mains. The vertical separation shall be maintained within 3 meters (10 feet) horizontally of the sewer and water crossing. When these vertical separations are met, no additional protection is required.

2. In no case shall pressure (force) sanitary main cross above, or within 600 mm (24 inches) of water lines.

3. When it is impossible to meet (1) above, the gravity flow sewer may be installed 450 mm (18 inches) above or 300 mm (12 inches) below the water main, provided that both the water main and sewer shall be constructed of push-on or mechanical ductile pipe. Pressure (Force) sewers may be installed 600 mm (24 inches) below the water line provided both the water line and sewer line are constructed of ductile iron pipe. The pipe for the sewer shall conform to the requirements for pressure sewers specified herein. Piping for the water main shall conform to Section 331000, WATER UTILITIES.

4. The required vertical separation between the sewer and the water main shall extend on each side of the crossing until the perpendicular distance from the water main to the sewer line is at least 3 meters (10 feet).

3.6 GENERAL PIPING INSTALLATION

A. Lay pipes true to line and grade. Gravity flow sewer shall be laid with bells facing upgrade. Pressure (force) mains shall have the bells facing the direction of flow.

B. Do not lay pipe on unstable material, in wet trench or when trench and weather conditions are unsuitable for the work.

C. Support pipe on compacted bedding material. Excavate bell holes only large enough to properly make the joint.

D. Inspect pipes and fittings, for defects before installation. Defective materials shall be plainly marked and removed from the site. Cut pipe shall have smooth regular ends at right angles to axis of pipe.

E. Clean interior of all pipe thoroughly before installation. When work is not in progress, open ends of pipe shall be closed securely to prevent entrance of storm water, dirt or other substances.

F. Lower pipe into trench carefully and bring to proper line, grade, and joint. After jointing, interior of each pipe shall be thoroughly wiped or swabbed to remove any dirt, trash or excess jointing materials.

G. Do not lay sewer pipe in same trench with another pipe or other utility. Sanitary sewers shall cross at least 18 inches 600 mm (2 feet) below water lines.

H. Do not walk on pipe in trenches until covered by layers of bedding or backfill material to a depth of 300 mm (12 inches) over the crown of the pipe.

I. Warning tape shall be continuously placed 300 mm (12 inches) above sewer pipe.

J. Install gravity sewer line in accordance with the provisions of these specifications and the following standards:

1. Ductile Iron Piping: AWWA C111 and C600.
2. Vitrified Clay Piping: ASTM C12.
3. Polyvinyl Chloride (PVC) Piping: ASTM D2321.

K. Gravity Flow Lines with Secondary Containment:

1. Install per manufacturer’s recommendations. Install all pipe centering devices to maintain an interstitial space below the invert of the carrier pipe. Both the carrier and containment pipe shall be tested for leaks.

3.7 CLEANOUTS

A. 150 millimeters (6 inches) in diameter and consisting of a ductile iron 45 degree fitting on end of run, or combination Y fitting and l/8 bend in the run with ductile iron pipe extension, water tight plug or cap and cast frame and cover flush with finished grade. Center-set cleanouts, located in unpaved areas, in a 300 by 300 by 150 mm (12 by 12 by 6 inches) thick concrete slab set flush with adjacent finished grade. Where cleanout is in force main, provide a blind flange top connection. The center of the flange shall be equipped with a 50 mm (2 inches) base valve to allow the pressure in the line to be relieved prior to removal of the blind flange. Frames and covers for pressure (force) mains shall be 600 mm (24 inches) in diameter.

B. The top of the cleanout assembly shall be 50 mm (2 inches) below the bottom of the cover to prevent loads being transferred from the frame and cover to the piping.

3.8 INSPECTION OF SEWERS

A. Inspect and obtain the Resident Engineer's approval. Thoroughly flush out before inspection. Lamp test between structures and show full bore indicating sewer is true to line and grade. Lip at joints on the inside of gravity sewer lines are not acceptable.

3.9 TESTING OF SANITARY SEWERS

A. Gravity Sewers and Manholes:

1. Air Test: Vitrified Clay Pipe ASTM C828. PVC Pipe, Uni-Bell Uni-B-6. Clean and isolate the section of sewer line to be tested. Plug or cap the ends of all branches, laterals, tees, wyes, and stubs to be included in the test to prevent air leakage. The line shall be pressurized to 28 kPa (4 psi) and allowed to stabilize. After pressure stabilization, the pressure shall be dropped to 24 kPa (3.5 psi) greater than the average back-pressure of any groundwater above the sewer. The minimum test time shall be as specified in Uni-Bell Uni-B-6.

END OF SECTION 333000

SECTION 334000 - STORM SEWER UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. This section specifies materials and procedures for construction of outside, underground storm sewer systems that are complete and ready for operation. This includes piping, structures and all other incidentals.

1.2 RELATED WORK

A. Excavation, Trench Widths, Pipe Bedding, Backfill, Shoring, Sheeting, Bracing: Section 312000, EARTH MOVING.

B. Concrete Work, Reinforcing, Placement and Finishing: Section 033000, CAST-IN-PLACE CONCRETE.

C. General plumbing, protection of Materials and Equipment, and quality assurance: Division 22.

D. Fabrication of Steel Ladders: Section 055000, METAL FABRICATIONS.

E. Materials and Testing Report Submittals: Division 01.

F. Erosion and Sediment Control: Division 01

1.3 ABBREVIATIONS

A. HDPE: High-density polyethylene

B. PE: Polyethylene

C. RCP: Reinforced Concrete Pipe

D. PVC: Polyvinyl Chloride

1.4 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, pipe, and fittings in direct sunlight.

B. Handle manholes, catch basins and stormwater inlets according to manufacturer's written rigging instructions.

1.5 COORDINATION

A. Coordinate connection to storm sewer main with the Public Agency providing storm sewer off-site drainage.

B. Coordinate exterior utility lines and connections to building services up to the actual extent of building wall.

1.6 QUALITY ASSURANCE

A. Products Criteria:

1. When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.

2. A nameplate bearing manufacturer's name or trademark, including model number, shall be securely affixed in a conspicuous place on equipment. In addition, the model number shall be either cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.

1.7 SUBMITTALS

A. Manufacturers' Literature and Data shall be submitted, as one package, for pipes, fittings and appurtenances, including jointing materials, hydrants, valves and other miscellaneous items.

1.8 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American Society for Testing and Materials (ASTM):

A185/A185M-07	Steel Welded Wire Reinforcement, Plain, for Concrete
A242/A242M-04(2009)	High-Strength Low-Alloy Structural Steel
A536-84(2009)	Ductile Iron Castings
A615/A615M-09b	Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
A760/A760M-10	Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains
A798/A798M-07	Installing Factory-Made Corrugated Steel Pipe for Sewers and Other Applications
A849-10	Post-Applied Coatings, Paving, and Linings for Corrugated Steel Sewer and Drainage Pipe
A929/A929M-01(2007)	Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe
B745/B745M-97(2005)	Corrugated Aluminum Pipe for Sewers and Drains
B788/B788M-09	Installing Factory-Made Corrugated Aluminum Culverts and Storm Sewer Pipe
C14-07	Non-reinforced Concrete Sewer, Storm Drain, and Culvert Pipe
C33/C33M-08	Concrete Aggregates

C76-11 ..... Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
C139-10 ..... Concrete Masonry Units for Construction of Catch Basins and Manholes
C150/C150M-11 ..... Portland Cement
C443-10 ..... Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
C478-09 ..... Precast Reinforced Concrete Manhole Sections
C506-10b ..... Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe
C507-10b ..... Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe
C655-09 ..... Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe
C857-07 ..... Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
C891-09 ..... Installation of Underground Precast Concrete Utility Structures
C913-08 ..... Precast Concrete Water and Wastewater Structures
C923-08 ..... Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals
C924-02(2009) ..... Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method
C990-09 ..... Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
C1103-03(2009) ..... Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
C1173-08 ..... Flexible Transition Couplings for Underground Piping Systems
C1433-10 ..... Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers
C1479-10 ..... Installation of Precast Concrete Sewer, Storm Drain, and Culvert Pipe Using Standard Installations
D448-08 ..... Sizes of Aggregate for Road and Bridge Construction
D698-07e1 ..... Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft3 (600 kN-m/m3))
D1056-07 ..... Flexible Cellular Materials—Sponge or Expanded Rubber
D1785-06 ..... Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
D2321-11 ..... Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
D2751-05 ..... Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings
D2774-08 ..... Underground Installation of Thermoplastic Pressure Piping
D3034-08 ..... Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
D3350-10 ..... Polyethylene Plastics Pipe and Fittings Materials
D3753-05e1 ..... Glass-Fiber-Reinforced Polyester Manholes and Wetwells
D4101-11 ..... Polypropylene Injection and Extrusion Materials
D5926-09 ..... Poly (Vinyl Chloride) (PVC) Gaskets for Drain, Waste, and Vent (DWV), Sewer, Sanitary, and Storm Plumbing Systems
F477-10 ..... Elastomeric Seals (Gaskets) for Joining Plastic Pipe
F679-08 ..... Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
F714-10 ..... Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter

F794-03(2009)..... Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
F891-10 ..... Coextruded Poly(Vinyl Chloride) (PVC) Plastic Pipe With a Cellular Core
F894-07 ..... Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
F949-10 ..... Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings
F1417-11 ..... Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air
F1668-08 ..... Construction Procedures for Buried Plastic Pipe

American Association of State Highway and Transportation Officials (AASHTO):

M190-04..... Bituminous-Coated Corrugated Metal Culvert Pipe and Pipe Arches
M198-10..... Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
M252-09..... Corrugated Polyethylene Drainage Pipe
M294-10..... Corrugated Polyethylene Pipe, 12 to 60 In. (300 to 1500 mm) Diameter

C. American Water Works Association(AWWA):

C105/A21.5-10..... Polyethylene Encasement for Ductile iron Pipe Systems
C110-08..... Ductile-Iron and Gray-Iron Fittings
C219-11..... Bolted, Sleeve-Type Couplings for Plain-End Pipe
C600-10..... Installation of Ductile iron Mains and Their Appurtenances
C900-07..... Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution
M23-2nd ed ..... PVC Pipe ”Design And Installation”

D. American Society of Mechanical Engineers (ASME):

A112.6.3-2001..... Floor and Trench Drains
A112.14.1-2003..... Backwater Valves
A112.36.2M-1991 ..... Cleanouts

E. American Concrete Institute (ACI):

318-05..... Structural Commentary and Commentary
350/350M-06..... Environmental Engineering Concrete Structures and Commentary

F. National Stone, Sand and Gravel Association (NSSGA): Quarried Stone for Erosion and Sediment Control

1.9 WARRANTY

A. The Contractor shall remedy any defect due to faulty material or workmanship and pay for any damage to other work resulting therefrom within a period of one year from final acceptance. Further, the Contractor will furnish all manufacturers' and suppliers' written guarantees and warranties covering materials and equipment furnished under this Contract.

PART 2 - PRODUCTS

2.1 FACTORY-ASSEMBLED PRODUCTS

A. Standardization of components shall be maximized to reduce spare part requirements. The Contractor shall guarantee performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.

2.2 PE PIPE AND FITTINGS

A. Corrugated PE drainage pipe and fittings, NPS 3 to NPS 10 (DN 80 to DN 250); ASTM F714, SDR 21 with smooth waterway for coupling joints.

1. Silt-tight Couplings: PE sleeve with ASTM D1056, Type 2, Class A, Grade 2 gasket material that mates with tube and fittings.

2. Soil-tight Couplings: AASHTO M252, corrugated, matching tube and fittings.

B. Corrugated PE pipe and fittings, NPS 12 to NPS 60 (DN 300 to DN 1500); ASTM F714, SDR 21 for pipes 3 to 24 inches (300 to 600 mm) with smooth waterway for coupling joints. Pipe shall be produced from PE certified by the resin producer as meeting the requirements of ASTM D3350, minimum cell class 335434C.

1. Silt-tight Couplings: PE sleeve with ASTM D1056, Type 2, Class A, Grade 2 gasket material that mates with tube and fittings.

2. Soil-tight Couplings: AASHTO M252, corrugated, matching tube and fittings.

3. Water tight joints shall be made using a PVC or PE coupling and rubber gaskets as recommended by the pipe manufacturer. Rubber gaskets shall conform to ASTM F477. Soil tight joints shall conform to requirements in AASHTO HB-17, Division II, for soil tightness and shall be as recommended by the manufacturer.

C. Profile Wall PE Pipe: Pipe shall comply with ASTM F894, Class 160.

1. Profile Wall PE Plastic Pipe Joints: Joints shall be as per ASTM F894, gasket type with integral bell.

D. PVC Pipe And Fittings

1. PVC Cellular-Core Pipe And Fittings: ASTM F891, Sewer and Drain Series, PS 50 minimum stiffness, PVC cellular-core pipe with plain ends for solvent-cemented joints.

2. Fittings: ASTM D3034, SDR 35, PVC socket-type fittings.

E. PVC Corrugated Sewer Piping

1. Pipe: ASTM F949, PVC, corrugated pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM F949, PVC molded or fabricated, socket type.
3. Gaskets: ASTM F477, elastomeric seals.

F. PVC Profile Sewer Piping

1. Pipe: ASTM F794, PVC profile, gravity sewer pipe with bell-and-spigot ends.
2. Fittings: ASTM D3034, PVC with bell ends.
3. Gaskets: ASTM F477, elastomeric seals.

G. PVC Gravity Sewer Piping

1. Pipe and fittings shall be ASTM F679, T-1 wall thickness, PVC gravity sewer pipe with bell-and-spigot ends.
2. Gaskets: ASTM F477, elastomeric seals for gasketed joints.

H. PVC Pressure Piping

1. Pipe: AWWA Class 150 PVC pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: AWWA C900, Class 150 PVC pipe with bell ends.
3. Gaskets: ASTM F477, elastomeric seals.

2.3 CONCRETE PIPE AND FITTINGS

A. Reinforced-Concrete sewer pipe and fittings shall be ASTM C76 or ASTM C655.

1. Bell-and-spigot ends and gasketed joints with ASTM C443, sealant joints with ASTM C990.
2. Class II, Wall B.

2.4 PRESSURE PIPE COUPLINGS

A. Couplings: AWWA C219, tubular-sleeve coupling, with center sleeve, gaskets, end rings, and bolt fasteners.

B. Metal, bolted, sleeve-type, reducing or transition coupling, for joining underground pressure piping. Include 150-psi (1035-kPa) minimum pressure rating and ends sized to match adjoining pipes.

C. Center-Sleeve Material: Ductile iron.

D. Gasket Material: Natural or synthetic rubber.

E. Metal Component Finish: Corrosion-resistant coating or material.

2.5 EXPANSION JOINTS AND DEFLECTION FITTINGS

A. Ductile iron flexible expansion joints: Compound fitting with combination of flanged and mechanical-joint ends complying with AWWA C110. Include two gasketed ball-joint sections and one or more gasketed sleeve sections, rated for 250-psi (1725-kPa) minimum working pressure and for offset and expansion indicated.

2.6 CLEANOUTS

A. Cast-Iron Cleanouts: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.

1. Top-Loading Classification(s): Heavy Duty
2. Pipe fitting and riser to cleanout shall be same material as main pipe line.

B. Plastic Cleanouts shall have PVC body with PVC threaded plug. Pipe fitting and riser to cleanout shall be of same material as main line pipe.

2.7 DRAINS

A. Cast-Iron Area Drains: ASME A112.6.3, gray-iron round body with anchor flange and round grate. Include bottom outlet with inside calk or spigot connection, of sizes indicated.

1. Top-Loading Classification(s): Heavy Duty.

B. Cast-Iron Trench Drains: ASME A112.6.3, 6 inch (150 mm) wide top surface, rectangular body with anchor flange or other anchoring device, and rectangular grate. Include units of total length indicated and quantity of bottom outlets with inside calk or spigot connections, of sizes indicated.

1. Top-Loading Classification(s): Heavy Duty.

2.8 ENCASEMENT FOR PIPING

A. Material: AWWA C105 high-density, cross-laminated polyethylene film of 0.004 inch (0.10 mm) minimum thickness.

B. Form: tube.

C. Color: Black.

2.9 MANHOLES AND CATCH BASINS

A. Standard Precast Concrete Manholes:

1. Description: ASTM C478 (ASTM C478M), precast, reinforced concrete, of depth indicated, with provision for sealant joints.

2. Diameter: 48 inches (1200 mm) minimum unless otherwise indicated.
3. Ballast: Increase thickness of precast concrete sections or add concrete to base section as required to prevent flotation.
4. Base Section: 6 inch (150 mm) minimum thickness for floor slab and 4-inch (102 mm) minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
5. Riser Sections: 4 inch (102 mm) minimum thickness, and lengths to provide depth indicated.
6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated, and top of cone of size that matches grade rings.
7. Joint Sealant: ASTM C990 (ASTM C990M), bitumen or butyl rubber.
8. Resilient Pipe Connectors: ASTM C923 (ASTM C923M), cast or fitted into manhole walls, for each pipe connection.
9. Steps: If total depth from floor of manhole to finished grade is greater than 60 inches (1500 mm). ASTM A615, deformed, 1/2 inch (13 mm) steel reinforcing rods encased in ASTM D4101, width of 16 inches (400 mm) minimum, spaced at 12 to 16 inch (300 to 400 mm) intervals.
10. Adjusting Rings: Reinforced-concrete rings, 6 to 9 inch (150 to 225 mm) total thickness, to match diameter of manhole frame and cover, and height as required to adjust manhole frame and cover to indicated elevation and slope.

B. Designed Precast Concrete Manholes:

1. Description: ASTM C913; designed for A-16 (AASHTO HS20-44), heavy-traffic, structural loading; of depth, shape, and dimensions indicated, with provision for sealant joints.
2. Ballast: Increase thickness of one or more precast concrete sections or add concrete to manhole as required to prevent flotation.
3. Joint Sealant: ASTM C990 (ASTM C990M), bitumen or butyl rubber.
4. Resilient Pipe Connectors: ASTM C923 (ASTM C923M), cast or fitted into manhole walls, for each pipe connection.
5. Steps: If total depth from floor of manhole to finished grade is greater than 60 inches (1500 mm). ASTM A615 deformed, 1/2 inch (13 mm) steel reinforcing rods encased in ASTM D 4101, PP, width of 16 inches (400 mm) minimum, spaced at 12 to 16 inch (300 to 400 mm) intervals.
6. Adjusting Rings: Reinforced-concrete rings, 6 to 9 inch (150 to 225 mm) total thickness, to match diameter of manhole frame and cover, and height as required to adjust manhole frame and cover to indicated elevation and slope.

C. Manhole Frames and Covers:

1. Description: Ferrous; 24 inch (610 mm) ID by 7 to 9 inch (175 to 225 mm) riser with 4 inch (102 mm) minimum width flange and 26-inch (600 mm) diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."

2. Material: ASTM A48/A48M, Class 35 gray iron unless otherwise indicated.

2.10 CONCRETE FOR MANHOLES AND CATCH BASINS

A. General: Cast-in-place concrete according to ACI 318, ACI 350/350R, and the following:

1. Cement: ASTM C150, Type II.
2. Fine Aggregate: ASTM C33, sand.
3. Coarse Aggregate: ASTM C33, crushed gravel.
4. Water: Potable.

B. Concrete Design Mix: 4000 psi (27.6 MPa) minimum, compressive strength in 28 days.

1. Reinforcing Fabric: ASTM A185, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A615, Grade 60 (420 MPa) deformed steel.

C. Manhole Channels and Benches: Channels shall be the main line pipe material. Include benches in all manholes and catch basins.

1. Channels: Main line pipe material or concrete invert. Height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope. Invert Slope: Same slope as the main line pipe. Bench to be concrete, sloped to drain into channel. Minimum of 6 inch slope from main line pipe to wall sides.

2.11 WARNING TAPE

A. Standard, 4-Mil polyethylene 3 inch (76 mm) wide tape detectable type, purple with black letters, and imprinted with “CAUTION BURIED STORM SEWER BELOW”.

PART 3 - EXECUTION

3.1 PIPE BEDDING

A. The bedding surface of the pipe shall provide a firm foundation of uniform density throughout the entire length of pipe. Concrete pipe requirements are such that when no bedding class is specified, concrete pipe shall be bedded in a soil foundation accurately shaped and rounded to conform with the lowest one-fourth of the outside portion of circular pipe. When necessary, the bedding shall be tamped. Bell holes and depressions for joints shall not be more than the length, depth, and width required for properly making the particular type of joint. Plastic pipe bedding requirements shall meet the requirements of ASTM D2321. Bedding, haunching and initial backfill shall be either Class IB or Class II material. Corrugated metal pipe bedding requirements shall conform to ASTM A798.

3.2 PIPING INSTALLATION

A. Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping as shown on the Drawings.

C. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

1. Do not lay pipe on unstable material, in wet trench or when trench and weather conditions are unsuitable for the work.
2. Support pipe on compacted bedding material. Excavate bell holes only large enough to properly make the joint.
3. Inspect pipes and fittings, for defects before installation. Defective materials shall be plainly marked and removed from the site. Cut pipe shall have smooth regular ends at right angles to axis of pipe.
4. Clean interior of all pipe thoroughly before installation. When work is not in progress, open ends of pipe shall be closed securely to prevent entrance of storm water, dirt or other substances.
5. Lower pipe into trench carefully and bring to proper line, grade, and joint. After jointing, interior of each pipe shall be thoroughly wiped or swabbed to remove any dirt, trash or excess jointing materials.
6. Do not walk on pipe in trenches until covered by layers of shading to a depth of 12 inches (300 mm) over the crown of the pipe.
7. Warning tape shall be continuously placed 12 inches (300 mm) above storm sewer piping.

D. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

E. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

F. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.

G. Install gravity-flow, nonpressure drainage piping according to the following:

1. Install piping pitched down in direction of flow.
2. Install cast iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
3. Install ductile iron piping and special fittings according to AWWA C600.
4. Install corrugated steel piping according to ASTM A798.

5. Install corrugated aluminum piping according to ASTM B788.
6. Install PE corrugated sewer piping according to ASTM D2321 with gasketed joints.
7. Install PVC cellular-core piping, PVC sewer piping, and PVC profile gravity sewer piping, according to ASTM D2321 and ASTM F1668.
8. Install reinforced concrete sewer piping according to ASTM C1479.

3.3 REGRADING

A. Raise or lower existing manholes and structures frames and covers in regraded areas to finish grade. Carefully remove, clean and salvage cast iron frames and covers. Adjust the elevation of the top of the manhole or structure as detailed on the drawings. Reset cast iron frame and cover, grouting below and around the frame. Install concrete collar around reset frame and cover as specified for new construction.

B. During periods when work is progressing on adjusting manholes or structures cover elevations, the Contractor shall install a temporary cover above the bench of the structure or manhole. The temporary cover shall be installed above the high flow elevation within the structure, and shall prevent debris from entering the wastewater stream.

3.4 CONNECTIONS TO EXISTING PUBLIC UTILITY MANHOLES

A. Comply with all rules and regulations of the public utility.

B. Cleanout Installation

1. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast iron soil pipe fittings in sewer pipes at branches for cleanouts and cast iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
    a. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic.
    b. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service.
2. Set cleanout frames and covers in earth in cast in-place concrete block, 18 by 18 by 12 inches (450 by 450 by 300 mm) deep. Set with tops 1 inch (25 mm) above surrounding earth grade.

C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.5 DRAIN INSTALLATION

A. Install type of drains in locations indicated.

1. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
2. Use Medium-Duty, top-loading classification cleanouts in paved foot-traffic areas.

3. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.
4. Use Extra-Heavy-Duty, top-loading classification cleanouts in roads.

B. Embed drains in 4 inch (102 mm) minimum concrete around bottom and sides.

C. Set drain frames and covers with tops flush with pavement surface.

3.6 MANHOLE INSTALLATION

A. Install manholes, complete with appurtenances and accessories indicated. Install precast concrete manhole sections with sealants according to ASTM C891.

B. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches (76 mm) finished surface elsewhere unless otherwise indicated.

C. Circular Structures:

1. Precast concrete segmental blocks shall lay true and plumb. All horizontal and vertical joints shall be completely filled with mortar. Parge interior and exterior of structure with 1/2 inch (15 mm) or cement mortar applied with a trowel and finished to an even glazed surface.
2. Precast reinforced concrete rings shall be installed true and plumb. The joints between rings and between rings and the base and top shall be sealed with a preform flexible gasket material specifically manufactured for this type of application. Adjust the length of the rings so that the eccentric conical top section will be at the required elevation. Cutting the conical top section is not acceptable.
3. Precast reinforced concrete manhole risers and tops. Install as specified for precast reinforced concrete rings.

D. Rectangular Structures:

1. Precast concrete structures shall be placed on a 8 inch (200 mm) reinforced concrete pad, or be provided with a precast concrete base section. Structures provided with a base section shall be set on an 8 inch (200 mm) thick aggregate base course compacted to a minimum of 95 percent of the maximum density as determined by ASTM D698. Set precast section true and plumb. Seal all joints with preform flexible gasket material.
2. Do not build structures when air temperature is 32 deg F (0 deg C), or below.
3. Invert channels shall be smooth and semicircular in shape conforming to inside of adjacent sewer section. Make changes in direction of flow with a smooth curve of as large a radius as size of structure will permit. Make changes in size and grade of channels gradually and evenly. Construct invert channels by one of the listed methods:
   a. Forming directly in concrete base of structure.
   b. Building up with brick and mortar.
4. Floor of structure outside the channels shall be smooth and slope toward channels not less than 1 to 12 or more than 1 to 6. Bottom slab and benches shall be concrete.
5. The wall that supports access rungs or ladder shall be 90 deg vertical from the floor of structure to manhole cover.

6. Install steps and ladders per the manufacturer’s recommendations. Steps and ladders shall not move or flex when used. All loose steps and ladders shall be replaced by the Contractor.

7. Install manhole frames and covers on a mortar bed, and flush with the finish pavement. Frames and covers shall not move when subject to vehicular traffic. Install a concrete collar around the frame to protect the frame from moving until the adjacent pavement is placed. In unpaved areas, the rim elevation shall be 2 inches (50 mm) above the adjacent finish grade. Install an 8 inch (203 mm) thick, by 12 inch (300 mm) concrete collar around the perimeter of the frame. Slope the top of the collar away from the frame.

3.7 CATCH BASIN INSTALLATION

A. Construct catch basins to sizes and shapes indicated.

B. Set frames and grates to elevations indicated.

3.8 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping in building's storm building drains specified in Division 22 Section FACILITY STORM DRAINAGE PIPING.

B. Encase entire connection fitting, plus 6 inch (150 mm) overlap, with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).

C. Make connections to existing piping and underground manholes.

1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping.

2. Make branch connections from side into existing piping, NPS 4 to NPS 20 (DN 100 to DN 500). Remove section of existing pipe, install wye fitting into existing piping.

3. Make branch connections from side into existing piping, NPS 21 (DN 525) or larger, or to underground manholes and structures by cutting into existing unit and creating an opening large enough to allow 3 inches (76 mm) of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe, manhole, or structure wall, use epoxy-bonding compound as interface between new and existing concrete and piping materials.

4. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

D. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.

a. Shielded flexible couplings for same or minor difference OD pipes.

b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

2. Use pressure-type pipe couplings for force-main joints.

3.9 IDENTIFICATION

A. Install green warning tape directly over piping and at outside edge of underground structures.

3.10 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Prior to final acceptance, provide a video record of all piping from the building to the municipal connection to show the lines are free from obstructions, properly sloped and joined.

1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:
    a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
    c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
    d. Infiltration: Water leakage into piping.
    e. Exfiltration: Water leakage from or around piping.
3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

3.11 TESTING OF STORM SEWERS

A. Submit separate report for each test.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to requirements of authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours advance notice.
4. Submit separate report for each test.

5. Air test gravity sewers. Concrete Pipes conform to ASTM C924, Plastic Pipes conform to ASTM F1417, all other pipe material conform to ASTM C828 or C924, after consulting with pipe manufacturer. Testing of individual joints shall conform to ASTM C1103.

C. Leaks and loss in test pressure constitute defects that must be repaired. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.12 CLEANING

A. Clean interior of piping of dirt and superfluous materials. Flush with water.

END OF SECTION 334000