Architexas

Project Manual

Fannin County Courthouse
Bonham, Texas

Architexas Project #1737
September 21, 2018

Phase II
Interior & Exterior Restoration
Issued for Construction

9/21/18

Project Team

Owner
Fannin County
101 E. Sam Rayburn Drive
Bonham, Texas 75418
903.583.7455
www.co.fannin.tx.us

Texas Historical Commission
Division of Architecture
108 W. 16th Street
2nd Floor
Austin, Texas 78701
512.475.3285
www.thc.texas.gov

Architect
Architexas
1907 Marilla
2nd Floor
Dallas, Texas 75201
214.748.4561
www.architexas.com

MEP Engineer
MEPCE
2928 Story Road West
Las Colinas, Texas 75038
972.870.9060
www.mepce.com

Project Team

Civil & Structural Engineer
JQ Engineering, LLP
100 Glass Street
Dallas, Texas 75207
214.623.5801
www.jqeng.com

Landscape Architect
Armstrong Berger
P.O. Box 191425
Dallas, Texas 75219
214.871.0893
www.armberg.com

AV & Acoustics
WJHW
3424 Midcourt Road, Suite 124
Carrollton, Texas 75206
972.934.3700
www.wjhw.com

Table of Contents

Division 00 - Procurement and Contract Requirements

00 0100	Project Team
00 0115	Table of Contents
00 1110	Notice to Contractors
00 1115	Requests for Competitive Sealed Proposals
00 3126	Environmental Reports
00 3132	Geotechnical Report
00 3138	Historic Paint and Finish Analysis Report
00 3144	Masonry Conservation Report
00 3150	Acoustical Report
00 7200	General Conditions
00 7300	Supplementary Conditions

Division 01 – General Requirements

01 1000	Summary of Work
01 2100	Allowances
01 2200	Unit Prices
01 2300	Alternates
01 2500	Substitution Procedures
01 2519	Substitution Request Form
01 2600	Contract Modification Procedures
01 2900	Payment Procedures
01 3100	Project Management and Coordination
01 3216	Construction Progress Schedules
01 3233	Construction Photographs
01 3300	Submittal Procedures
01 3591	Restoration Project Procedures
01 3592	Art Conservator
01 4000	Quality Requirements
01 4001	Qualification Statement Form
01 4523	Testing and Inspection Services
01 5000	Temporary Facilities and Controls
01 5639	Temporary Tree Protection and Pruning
01 5800	Project Identification
01 6000	Product Requirements
01 7123	Field Engineering
01 7329	Cutting and Patching
01 7700	Closeout Procedures

Division 02 – Existing Conditions

02 4119	Selective Demolition

9/21/18

Table of Contents

Division 03 – Concrete

03 0330	Concrete Restoration and Cleaning
03 3300	Cast-In-Place Concrete

Division 04 – Masonry

04 0341	Restoration Mortar
04 0342	Masonry Restoration
04 0344	Masonry Cleaning
04 0513	Masonry Mortaring
04 0516	Masonry Grouting
04 2000	Unit Masonry
04 4000	Stone Assemblies
04 7200	Cast Stone

Division 05 – Metals

05 1200	Structural Steel
05 3100	Steel Deck
05 4400	Cold-Formed Metal Trusses
05 5000	Metal Fabrications
05 5100	Metal Stairs
05 7000	Ornamental Metals

Division 06 – Wood, Plastics and Composites

06 1000	Rough Carpentry
06 4000	Architectural Woodwork
06 4100	Architectural Wood Casework
06 4600	Wood Trim
06 6116	Solid Surfacing Fabrications

Division 07 – Thermal and Moisture Protection

07 1700	Bentonite Waterproofing
07 2126	Blown Insulation
07 2600	Vapor Retarders
07 3116	Metal Shingles
07 5400	Thermoplastic Membrane Roofing
07 6200	Sheet Metal Flashing and Trim
07 6300	Aluminum Cornice

9/21/18

Table of Contents

07 6400 Aluminum Dormers
07 8100 Applied Fireproofing
07 8123 Intumescent Mastic Fireproofing
07 8400 Firestopping
07 9200 Joint Sealers

Division 08 – Openings

08 0386 Vault Door Restoration
08 1113 Hollow Metal Doors and Frames
08 1433 Stile and Rail Wood Doors
08 3100 Access Doors and Panels
08 5200 Wood Windows
08 7100 Door Hardware
08 7113 Automatic Door Operators
08 8000 Glazing
08 9100 Louvers

Division 09 – Finishes

09 2200 Metal Support Assemblies
09 2300 Gypsum Plastering
09 2313 Acoustical Plastering
09 2900 Gypsum Board
09 3000 Tiling
09 6400 Wood Flooring
09 6516 Resilient Sheet Flooring
09 6723 Resinous Flooring
09 9100 Painting

Division 10 – Specialties

10 1200 Bulletin Boards
10 1400 Signage
10 1460 Accessible Parking Signs
10 2116 Plastic Toilet Compartments
10 2813 Toilet Accessories
10 4413 Fire Extinguishers
10 7429 Historic Cupola Clock Tower

Division 11 – Equipment

11 5213 Projection Screens

9/21/18

Table of Contents

Division 12 – Furnishings

12 2113 Horizontal Louver Blinds
12 5000 Chairs and Pews

Division 14 – Conveying Equipment

14 2123 Electric Passenger Elevators
14 4200 Wheelchair Lifts

Division 21 – Fire Suppression

21 0500 Common Work Results for Fire Suppression
21 1000 Water-Based Fire Suppression Systems
21 3113 Electric-Drive, Centrifugal Fire Pumps

Division 22 – Plumbing

22 0500 Common Work Results for Plumbing
22 0519 Meters and Gages for Plumbing Piping
22 0523 General Duty Valves for Plumbing Piping
22 0529 Hangers and Supports for Plumbing Piping and Equipment
22 0553 Identification for Plumbing Piping and Equipment
22 0700 Plumbing Insulation
22 1116 Domestic Water Piping
22 1119 Domestic Water Piping Specialties
22 1123 Domestic Water Pumps
22 1125 Facility Natural Gas Piping
22 1316 Sanitary Waste and Vent Piping
22 1319 Sanitary Waste Piping Specialties
22 1329 Sanitary Sewage Pumps
22 1429 Sump Pumps
22 3300 Electric Domestic Water Heaters
22 4000 Plumbing Fixtures
22 4700 Drinking Fountains and Water Coolers

Division 23 – Heating Ventilating and Air Conditioning

23 0500 Common Work Results for HVAC
23 0513 Common Motor Requirements for HVAC Equipment
23 0519 Thermometers and Gages for HVAC Piping
23 0523 General Duty Valves for HVAC Piping

9/21/18

Table of Contents

23 0529	Hangers and Supports for HVAC Piping and Equipment
23 0533	Heat Tracing for HVAC Piping
23 0553	Identification for HVAC Piping and Equipment
23 0593	Testing, Adjusting and Balancing for HVAC
23 0700	HVAC Insulation
23 0800	Commissioning for HVAC
23 0923	Instrumentation and Controls for HVAC
23 0993	Points List and Sequence of Operations for HVAC Controls
23 2113	Hydronic Piping
23 2123	Hydronic Pumps
23 3113	Metal Ducts
23 3300	Air Duct Accessories
23 3600	Air Terminal Units
23 3713	Diffusers, Registers and Grilles
23 6423	Scroll Water Chillers
23 7313	Modular Indoor Central Station Air Handling Units
23 8126	Split System Air Conditioners

Division 26 – Electrical

26 0500	Common Work Results for Electrical
26 0519	Low Voltage Electrical Power Conductors
26 0526	Grounding and Bonding
26 0529	Hangers and Supports for Electrical Systems
26 0533	Raceway and Boxes for Electrical Systems
26 0553	Identification for Electrical Systems
26 0800	Electrical Commissioning
26 0923	Lighting Control Devices
26 0943	Network Lighting Controls
26 2200	Low Voltage Transformers
26 2413	Switchboards
26 2416	Panelboards
26 2726	Wiring Devices
26 2816	Enclosed Switches and Circuit Breakers
26 2923	Variable Frequency Motor Controllers
26 3213	Engine Generators
26 3353	Static Uninterruptible Power Supply
26 3600	Transfer Switches
26 4113	Lightning Protection for Structures
26 5100	Interior Lighting
26 5600	Exterior Lighting

Division 27 – Communications

27 0000	Communications Basic Requirements
27 0526	Communications Grounding and Bonding
27 0528	Communications Building Pathways

9/21/18

Table of Contents

27 0800	Communications System Commissioning
27 0811	Communications Twisted Pair Testing
27 1100	Communications Equipment Rooms
27 1313	Communications Twisted Pair Cabling
27 2133	Communications Wireless Access Points
27 4116	Integrated Audio Video Systems and Equipment

Division 28 – Electronic Safety and Security

28 0000	Security Basic Requirements
28 0513	Security System Cabling
28 0553	Security System Labeling
28 0800	Security System Acceptance Testing
28 1300	Access Control & Alarm Monitoring System
28 1600	Intrusion Detection System
28 2300	Video Surveillance System (VSS)
28 3100	Voice Evacuation Fire Alarm System

Division 31 - Earthwork

31 1000	Site Preparation and Demolition
31 2200	Earthwork
31 2333	Trench Excavation
31 2334	Trench Backfill
31 2335	Trench Safety Systems
31 2500	Erosion Control
31 6301	Helical Piles

Division 32 – Exterior Improvements

32 1313	Portland Cement Concrete Pavement
32 8400	Planting Irrigation
32 9000	Planting
32 9200	Turf and Grasses

Division 33 –Site Utilities

33 1000	Water Distribution
33 3100	Wastewater Services
33 4000	Storm Drainage

NOTICE TO CONTRACTORS

OFFICIAL PUBLIC NOTICE
FANNIN COUNTY, TEXAS

TEXAS HISTORICAL COMMISSION
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PROPOSAL MUST BE CLEARLY MARKED

Notice is hereby given that Competitive Sealed Proposals (CSP) for the Interior & Exterior Restoration of the historic Fannin County Courthouse located in Bonham, Texas will be received until **1:30pm CST, October 23rd 2018**. Submit proposals to:

Via UPS, FedEx, Courier, or hand delivery:

Fannin County Purchasing
200 East 1st Street
Bonham, TX 75418
903-583-0054

Via USPS:

Fannin County Purchasing
101 E. Sam Rayburn Drive
Bonham, TX 75418

NOTE: The Time-Date Stamp Clock located in the County's Office will serve as the OFFICIAL CLOCK for the purpose of verifying the date and time of receipt of Proposals.

Proposals will be opened on October 23, 2018 at 1:30pm CST at 200 East 1st Street in Bonham, TX.

Electronic copies of plans and specifications may be obtained from the architect of record:

Architexas
ATTN: Renee Bresson
1907 Marilla, 2nd Floor
Dallas, TX 75201
214-748-4561
rbresson@architexas.com

A Proposal package containing information on the project and instructions for preparing and submitting a Proposal may be obtained from:

County's website:

www.co.fannin.tx.us

Texas State Business Daily:

www.txsmartbuy.com/sp

A Pre-Proposal Conference will be held at **10:00am CST on October 2, 2018** at the existing building located at:

101 E. Sam Rayburn Drive
Bonham, TX 75418

Although the Pre-Proposal Conference is not mandatory, Contractors are strongly encouraged to attend.

A Proposal Guarantee in the amount of five percent (5%) of the total Proposal must accompany the Proposal. Bid bond must be executed with a surety company authorized to do business in the State of Texas or bid shall be deemed unresponsive.

Proposers should use lump sum pricing in their Proposals but should be prepared to itemize work elements for purposes of negotiations. Retainage in the amount of 5% will be withheld from each payment.

Payment and Performance bonds in the amount of 100% of the contact amount will be required.

Contractors will be required to comply with all applicable Equal Employment Opportunity laws and regulations, all Federal, State, and local regulations for construction safety and health standards, and all state statutes and regulations and local ordinances relating to the performance of construction related services, including the County's HUB Subcontracting requirements.

The successful Contractor must commence work upon issuance by Owner of a written Notice to Proceed. The Owner reserves the right to reject any and all Proposals and to waive any formality in the Proposals received. Proposals may not be withdrawn for ninety- (90) calendar days after the date on which they are opened.

The Owner requires that Substantial Completion for this Project be achieved within **600** calendar days after a Notice to Proceed is issued.

END OF DOCUMENT

FANNIN COUNTY, TEXAS

TEXAS HISTORICAL COMMISSION
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REQUEST FOR PROPOSALS

#2018-02

CONSTRUCTION SERVICES
FANNIN COUNTY COURTHOUSE
INTERIOR & EXTERIOR RESTORATION

DEADLINE: October 23, 2018 at 1:30pm CST

FANNIN COUNTY PURCHASING
200 EAST 1ST STREET
BONHAM, TEXAS 75418

CONTACT:
Fannin County Purchasing
(903) 583-0054
fcch@fanninco.net

Request for Proposals

1. Purpose

Fannin County (COUNTY) is soliciting this request for Competitive Sealed Proposals (CSP) from General Contractors (GC) for the Fannin County Courthouse Interior & Exterior Restoration project (RFP #2018-02). Scope includes restoration of historic site, restoration and reconstruction of exterior masonry, tower and roof reconstruction, integration of new mechanical / plumbing / electrical / AV / IT / security systems, ADA upgrades, complete finish out and restoration of interior. The estimated completion date of the Project is 600 calendar days from the date of issuance of the Notice to Proceed under the Contract for Work. The estimated construction budget for the restoration Project is $14,500,000.00.

Selection will be based on the Offeror that submits the proposal that offers the best value for the COUNTY based on: (1) the selection criteria and the weighted value for those criteria in this request for proposal (RFP); and (2) the County's ranking evaluation.

The County reserves the right to reject any and all proposals, to modify, reschedule or cancel this RFP at any time prior to the submission deadline, and to waive irregularities or informalities in the responses and submission.

2. Responses to Solicitation

a. Submission of Proposals: Interested parties are instructed to carefully examine this entire RFP. Firms interested in providing services for this Project must provide written statements of proposals in accordance with this solicitation.

b. Proposal Guarantee: Proposal guarantee options are explained in Attachment D.

c. Deadline: Completed submissions must be received no later than Tuesday, October 23, 2018 at 1:30pm (CST). The COUNTY will not accept late submissions. Proposals must be delivered to the following address:

Via UPS, FedEx, Courier, or hand delivery:

Fannin County Purchasing
200 East 1st Street
Bonham, TX 75418
903-583-0054

Via USPS:

Fannin County Purchasing
101 E. Sam Rayburn Drive
Bonham, TX 75418

d. All proposals must be submitted in an opaque, sealed envelope. The name of the Offeror and the words Proposal for RFP for the Courthouse Selective Demolition Project must appear conspicuously on the face of the envelope.

e. Proposal opening: Proposals will be publicly opened on October 23, 2018 at 1:30pm CST at address above.

f. Pre-Proposal Conference will be held on Tuesday, October 2, 2018 at 10am CST at the existing building at 101 E. Sam Rayburn Drive, Bonham, TX 75418. Although the Conference is not mandatory, Contractors are strongly encouraged to attend.

g. Addenda: Any requests for interpretation, clarification, etc. must be submitted to the COUNTY no later than October 9, 2018 at 3pm CST or will not be considered. If the COUNTY determines that a response is required to requests received, the responses will be made by one or more addendum issued no later than October 16, 2018 at 3pm CST.

If the COUNTY, in its sole discretion and authority, determines that a clarification or modification is required, such information shall be issued in writing as an addendum. Offerors are encouraged to routinely check the County's website www.co.fannin.tx.us for any addenda. Offerors are responsible for reviewing any addenda prior to the submission deadline. Proposals will be subject to the terms of the RFP as modified or clarified by all addenda, and each Offeror will be bound by such terms, whether or not the Offeror has reviewed the addenda. Interpretations, corrections or changes to the RFP made in any other manner other than writing are not binding upon the COUNTY, and Offerors may not rely upon such interpretations, corrections or changes. Oral explanations or instructions given before the award of the Contract are not binding.

Contact: Fannin County Purchasing
200 East 1st Street
Bonham, TX 75418
Email: fcch@fanninco.net
Telephone: (903) 583-0054

3. Definitions

Addendum: An addition, change, or supplement to a solicitation document issued prior to the opening date.

Architect: The designated Architect acting for and on behalf of the COUNTY.

Best Value: Factors to be considered in determining lowest overall cost and highest worth in making certain purchases and/or procurements.

Bid Bond: The Bid Bond, from a surety company authorized to do business in the State of Texas, to be made by the Offeror, which is to accompany the Proposal as a guaranty of good faith to enter into a written Contract.

County: Fannin County, Texas (COUNTY).

Competitive Sealed Proposals (CSP): The process of advertising a request for proposal (RFP), the evaluation of submitted proposals and awarding of the contract.

Construction Documents: The plans, specifications, drawings, scope of work, associated and made a part of this Request for Proposal by Architexas – Architecture, Planning and Historic Preservation, Inc. for the COUNTY.

Contract: The agreement awarded as a result of this RFP and all exhibits thereto. This RFP, any Addendum issued in conjunction with this RFP, the successful respondent's proposal, and subsequent submission by respondent, may be incorporated therein.

Contract Documents: The Contract Documents will generally consists of the Contract, Addenda, the Bonds, Construction Documents, the specifications and drawings, together with all amendments, modifications, and supplements issued after Contract Time commences.

Contract Time: The number of calendar days or the date stated in the Contract for the completion of the Work.

General Contractor: Any person, company, or respondent who submits a response to this solicitation; GC.

Historically Underutilized Business (HUB): A minority or women-owned business as defined by Texas Government Code, Title 10, Subtitle D, Chapter 2161.

Offeror: Any individual, firm, joint venture, partnership, corporation or other legal entity submitting a Proposal or Bid.

Opening Date: The day and time, after submission of proposals, when sealed responses are opened.

Payment Bond: A surety Bond in the amount of the Contract, solely for the protection of all claimants supplying labor and material in the prosecution of the Work provided for in the Contract.

Performance Bond: A surety Bond in the amount of the Contract conditioned upon the faithful performance of the Work in accordance with the drawings and specifications. Said Bond is solely for the protection of the COUNTY.

Prevailing Wages: The general prevailing rates of per diem wages for specific classes of work within the locality of the project. The County has determined that the Prevailing Wage Rates for the Project are the Davis-Bacon wage rates for Fannin County as determined by the U.S. Department of Labor. The contractor and all subcontractors must pay workers not less than the Prevailing Wage Rates. A copy of the Prevailing Wage Rates for this Project is set out in Attachment H.

Proposal or Statement of Proposals: The written offer to the COUNTY made on the prescribed form by the Offeror to furnish the materials or equipment and / or perform the Work or services proposed.

Proposals Opening: The public opening of Statements of Proposals, in which the names of the offerors and the amount of their proposals to a solicitation are publicly read and recorded.

Request for Proposals (RFP): A solicitation document requesting submittal of proposals in response to the scope of goods and services and usually includes some form of a cost proposal. The RFP process allows for negotiations between a proposer and the issuing organization.

Work: The entire completed construction or the various separately identifiable parts thereof required to be finished under the Contract Documents. Work is the result of performing services, furnishing labor, and furnishing and incorporating materials and equipment into the construction, all as required by the Contract Documents.

4. Scope of Services

The following scope and approach is provided as basic guidance for responding to this RFP. The services to be provided shall include, but is not limited to, the following:

a. The GC shall provide all labor, material and equipment required to complete the selective demolition of the courthouse, contained within the Construction Documents within 600 calendar days.

b. Perform the Work described in the Construction Documents. Offerors are instructed to carefully review the Construction Documents, which are incorporated into this RFP.

c. The COUNTY will contract separately with a different provider for construction materials engineering, testing and inspection services and verification testing in order to determine the acceptability of the Work.

5. Selection Process

A Selection Committee comprised of representatives of the COUNTY and Architect will review and evaluate the responses to this RFP, score the Proposals based on the scores received, and make a recommendation for selection to the County Commissioners Court. The Commissioners Court will make the final decision on the selection of the Offeror who provides the best value. The COUNTY shall select the Offeror which, in the determination of the Commissioners Court, has submitted the proposal that offers the best value for the COUNTY based on: (1) the selection criteria in this RFP, and the scores received, and (2) the COUNTY'S ranking evaluation.

COUNTY reserves the right to interview Offerors, and to contact any individual, agencies or employers listed in a submittal, to contact others who may have experience and/or knowledge of the Offeror's relevant performance and/or qualifications; and to request additional information from any and all Offerors.

The COUNTY reserves the right to conduct a review of records, systems, procedures, etc., of any entity selected for award. This may occur prior to, or subsequent to the award of the Contract. Material misrepresentation of the Offeror's ability to perform as stated in the Statement of Proposals may result in cancellation of the Contract.

Statements of Proposals that do not meet the requirements outlined in this RFP may be deemed non-responsive by the Selection Committee.

6. Selection Criteria

The Selection Committee, in their deliberations, will consider the following factors using the evaluation rating system shown below. Submittals will be evaluated and ranked according to points received:

a. Price *(35 points)*

b. Delivery Schedule *(25 points)*

c. Past Experience on Projects of Similar Size and Scope *(15 points)*

d. References *(10 points)*

e. Proposed Subcontractors *(15 points)*

TOTAL POINTS POSSIBLE = 100

7. Selection and Negotiations

a. After receipt of the written proposal submittals, Offerors will be evaluated and ranked on the selection criteria described in this RFP.

b. The COUNTY may make the selection of the successful Offeror on the basis of the proposals initially submitted, without discussion, clarification or modification.

c. The COUNTY will enter into negotiations with the Offeror determined to be the first-ranked Offeror by the Commissioners Court to reach an appropriate scope and fee for the Project.

d. If the COUNTY is unable to negotiate a satisfactory contract with the first-ranked Offeror, the COUNTY shall, formally and in writing, end negotiations with that Offeror and proceed to the next-ranked Offeror in the order of the selection ranking until a contract is reached or all proposals are rejected.

e. The COUNTY reserves the right to negotiate all elements of the Proposal with the Offeror.

f. The successful Offeror will be required to enter into a written Contract for Construction Services with Fannin County, as described in this RFP. Offeror shall agree to a lump sum fee, which shall include all costs associated with the services outlined herein. Costs sometimes billed separately as reimbursable costs shall be declared and included in the lump sum amount for negotiation purposes. Invoices shall be provided by GC setting forth the percentage of work completed to date, establishing the amount due based on the percentage completed, less retainage, any previous amounts billed, and/or paid to date.

g. The COUNTY will notify the selected and non-selected Offerors in writing regarding the results of the selection process.

h. The selection for these services will be in accordance with the procurement regulations and practices of COUNTY.

i. COUNTY reserves the right to reject any and all submissions entirely at its discretion, waive technicalities or irregularities, and/or accept that proposal which it deems to be in the best interest of the COUNTY. COUNTY reserves the right to reject any and all proposals, to modify, reschedule or cancel this RFP at any time prior to the submission deadline, and to waive irregularities of informalities in the responses and submission.

8. Award of Contract

The COUNTY reserves the right to accept or reject any and all proposals and to: (a) re-solicit for proposals; or (b) abandon, temporarily or permanently this selection process, as it deems necessary to be in the best interests of the COUNTY**.** Receipt and consideration of any proposal shall, under no circumstances, obligate the COUNTY to accept any proposal.

9. Statement of Proposals Contents

Submittals shall include the following:

a. Cover Sheet and Prices (Attachment A)

Include the complete legal name of the proposing GC, the location of the office which will have the responsibility for the services to be provided, and the name, address, telephone, facsimile number, and e-mail address of the primary authorized representative knowledgeable of the submittal. The total amount of the bid proposal (including Alternates and unit pricing) and GC's authorized signature must appear on this sheet.

b. Scope of Services and Delivery Schedule (not to exceed 3 sheets)

Each Offeror shall include in its proposal a detailed scope of services which shows project approach and understanding of the process to undertake such complex project and complete it on time and in compliance with all applicable rules, regulations, standards and requirements.

The Offeror shall also include description of its ability to meet the estimated completion date and indicate the amount of days the Offeror requires to complete the Work. The Offeror shall also indicate an estimate of its earliest start date and its methods of developing and maintaining project schedules.

c. Overall Qualifications and Experience (not to exceed 3 sheets)

State the overall qualifications and experience of the firm. Include a list of several comparable projects the firm has completed in the past five (5) years. Please include: name; location; delivery method; project description (size, renovation, rehab, or new); costs; number of change orders; name of project manager and superintendent; name of Owner representative; and names of each subcontractor (mechanical, plumbing, electrical, etc.).

State the overall depth of staff, including experience relevant to the scope of work. Include work experience history for the proposed project manager, superintendent and each key team member that are most likely to be directly involved with the Work. Include an organizational chart and descriptions of

the key team members' roles and responsibilities in performing the proposed services.

Disclose any current or former employees who are current or former employees of the COUNTY. Disclose any proposed personnel who are related to any current or former employees of the COUNTY.

Offerors must disclose: (1) any pending litigation; (2) any litigation within the last five (5) years; and (3) any litigation within the last seven (7) years in conjunction with construction contracts. The proposer shall provide information on the circumstances and status of any disciplinary action taken against the firm or any individuals with the Offeror that will be assigned to this project, during the past three (3) years with any state, local or federal regulatory bodies or professional organizations.

d. References (Attachment B)

Provide the names, addresses, email address and telephone numbers of references for three (3) projects completed in the past five (5) years, and the firm's permission to contact these and other known references to verify past performance. The references *shall not include* Fannin County, Texas or any of its boards, commissions, departments, officials or employees.

e. Proposed Subcontractors (Attachment C)

Each Offeror must provide a list of all subcontractors which will be used on this project and include a work history for each of the subcontractors.

f. Proposal Guarantee (Attachment D)

Provide a proposal bond from a surety company authorized to do business in the State of Texas for five percent (5%) of the total proposal with submitted proposal. If the successful Offeror fails to sign the construction contract with the County within (10) days after the award, or to provide the payment and performance bonds or required insurance within 10 days thereafter, the COUNTY will have the right to make demand on the proposal bond. A performance and payment bond for the full amount of the construction contract is required from the successful Offeror prior to commencement of the Work.

g. Residence Certification / Tax Form (Attachment E)

Each Offeror must complete Attachment E – Residence Certification / Tax Form.

h. Proof of Insurance (Attachment F and G)

Each Offeror should include current and valid proofs of insurance. Insurance certificates showing the Offeror's EXISTING insurance coverage should be provided with the Proposal as described in Attachment F. Attachment F also sets out the insurance that the selected Offeror will be required to maintain, and to require its subcontractors to maintain, under the Construction Contract. Attachment G sets out the legal requirements for Workers Compensation Insurance Coverage applicable to this Project.

i. Historically Underutilized Business (HUB) Requirements

Historically Underutilized Business Subcontracting Plan (HSP) shall be included with bid response or bid shall be deemed unresponsive.

Forms are attached.

j. Pursuant to Amended Texas Government Code Chapter 2270 in regards to HB 89, effective September 1, 2017

Prohibition on Contracts with Companies Boycotting Israel. Effective September 1, 2017, a state agency and a political subdivision (which includes a county) may not enter a contract with a company for goods and services unless contract contains written verification from the company that: (i) it does not Boycott Israel; and (ii) will not Boycott Israel during the term of the contract. **Therefore the included House Bill 89 Verification shall be included within bid package or said bid shall not be considered.**

Forms are attached.

k. Pursuant to Government Code 2252.908 in regards to HB 1295

Filing of application of Certificate of Interested Parties (Form 1295) shall be completed and included in within bid package or said bid shall not be considered. Below is the link to the State of Texas Ethics Commission Form 1295 Certificate of Interested Parties Electronic Filing Application:

https://www.ethics.state.tx.us/whatsnew/elf_info_form1295.htm

10. Professional Standards

Contractor will use its best efforts, skill, judgment, and abilities to perform the Work and services and to further the interests of COUNTY. All work performed in connection with the contract shall be performed in a good and workmanlike manner, in accordance with the plans and specifications, the COUNTY'S requirements and procedures, and in compliance with all applicable national, federal, state, and municipal, laws, regulations, codes, ordinances and orders (collectively, the "Applicable Laws").

Without limiting the foregoing, Contractor is aware of, is fully informed about, and in full compliance with its obligations under existing applicable law and regulations, including Title VI of the Civil Rights Act of 1964, as amended (42 USC 2000(D)), Executive Order 11246, as amended (41 CFR 60-1 and 60-2), Vietnam Era Veterans Readjustment Act of 1974, as amended (41 CFR 60-250), Rehabilitation Act of 1973, as amended (41 CFR 60-741), Age Discrimination Act of 1975 (42 USC 6101 et seq.), Non-segregated Facilities (41 CFR 60-1), Omnibus Budget Reconciliation Provision, Section 952, Fair Labor Standards Act of 1938, Sections 6, 7, and 12, as amended, Immigration Reform and Control Act of 1986, and Utilization of Small Business Concerns and Small Business Concerns Owned and Controlled by Socially and Economically Disadvantaged Individuals (PL 96-507), the Americans with Disabilities Act of 1990 (42 USC 12101 et seq.), the Civil Rights Act of 1991 and all laws and regulations and executive orders as are applicable.

11. Completion of Responses

a. Information presented in the Proposals will be used to evaluate the professional qualifications of the Offerors and to determine the Offeror which will be selected by the COUNTY.

b. Responses shall be completed in accordance with the requirements of this RFP. Statements made by an Offeror shall be without ambiguity and with adequate elaboration where necessary for clear understanding.

12. Withdrawal of Proposals

An authorized representative of the Offeror may withdraw their Proposal at any time prior to the RFP submission deadline.

13. Tentative Schedule of Events

RFP Posting Date	9/21/18
Pre-Proposal Conference	10/02/18
Deadline for Submission of Questions	10/09/18
Deadline for Responses to Questions	10/16/18
Deadline for Submission of Proposals	10/23/18
Expected Selection and Award	11/06/18

COUNTY reserves the right to change the dates in the Tentative Schedule listed above upon notification on the COUNTY website. It is the responsibility of

interested parties to periodically review the COUNTY website for updates to the RFP prior to submitting Proposals.

14. Period of Acceptance

Offeror acknowledges that by submitting the Proposals, the Offeror makes an offer that, if accepted by the COUNTY, constitutes a valid and binding contract as to any and all items accepted in writing by the COUNTY. The period of acceptance of Proposals is ninety (90) calendar days from the date of proposal opening.

15. Tax Exemption

The COUNTY is exempt from federal excise and state sales tax; therefore, taxes must not be included in the proposed contact amount.

16. Terms of Payment

The selected Offeror will be required to enter into a written Construction Contract with Fannin County, Texas which will incorporate the terms of this RFP into the Contract. The COUNTY intends to utilize AIA A101 Standard Form of Agreement between Owner and Contractor with addenda, and the A201 General Conditions, all as modified by the COUNTY.

The successful Offeror shall agree to a lump sum fee payment, which shall include all costs associated with the services outlined herein and those mutually agreed upon prior to contract execution. Any cost billed separately as a reimbursable shall be declared and included in the lump sum amount. Invoices shall be provided by the Offeror which set forth the percentage of work completed to date, establishing the amount due based upon the percentage completed less any previous amounts paid. Payments shall be made in accordance with Texas Government Code, Chapter 2251.

17. Prevailing Wages

Texas Government Code Chapter 2258 requires the Offeror and all subcontractors to pay not less than the Prevailing Wage Rates to all persons performing labor for the Project. The Offeror and all subcontractors must comply with the applicable provisions of Chapter 2258. The Prevailing Wage Rates for

this Project are the Davis Bacon Wage Rates for Fannin County, Texas described in Attachment H, hereto.

18. Workers' Compensation

Offeror must comply with Workers' Compensation requirements in accordance with the State of Texas rules and regulations, including the requirement that the Offeror and all subcontractors maintain worker's compensation coverage on their employees.

19. Insurance

A certificate of the Offeror's existing insurance coverage shall be submitted with the statement of proposals as proof of insurability. If the current coverage does not meet the insurance requirements, that will be required in the construction contract, as described in Attachment F, the Offeror should request an affidavit of insurability from its insurance agent that certifies the requirements can and will be met. Failure to provide the required insurance coverage may be cause for nullification of an award of the Contract. The Offeror represents and warrants that it will provide the COUNTY within 10 days after execution of the construction contract, and prior to the commencement of the work, a certificate of insurance evidencing that the Offeror has obtained all of the insurance coverage with endorsements, as described in Attachment F.

20. Availability of Records

Fannin County, and any duly authorized representatives of same, shall have, for a period of not less than four (4) years after the Contract term, access to, and the right to examine any and all pertinent books, records, documents, invoices, papers, and the like, of the individual(s) or firm(s) office or firm, which shall relate to the performance of the Work or services to be provided.

21. Public Information

The COUNTY is a subdivision of the State of Texas and is subject to the Texas Public Information Act, Chapter 552 of the Texas Government Code. Any information submitted to the COUNTY is presumed to be public information and available to the public. If the Offeror believes that any information or materials submitted to the COUNTY as part of its Proposal or in connection therewith, including financial or proprietary information, is exempt from disclosure under the

Texas Public Information Act, then the Offeror must clearly and conspicuously write the word “CONFIDENTIAL” on each page containing confidential information. If a request is made for copies of the information marked Confidential under the Texas Information Act, the COUNTY will advise the Offeror of the request. If requested by the Offeror, the COUNTY request an opinion from the Texas Attorney General’s Office as to whether the information is subject to disclosure under the Texas Public Information Act. The Offeror shall be responsible for timely providing information to the Texas Attorney General to substantiate its claim that the information is not subject to disclosure. The COUNTY will abide by the decision of the Office of the Texas Attorney General.

22. Independent Relationship

Offeror is and shall remain an independent contractor in relation to the COUNTY. The COUNTY shall not be responsible for withholding taxes from payments made under any contract resulting from this RFP. Offeror shall have no claim against the COUNTY for vacation pay, sick leave, retirement benefits, social security, workers’ compensation, health or disability benefits, unemployment insurance benefits, or employee benefits of any kind.

23. Cost Incurred in Responding

All costs directly or indirectly related to preparation of a response to the RFP or any oral presentation required to supplement and/or clarify a Proposal which may be required by the COUNTY shall be the sole responsibility of and shall be borne by the Offeror.

24. Construction Contract

The COUNTY intends to utilize AIA A101 Standard Form of Agreement between Owner and Contractor with addenda, and the A201 General Conditions, all as modified by the COUNTY.

25. Non-Endorsement or Publicity

The successful Offeror shall not issue any news releases or other statements pertaining to the award or services to be performed under the Contract which would state or imply the COUNTY’S endorsement of the Offeror’s services.

26. Unauthorized Communications

All communications in connection with RFP must be made only with Fannin County Purchasing.

After issuance of this RFP and until such time as the contract for the work has been finally awarded, Offerors are prohibited from contacting the County Judge, County Commissioners, or any COUNTY staff member other than Fannin County Purchasing, and from allowing or authorizing others to do so, in order to ask questions, present information on the RFP or the Project or to influence the selection of the GC. Failure to comply with these requirements may be grounds for disqualification.

27. Assignment

The selected Offeror may not assign its rights or duties under an award of the contract and may not assign its obligations under the Contract.

28. Errors or Omissions

Offerors will not be allowed to rely on any errors or omissions in this RFP. Where errors or omissions appear in this RFP, the Offeror shall promptly notify the COUNTY in writing of the error or omission it discovers. Any errors, omissions or inconsistencies in this RFP that would have a material adverse effect on the Project must be reported to the COUNTY no later than seven (7) calendar days prior to the published submission deadline.

29. Right to Assurance

After the award of the Contract, whenever the COUNTY has reason to question the Offerors intent to perform, the COUNTY may demand that the Offeror give written assurance of Offeror's intent to perform. In the event a demand is made, and no assurance is given within seven (7) calendar days, the COUNTY may treat this failure as an anticipatory repudiation of the contract.

30. Change Orders

No oral statement of any person shall modify or otherwise change or affect the terms, conditions or specifications stated in the resulting contract. No change order shall be valid or enforceable unless it is in writing and approved by the Commissioners Court, and signed by the COUNTY and the Offeror.

31. Venue

The RFP and any resulting contract will be governed by and construed according to the laws of the State of Texas. Venue for any claim or dispute arising in connection with this RFP shall lie exclusively in courts of competent jurisdication in Fannin County, Texas.

32. Conflict of Interest/Disclosures

In submitting a proposal, each Offeror represents and warrants to the COUNTY that Offeror and its employees, agents and representatives have no actual or potential conflicts of interest in providing services to the COUNTY under this RFP and that the provision of services under this RFP would not create an appearance of impropriety.

Each Offeror represents and warrants that it has a duty if awarded the Contract to immediately advise the COUNTY once it becomes aware that any of the representations and warranties made pursuant to this RFP are no longer accurate.

33. Acceptance of Evaluation Methodology and Waiver of Claims

By submitting a Proposal in response to this RFP, each Offeror accepts the evaluation process utilized by the COUNTY, and acknowledges and accepts that the determination of the Offeror that offers the "best value" will require subjective judgments by the Selection Committee, the COUNTY'S personnel and the Commissioners Court. Each Offeror further acknowledges that evaluations are required to be made public in accordance with Applicable Law. **BY SUBMITTING A PROPOSAL TO THE RFP, THE OFFEROR AGREES THAT IT WAIVES ANY CLAIMS IT HAS OR MAY HAVE AGAINST THE COUNTY, THE MEMBERS OF THE SELECTION COMMITTEE, THE COUNTY'S EMPLOYEES, OFFICERS, AGENTS, REPRESENTATIVES, AND THE COUNTY JUDGE AND THE COUNTY COMMISSIONERS IN CONNECTION WITH OR ARISING OUT OF THIS RFP, INCLUDING THE ADMINISTRATION OF THE RFP, THE BASIS FOR SELECTION, AND ANY DISCLOSURE OF INFORMATION REGARDING THE OFFERORS OR EVALUATIONS.**

ATTACHMENT A

TEXAS HISTORICAL COMMISSION
real places telling real stories

FANNIN COUNTY

RFP #2018-02

COVER SHEET

COMPANY NAME: _____

ADDRESS: _____

_____

EMAIL ADDRESS: _____

TELEPHONE: _____

REPRESENTATIVE NAME (PRINT): _____

Please agree to the following below:

I, _____ , an authorized representative of the firm indicated above, have reviewed and understand the Fannin County's RFP for Construction Services to perform the Work specified in the Contract Documents.

_____ _____

Signature *Date*

TOTAL BASE BID (INCLUDING ALLOWANCES): $ _____

ADD ALTERNATE #1 - PERIMETER WALL $_____

UNIT PRICE #1 - MASONRY CLEANING $_____

UNIT PRICE #2 – MASONRY PATCHING $_____

UNIT PRICE #3 – MASONRY REPLACEMENT $_____

UNIT PRICE #4 – METAL PAN VAULT CEILING $_____

UNIT PRICE #5 – MASONRY INFILL $_____

UNIT PRICE #6 – WOOD JOIST REPLACEMENT $_____

ATTACHMENT B

FANNIN COUNTY

RFP #2018-02

REFERENCES

Provide a minimum of three (3) government entities or companies for which you have performed similar work of the same scope and size as defined in this RFP. If additional space is required, include attachment to this section of the RFP.

REFERENCE #1

ENTITY: _____

PROJECT: _____

DATE OF SERVICE: _____

PROJECT COST: _____

POINT OF CONTACT: _____

TELEPHONE: _____ EMAIL: _____

BRIEF DESCRIPTION OF WORK PERFORMED: _____

_____

_____

_____

ATTACHMENT B

REFERENCE #2

ENTITY: _____

PROJECT: _____

DATE OF SERVICE: _____

PROJECT COST: _____

POINT OF CONTACT: _____

TELEPHONE: _____ EMAIL: _____

BRIEF DESCRIPTION OF WORK PERFORMED: _____

_____

_____

_____

REFERENCE #3

ENTITY: _____

PROJECT: _____

DATE OF SERVICE: _____

PROJECT COST: _____

POINT OF CONTACT: _____

TELEPHONE: _____ EMAIL: _____

BRIEF DESCRIPTION OF WORK PERFORMED: _____

_____

_____

_____

ATTACHMENT C

FANNIN COUNTY

RFP #2018-02

LIST OF SUBCONTRACTORS

Provide a list of the subcontractors with contact information that the GC proposes to use on the project. If additional space is required, include attachment to this section of the RFP.

SUBCONTRACTOR #1

COMPANY NAME: _____

TRADE: _____

POINT OF CONTACT: _____

TELEPHONE: _____ EMAIL: _____

WORK HISTORY: _____

_____

_____

SUBCONTRACTOR #2

COMPANY NAME: _____

TRADE: _____

POINT OF CONTACT: _____

TELEPHONE: _____ EMAIL: _____

WORK HISTORY: _____

_____

_____

ATTACHMENT C

SUBCONTRACTOR #3

COMPANY NAME: _____

TRADE: _____

POINT OF CONTACT: _____

TELEPHONE: _____ EMAIL: _____

WORK HISTORY: _____

_____

_____

SUBCONTRACTOR #4

COMPANY NAME: _____

TRADE: _____

POINT OF CONTACT: _____

TELEPHONE: _____ EMAIL: _____

WORK HISTORY: _____

_____

_____

SUBCONTRACTOR #5

COMPANY NAME: _____

TRADE: _____

POINT OF CONTACT: _____

TELEPHONE: _____ EMAIL: _____

WORK HISTORY: _____

_____

_____

ATTACHMENT C

SUBCONTRACTOR #6

COMPANY NAME: _____

TRADE: _____

POINT OF CONTACT: _____

TELEPHONE: _____ EMAIL: _____

WORK HISTORY: _____

_____

_____

SUBCONTRACTOR #7

COMPANY NAME: _____

TRADE: _____

POINT OF CONTACT: _____

TELEPHONE: _____ EMAIL: _____

WORK HISTORY: _____

_____

_____

SUBCONTRACTOR #8

COMPANY NAME: _____

TRADE: _____

POINT OF CONTACT: _____

TELEPHONE: _____ EMAIL: _____

WORK HISTORY: _____

_____

_____

ATTACHMENT C

SUBCONTRACTOR #9

COMPANY NAME: _____

TRADE: _____

POINT OF CONTACT: _____

TELEPHONE: _____ EMAIL: _____

WORK HISTORY: _____

_____

_____

SUBCONTRACTOR #10

COMPANY NAME: _____

TRADE: _____

POINT OF CONTACT: _____

TELEPHONE: _____ EMAIL: _____

WORK HISTORY: _____

_____

_____

ATTACHMENT D

FANNIN COUNTY

RFP #2018-02

PROPOSAL GUARANTEE

A guarantee shall be submitted with each proposal that the Offeror will execute the construction contract within 10 days after the award and furnish performance and payment bonds and required insurance within 10 days after the contract has been signed. The performance and payment bonds shall be in the amount of 100% of contract price, and shall be executed by a surety company authorized to do business in the State of Texas. If performance and payment bonds are not returned to the COUNTY within 10 days from the award, the COUNTY has the right to render the award ineffective.

Offeror guarantee should be submitted to the COUNTY with the proposal prior to the RFP deadline in the amount of 5% of the proposal. The bid bond, must be executed with a surety company authorized to do business in the State of Texas or bid shall be deemed unresponsive. The proposal guarantee should be attached to this form and submitted with proposal to the following address:

Via UPS, FedEx, Courier, or hand delivery:	Via USPS:
Fannin County Purchasing	**Fannin County Purchasing**
200 East 1st Street	**101 E. Sam Rayburn Drive**
Bonham, TX 75418	**Bonham, TX 75418**

The COUNTY may retain all bonds and proposal checks of the Offerors selected for potential negotiations until after the award and approval of the contract and receipt of performance and payment bonds, and required insurance from the successful Offeror. Authorization is hereby granted for the COUNTY to return the proposal check via regular mail without liability of any kind or nature to the address listed below.

BID FOR: _____ CHECK #:_____

DRAWN ON: _____ BANK: _____

DATED: _____ AMOUNT $: _____

NAME: _____

ADDRESS: _____

_____ TELEPHONE: _____

SIGNATURE: _____

ATTACHMENT E

FANNIN COUNTY

RFP #2018-02

RESIDENCE CERTIFICATION / TAX FORM

Pursuant to Texas Government Code §2252.001 *et seq*., as amended, the COUNTY requests Residence Certification. §2252.001 *et seq*. of the Government Code provides some restrictions on the awarding of governmental contracts; pertinent provisions of §2252.001 are stated below:

(3) "Nonresident bidder" refers to a person who is not a resident.

(4) "Resident bidder" refers to a person whose principal place of business is in this state, including a contractor whose ultimate parent company or majority owner has its principal place of business in this state.

☐ I certify that _____ (Company Name) is a Resident Bidder of Texas as defined in Government Code §2252.001

☐ I certify that _____ (Company Name) is a Nonresident Bidder of Texas as defined in Government Code §2252.001 and our principal place of business is in _____ (City and State)

TAXPAYER IDENTIFICATION NUMBER (T.I.N.): _____

COMPANY NAME SUBMITTING BID PROPOSAL: _____

ADDRESS: _____

_____

SIGNATURE: _____

ATTACHMENT F

FANNIN COUNTY

RFP #2018-02

INSURANCE REQUIREMENTS

A. Certificate Of Insurance Showing Offeror's Existing Coverage

The Offeror must include with its Proposal an insurance certificate in Acord form showing the insurance which the Offeror currently maintains.

B. Insurance which will be Required under the Construction Contract.

The following insurance requirements which will be set out in the Construction Contract. The selected Offeror must provide, at a minimum, the insurance required below. The selected Offeror must provide a certificate of insurance no later than 10 days after the construction contract is signed, as evidence that the required coverage has been obtained, and must provide the proof that subcontractors have obtained Workers Compensation Insurance as described in Attachment G.

(1) General Requirements.

Contractor shall carry insurance in the types and amounts indicated below for the duration of the Contract, (or such longer period as may be stated below) which coverage shall extend to, and include, items owned by Owner in the care, custody and control of Contractor prior to and during construction and warranty period.

Contractor must complete and forward the Certificate of Insurance to Owner no later than 10 days after the Contract is executed, and before any Work is performed on Owner's Property, as verification that the required coverage has been obtained. Contractor shall not commence Work until the required insurance is obtained and until such insurance has been reviewed by Owner. Approval of insurance by Owner shall not relieve or decrease the liability of Contractor hereunder and shall not be construed to be a limitation of liability on the part of Contractor. Contractor must also complete and forward the Certificate of Insurance to Owner whenever a previously identified policy period has expired, or Contractor obtains insurance through a new insurer, as verification of continuing coverage.

Contractor's insurance coverage is to be written by companies licensed to do business in the State of Texas at the time the policies are issued and shall be written by companies with A.M. Best ratings of A VII or better.

All endorsements naming the Owner as additional insured, waivers, and notices of cancellation endorsements as well as the Certificate of Insurance shall show the following contact information and address for the Owner:

Fannin County, Texas

Attn.: Purchasing Agent

200 East 1st Street

Bonham, TX 75418

Phone (903) 583-0054

.

The "other" insurance clause shall not apply to the Owner where the Owner is an additional insured shown on any policy. It is intended that policies required in the Contract, covering both Owner and Contractor, shall be considered primary coverage as applicable.

If insurance policies are not written for amounts specified below, Contractor shall carry Umbrella or Excess Liability Insurance for any differences in amounts specified. If Excess Liability Insurance is provided, it shall follow the form of the primary coverage.

Owner shall be entitled, upon request and without expense, to receive certified copies of policies and endorsements thereto and may make any reasonable requests for deletion or revision or modification of particular policy terms, conditions, limitations, or exclusions except where policy provisions are established by law or regulations binding upon either of the parties hereto or the underwriter on any such policies.

Owner reserves the right to review the insurance requirements set forth during the effective period of this Contract and to make reasonable adjustments to insurance coverage, limits, and exclusions when deemed necessary and prudent by Owner based upon changes in statutory law, court decisions, the claims history of the industry or financial condition of the insurance company as well as Contractor. Provided, however, in event of any such adjustments by Owner, Contractor shall be entitled to a Change Order for any increased costs Contractor incurs as a result of such adjustments.

Contractor shall not cause any insurance to be canceled nor permit any insurance to lapse during the term of the Contract or as required in the Contract.

Contractor shall be responsible for premiums and deductibles stated in policies. All deductibles shall be disclosed to Owner upon request.

Contractor shall provide Owner thirty (30) days written notice of erosion of the aggregate limits below occurrence limits for all applicable coverages indicated within the Contract.

If Owner owned property is being transported or stored off-site by Contractor, then the appropriate property policy will be endorsed for transit and storage in an amount sufficient to protect Owner's property.

The insurance coverages required under this Contract are required minimums and are not intended to limit the responsibility or liability of Contractor.

(2) **Business Automobile Liability Insurance.** Provide coverage for all owned, non-owned and hired vehicles. The policy shall contain the following endorsements in favor of Owner or such alternate endorsement designations as Owner may hereafter specify:

a) Waiver of Subrogation endorsement TE 2046A or its equivalent;

b) 30 day Notice of Cancellation endorsement TE 0202A or its equivalent; and

c) Additional Insured endorsement TE 9901 B or its equivalent.

Provide coverage in the following types and amounts:

A minimum combined single limit of $500,000 per occurrence for bodily injury and property damage.

(3) **Workers' Compensation and Employers' Liability Insurance**. Coverage shall be consistent with statutory benefits outlined in the Texas Workers' Compensation Act (Section 401). The Certificate of Insurance must be presented as evidence of coverage for Contractor. Contractor's policy shall apply to the State of Texas and include these endorsements or their equivalents in favor of Owner:

a) Waiver of Subrogation, form WC 420304; and

b) 30 day Notice of Cancellation, form WC 420601.

The minimum policy limits for Employers' Liability Insurance coverage shall be as follows:

$500,000 bodily injury per accident, $500,000 bodily injury by disease policy limit and $500,000 bodily injury by disease each employee.

(**4)** **Commercial General Liability Insurance.** The Policy shall contain the following provisions:

a) Blanket contractual liability coverage for liability assumed under the Contract and all contracts relative to this Project.

b) Completed Operations/Products Liability for the duration of the warranty period.

c) Explosion, Collapse and Underground (X, C & U) coverage.

d) Independent Contractors coverage.

e) Aggregate limits of insurance per project, endorsement CG 2503.

f) Owner shall be listed as an Additional Insured, endorsement CG 2010 10 11 (or its equivalent) on a primary and non-contributory basis.

g) 30-day notice of cancellation in favor of Owner, endorsement CG 0205.

h) Waiver of Transfer of Recovery Against Others in favor of Owner, endorsement CG 2404.

i) Coverage shall not include any endorsements or policy language excluding or limiting Products/ Completed Operations coverage, Contractual or Cross Liability.

Continuous coverage must be maintained for the duration of this Contract and for not less than thirty-six (36) months following substantial completion of the Project.

Provide coverages A&B with minimum limits as follows:

A combined bodily injury and property damage limit of $2,000,000 per occurrence.

Per Occurrence Limit shall be at least $ 1,000,000.

General & Products/Completed Operations Aggregate Limit shall be at least $2,000,000.

(5) **Builders' Risk Insurance.** Coverage shall be in the contract amount and coverage shall continue until the Work is accepted by Owner. Owner shall be a loss payee on the policy. If off site storage is permitted, coverage shall include transit and storage in an amount sufficient to protect property being transported or stored. The insurance shall include coverage for loss of use of Owner's property due to fire or other hazards covered by such insurance.

(6) **Umbrella Excess Liability Coverage** in an amount of not less than Two Million Dollars ($2,000,000), combined single limit bodily injury/property damage with coverage to be in excess of the employer's liability, commercial general liability, and automobile liability insurance required above for each occurrence and in the aggregate. Owner shall be listed as an additional insured. A waiver of subrogation endorsement shall be obtained in favor of Owner, and a 30 day notice of cancellation endorsement in favor of the Owner.

Subcontractor Insurance Requirements:

Contractor shall require its Subcontractors to maintain (i) commercially reasonable liability insurance coverage in accordance with requirements established by Contractor with waiver of subrogation endorsements in favor of Owner and Contractor; and (ii) worker's compensation and employer's liability insurance meeting, at a minimum, the same requirements identified in (3) above.

ATTACHMENT G

FANNIN COUNTY

RFP #2018-02

TWCC RULE 110.110 - WORKERS' COMPENSATION INSURANCE COVERAGE

If this bid proposal package is for a building or construction contract, all of the provisions of this rule as shown below apply. Since this is a mandatory requirement, cost increases should not be experienced because of the need to comply with the Texas Workers' Compensation Law. For additional information contact the:

Texas Workers' Compensation Commission
Southfield Building
400 S. IH-35
Austin, TX 78704-7491
(512) 440-3618

A. Definitions:

Certificate of coverage ("Certificate"):
A copy of a certificate of insurance, a certificate of authority to self-insure issued by the commission, or a coverage agreement, TWCC-81, TWCC-82, TWCC-83, or TWCC-84 showing statutory workers' compensation insurance coverage for the person's or entity's employees providing services on a project, for the duration of the project.

Duration of the project:
Includes the time from the beginning of the work on the project until the contractor's / person's work on the project has been completed and accepted by the governmental entity.

Persons providing services on the project ("subcontractor" in §406.096):
Includes all persons or entities performing all or part of the services the contractor has undertaken to perform on the project, regardless of whether that person contracted directly with the contractor and regardless of whether that person has employees. This includes, without limitation, independent contractors, subcontractors, leasing companies, motor carriers, owner-operators, employees of any such entity, or employees of any entity which furnishes persons to provide services on the project. "Services" include, without limitation, providing, hauling or delivering equipment or materials, providing labor, transportation, or other service related to a project. "Services" does not include activities unrelated to the project, such as food / beverage vendors, office supply deliveries, and delivery of portable toilets.

B. The Contractor shall provide coverage, based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements, which meets the statutory requirements

of Texas Labor Code, Section 401.011(44) for all employees of the contractor providing services on the project, for the duration of the project.

C. The Contractor must provide a certificate of coverage to the governmental entity prior to being awarded the contract.

D. If the coverage period shown on the Contractor's current certificate of coverage ends during the duration of the project, the Contractor must, prior to the end of the coverage period, file a new certificate of coverage with the governmental entity showing that coverage has been extended.

E. The Contractor shall obtain from each person providing services on a project, and provide to the governmental entity:

(1) A certificate of coverage, prior to that person beginning work on the project, so the governmental entity will have on file certificates of coverage showing coverage for all persons providing services on the project; and

(2) No later than seven (7) days after receipt by the Contractor, a new certificate of coverage showing extension of coverage, if the coverage period shown on the current certificate of coverage ends during the duration of the project.

F. The Contractor shall retain all required certificates of coverage for the duration of the project and for one (1) year thereafter.

G. The Contractor shall notify the governmental entity in writing by certified mail or personal delivery, within ten (10) days after the contractor knew or should have known, of any change that materially affects the provision of coverage of any person providing services on the project.

H. The Contractor shall post on each project site a notice, in the text, form and manner prescribed by the Texas Workers' Compensation Commission, informing all persons providing services on the project that they are required to be covered, and stating how a person may verify coverage and report lack of coverage.

I. The Contractor shall contractually require each person with whom it contracts to provide services on a project to:

(1) Provide coverage, based on reporting of classification codes and payroll amounts and filing of any coverage agreements, which meets the statutory requirements of Texas Labor Code, Section 401.011(44) for all its employees providing services on the project, for the duration of the project.

(2) Provide to the Contractor, prior to that person beginning work on the project a certificate of coverage showing that coverage is being provided for all employees of the person providing services on the project, for the duration of the project.

(3) Provide the Contractor, prior to the end of coverage period, a new certificate of coverage showing extension of coverage, if the coverage period shown on the current certificate of coverage ends during the duration of the project.

(4) Obtain from each other person with whom it contracts, and provide to the Contractor:

(a) A certificate of coverage, prior to the other person beginning work on the project, and

(b) A new certificate of coverage showing extension of coverage, prior to the end of the coverage period, if the coverage period shown on the current certificate of coverage ends during the duration of the project;

(5) Retain all required certificates of coverage on file for the duration of the project and for one (1) year thereafter.

(6) Notify the government entity in writing by certified mail or personal delivery, within ten (10) days after the person knew or should have known, of any change that materially affects the provision of coverage of any person providing services on the project; and

(7) Contractually require each person with whom it contracts, to perform as required by paragraphs (1) - (7), with the certificates of coverage to be provided to the person for whom they are providing services.

J. By signing this contract or providing or causing to be provided a certificate of coverage, the Contractor is representing to the governmental entity that all employees of the contractor who will provide services on the project will be covered by workers' compensation coverage for the duration of the project, that the coverage will be based on proper reporting of classification codes and payroll amounts, and that all coverage agreements will be filed with the appropriate insurance carrier or, in the case of a self-insured, with the commission's Division of Self-Insurance Regulation. Providing false or misleading information may subject the contractor to administrative penalties, criminal penalties, civil penalties, or other civil actions.

K. The Contractor's failure to comply with any of these provisions is a breach of contract by the contractor which entitles the governmental entity to declare the contract void if the Contractor does not remedy the breach within ten (10) days after receipt of notice of breach from the governmental entity.

ATTACHMENT H

FANNIN COUNTY

RFP #2018-02

PREVAILING WAGE RATES

The Prevailing Wage Rates for this Project are attached hereto:

General Decision Number: TX170170 09/08/2017 TX170

Superseded General Decision Number: TX20160170

State: Texas

Construction Type: Building

County: Fannin County in Texas.

BUILDING CONSTRUCTION PROJECTS (does not include single family homes or apartments up to and including 4 stories).

Note: Under Executive Order (EO) 13658, an hourly minimum wage of $10.20 for calendar year 2017 applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least $10.20 (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in calendar year 2017. The EO minimum wage rate will be adjusted annually. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/06/2017
1	04/07/2017
2	04/14/2017
3	09/08/2017

ASBE0021-002 06/01/2016

	Rates	Fringes
ASBESTOS WORKER/HEAT & FROST INSULATOR	$ 24.32	7.52

BOIL0074-003 01/01/2017

	Rates	Fringes
BOILERMAKER	$ 28.00	22.35

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* IRON0263-019 06/01/2017

	Rates	Fringes
Ironworker, reinforcing and structural	$ 23.25	7.32

LABO0154-022 05/01/2008

	Rates	Fringes
Laborers: (Mason Tender - Cement/Concrete)	$ 14.25	2.90

SUTX2009-025 04/20/2009

	Rates	Fringes
BRICKLAYER	$ 20.00	0.00
CARPENTER, Includes Acoustical Ceiling Installation, and Hardwood Floor Installation	$ 13.40	0.00
CEMENT MASON/CONCRETE FINISHER	$ 13.29	0.00
ELECTRICIAN	$ 18.06	4.87
IRONWORKER, STRUCTURAL	$ 15.48	0.00
LABORER: Common or General	$ 10.00	0.00
LABORER: Landscape & Irrigation	$ 8.50	0.22
LABORER: Mason Tender - Brick	$ 12.02	0.00
LABORER: Mortar Mixer	$ 12.00	0.00
OPERATOR: Backhoe/Excavator/Trackhoe	$ 11.00	0.00
OPERATOR: Bulldozer	$ 13.00	0.31

OPERATOR: Crane.....$ 21.33 0.00

OPERATOR: Forklift.....$ 14.58 0.00

OPERATOR: Loader (Front End)....$ 10.54 0.00

PAINTER: Brush, Roller and Spray.....$ 13.50 0.00

PLUMBER.....$ 20.38 4.74

ROOFER.....$ 13.64 1.80

SHEET METAL WORKER.....$ 17.00 0.00

TILE SETTER.....$ 15.00 0.00

TRUCK DRIVER.....$ 12.52 0.00

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical

order of "identifiers" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than "SU" or "UAVG" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the "SU" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISION

General Decision Number: TX170116 01/06/2017 TX116

Superseded General Decision Number: TX20160116

State: Texas

Construction Type: Heavy

Counties: Cass, Cherokee, Erath, Fannin, Franklin, Hood, Hopkins, Marion, Montague, Morris, Nacogdoches, Navarro, Palo Pinto, Panola, Rains, Red River, Somervell, Titus, Van Zandt and Wood Counties in Texas.

HEAVY CONSTRUCTION PROJECTS

Note: Under Executive Order (EO) 13658, an hourly minimum wage of $10.20 for calendar year 2017 applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least $10.20 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in calendar year 2017. The EO minimum wage rate will be adjusted annually. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/06/2017

SUTX2009-129 04/21/2009

	Rates	Fringes

CEMENT MASON/CONCRETE FINISHER...$ 13.00 0.00

LABORER: Common or General.....$ 8.61 0.00

LABORER: Pipelayer.....$ 9.94 0.00

OPERATOR: Backhoe/Trackhoe.....$ 11.75 0.00

OPERATOR: Bulldozer.....$ 14.25 0.00

OPERATOR: Front End Loader.....$ 11.52 0.00

TRUCK DRIVER.....$ 10.80 0.26

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of "identifiers" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than "SU" or "UAVG" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the "SU" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion

date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal

process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
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Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

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Washington, DC 20210

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END OF GENERAL DECISION

General Decision Number: TX170038 01/06/2017 TX38

Superseded General Decision Number: TX20160038

State: Texas

Construction Type: Highway

Counties: Anderson, Angelina, Bosque, Camp, Cass, Cherokee, Erath, Falls, Fannin, Franklin, Freestone, Grimes, Hamilton, Henderson, Hill, Hood, Hopkins, Houston, Jack, Jasper, Lamar, Leon, Limestone, Madison, Marion, Milam, Morris, Nacogdoches, Navarro, Newton, Palo Pinto, Panola, Polk, Rains, Red River, Sabine, San Augustine, Shelby, Somervell, Titus, Trinity, Tyler, Van Zandt, Walker, Washington and Wood Counties in Texas.

HIGHWAY CONSTRUCTION PROJECTS (excluding tunnels, building structures in rest area projects & railroad construction; bascule, suspension & spandrel arch bridges designed for commercial navigation, bridges involving marine construction; and other major bridges).

Note: Under Executive Order (EO) 13658, an hourly minimum wage of $10.20 for calendar year 2017 applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least $10.20 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in calendar year 2017. The EO minimum wage rate will be adjusted annually. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/06/2017

* SUTX2011-009 08/08/2011

	Rates	Fringes
CONCRETE FINISHER (Paving and Structures)	$ 13.38	
ELECTRICIAN	$ 20.92	
FORM BUILDER/FORM SETTER		
Paving & Curb	$ 11.33	
Structures	$ 13.07	

LABORER

Asphalt Raker.....$ 11.34
Flagger.....$ 9.03
Laborer, Common.....$ 10.30
Laborer, Utility.....$ 11.53
Pipelayer.....$ 13.24
Work Zone Barricade
Servicer.....$ 11.22

POWER EQUIPMENT OPERATOR:

Agricultural Tractor.....$ 12.35
Asphalt Distributor.....$ 14.36
Asphalt Paving Machine.....$ 12.92
Broom or Sweeper.....$ 10.30
Concrete Pavement
Finishing Machine.....$ 19.31
Concrete Paving, Curing,
Float, Texturing Machine....$ 16.34
Crane, Hydraulic 80 Tons
or Less.....$ 20.21
Crane, Lattice boom 80
Tons or less.....$ 14.67
Crane, Lattice boom over
80 Tons.....$ 17.49
Crawler Tractor.....$ 13.38
Excavator 50,000 pounds or
less.....$ 13.88
Excavator, Over 50,000
pounds.....$ 16.22
Foundation Drill, Truck
Mounted.....$ 20.76
Front End Loader 3 cu yd
or Less.....$ 12.89
Front End Loader, over 3
cu yd.....$ 12.32
Loader/Backhoe.....$ 12.87
Mechanic.....$ 18.58
Milling Machine.....$ 12.86
Motor Grader, Fine Grade....$ 17.07
Motor Grader, Rough.....$ 15.12
Pavement Marking Machine....$ 13.17
Reclaimer/Pulverizer.....$ 10.46
Roller, Asphalt.....$ 11.68
Roller, other.....$ 10.30
Scraper.....$ 12.43

Spreader Box.....$ 13.68

Servicer.....$ 13.83

Steel Worker (Reinforcing).....$ 15.83

TRUCK DRIVER
Lowboy-Float.....$ 14.30
Off Road Hauler.....$ 12.23
Single Axle.....$ 10.30
Single or Tandem Axle Dump..$ 12.28
Tandem Axle Tractor with
Semi Trailer.....$ 12.50

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
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Branch of Construction Wage Determinations. Write to:

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2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
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The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

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200 Constitution Avenue, N.W.
Washington, DC 20210

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END OF GENERAL DECISION

Rev. 2/17

HUB Subcontracting Plan (HSP)

QUICK CHECKLIST

While this HSP Quick Checklist is being provided to merely assist you in readily identifying the sections of the HSP form that you will need to complete, it is very important that you adhere to the instructions in the HSP form and instructions provided by the contracting agency.

➤ **If you will be awarding <u>all</u> of the subcontracting work you have to offer under the contract to <u>only</u> Texas certified HUB vendors, complete:**

- ☐ Section 1 - Respondent and Requisition Information
- ☐ Section 2 a. - Yes, I will be subcontracting portions of the contract.
- ☐ Section 2 b. - List all the portions of work you will subcontract, and indicate the percentage of the contract you expect to award to Texas certified HUB vendors.
- ☐ Section 2 c. - Yes
- ☐ Section 4 - Affirmation
- ☐ GFE Method A (Attachment A) - Complete an Attachment A for each of the subcontracting opportunities you listed in Section 2 b.

➤ **If you will be subcontracting any portion of the contract to Texas certified HUB vendors and Non-HUB vendors, and the aggregate percentage of all the subcontracting work you will be awarding to the Texas certified HUB vendors with which you <u>do not</u> have a *<u>continuous contract</u>** in place for more than five (5) years *<u>meets or exceeds</u>* the HUB Goal the contracting agency identified in the "Agency Special Instructions/Additional Requirements", complete:**

- ☐ Section 1 - Respondent and Requisition Information
- ☐ Section 2 a. - Yes, I will be subcontracting portions of the contract.
- ☐ Section 2 b. - List all the portions of work you will subcontract, and indicate the percentage of the contract you expect to award to Texas certified HUB vendors and Non-HUB vendors.
- ☐ Section 2 c. - No
- ☐ Section 2 d. - Yes
- ☐ Section 4 - Affirmation
- ☐ GFE Method A (Attachment A) - Complete an Attachment A for each of the subcontracting opportunities you listed in Section 2 b.

➤ **If you will be subcontracting any portion of the contract to Texas certified HUB vendors and Non-HUB vendors or only to Non-HUB vendors, and the aggregate percentage of all the subcontracting work you will be awarding to the Texas certified HUB vendors with which you <u>do not</u> have a *<u>continuous contract</u>** in place for more than five (5) years *<u>does not meet or exceed</u>* the HUB Goal the contracting agency identified in the "Agency Special Instructions/Additional Requirements", complete:**

- ☐ Section 1 - Respondent and Requisition Information
- ☐ Section 2 a. - Yes, I will be subcontracting portions of the contract.
- ☐ Section 2 b. - List all the portions of work you will subcontract, and indicate the percentage of the contract you expect to award to Texas certified HUB vendors and Non-HUB vendors.
- ☐ Section 2 c. - No
- ☐ Section 2 d. - No
- ☐ Section 4 - Affirmation
- ☐ GFE Method B (Attachment B) - Complete an Attachment B for each of the subcontracting opportunities you listed in Section 2 b.

➤ **If you will not be subcontracting any portion of the contract and will be fulfilling the entire contract with your own resources (i.e., employees, supplies, materials and/or equipment), complete:**

- ☐ Section 1 - Respondent and Requisition Information
- ☐ Section 2 a. - No, I will not be subcontracting any portion of the contract, and I will be fulfilling the entire contract with my own resources.
- ☐ Section 3 - Self Performing Justification
- ☐ Section 4 - Affirmation

***<u>Continuous Contract</u>:** Any existing written agreement (including any renewals that are exercised) between a prime contractor and a HUB vendor, where the HUB vendor provides the prime contractor with goods or service, to include under the same contract for a specified period of time. The frequency the HUB vendor is utilized or paid during the term of the contract is not relevant to whether the contract is considered continuous. Two or more contracts that run concurrently or overlap one another for different periods of time are considered by CPA to be individual contracts rather than renewals or extensions to the original contract. In such situations the prime contractor and HUB vendor are entering (have entered) into "new" contracts.*

Rev. 2/17

HUB Subcontracting Plan (HSP)

In accordance with Texas Gov't Code §2161.252, the contracting agency has determined that subcontracting opportunities are probable under this contract. Therefore, all respondents, including State of Texas certified Historically Underutilized Businesses (HUBs) must complete and submit this State of Texas HUB Subcontracting Plan (HSP) with their response to the bid requisition (solicitation).

NOTE: Responses that do not include a completed HSP shall be rejected pursuant to Texas Gov't Code §2161.252(b).

The HUB Program promotes equal business opportunities for economically disadvantaged persons to contract with the State of Texas in accordance with the goals specified in the 2009 State of Texas Disparity Study. The statewide HUB goals defined in 34 Texas Administrative Code (TAC) §20.284 are:

- ***11.2 percent for heavy construction other than building contracts,***
- ***21.1 percent for all building construction, including general contractors and operative builders' contracts,***
- ***32.9 percent for all special trade construction contracts,***
- ***23.7 percent for professional services contracts,***
- ***26.0 percent for all other services contracts, and***
- ***21.1 percent for commodities contracts.***

- - Agency Special Instructions/Additional Requirements - -

*In accordance with 34 TAC §20.285(d)(1)(D)(iii), a respondent (prime contractor) may demonstrate good faith effort to utilize Texas certified HUBs for its subcontracting opportunities if the total value of the respondent's subcontracts with Texas certified HUBs meets or exceeds the statewide HUB goal or the agency specific HUB goal, whichever is higher. When a respondent uses this method to demonstrate good faith effort, the respondent must identify the HUBs with which it will subcontract. If using existing contracts with Texas certified HUBs to satisfy this requirement, only the aggregate percentage of the contracts expected to be subcontracted to HUBs with which the respondent **does not** have a **continuous contract*** in place for **more than five (5) years** shall qualify for meeting the HUB goal. This limitation is designed to encourage vendor rotation as recommended by the 2009 Texas Disparity Study.*

Fannin County Courthouse Restoration Phase II - Proposal 18018

The following opportunities/NIGP Commodity Codes have been identified but not limited to as probable HUB opportunities:

909-22/909-37/909-45/909-48/909-74/909-75/909-76
910-01/910-03/910-06/910-13/910-14/910-15/910-17/910-30/910-36/910-38/910-51/910-53/910-54
910-65/910-73/910-80/910-82
914-27/914-28/914-29/914-30/914-38/914-44/914-47/914-50/914-53/914-55/914-57/914-60/914-61
914/64/914-68/914-73/914-79/914-83/914-84/914-85/914-88

If any contractor requires help with identifying HUB contractors for the above referenced proposal do not hesitate to contact the Fannin County Courthouse Restoration Bid Processing and Procurement Advisor at fcch@fanninco.net.

SECTION 1: RESPONDENT AND REQUISITION INFORMATION

a. Respondent (Company) Name: _____ State of Texas VID #: _____

Point of Contact: _____ Phone #: _____

E-mail Address: _____ Fax #: _____

b. Is your company a State of Texas certified HUB? ☐ **- Yes** ☐ **- No**

c. Requisition #: _____ Bid Open Date: _____ (mm/dd/yyyy)

Enter your company's name here: _____ Requisition #: _____

SECTION 2: RESPONDENT'S SUBCONTRACTING INTENTIONS

After dividing the contract work into reasonable lots or portions to the extent consistent with prudent industry practices, and taking into consideration the scope of work to be performed under the proposed contract, including all potential subcontracting opportunities, the respondent must determine what portions of work, **including contracted staffing, goods and services will be subcontracted**. Note: In accordance with 34 TAC §20.282, a "Subcontractor" means a person who contracts with a prime contractor to work, to supply commodities, or to contribute toward completing work for a governmental entity.

a. Check the appropriate box (Yes or No) that identifies your subcontracting intentions:

☐ - *Yes*, I will be subcontracting portions of the contract. (If *Yes*, complete Item b of this SECTION and continue to Item c of this SECTION.)

☐ - *No*, I will not be subcontracting any portion of the contract, and I will be fulfilling the entire contract with my own resources, including employees, goods and services. (If *No*, continue to SECTION 3 and SECTION 4.)

b. List all the portions of work (subcontracting opportunities) you will subcontract. Also, based on the total value of the contract, identify the percentages of the contract you expect to award to Texas certified HUBs, and the percentage of the contract you expect to award to vendors that are not a Texas certified HUB (i.e., Non-HUB).

Item #	Subcontracting Opportunity Description	HUBs		Non-HUBs
		Percentage of the contract expected to be subcontracted to HUBs with which you do not have a continuous contract* in place for more than five (5) years.	**Percentage of the contract expected to be subcontracted to HUBs with which you have a continuous contract* in place for more than five (5) years.**	Percentage of the contract expected to be subcontracted to non-HUBs.
1		%	%	%
2		%	%	%
3		%	%	%
4		%	%	%
5		%	%	%
6		%	%	%
7		%	%	%
8		%	%	%
9		%	%	%
10		%	%	%
11		%	%	%
12		%	%	%
13		%	%	%
14		%	%	%
15		%	%	%
	Aggregate percentages of the contract expected to be subcontracted:	**%**	**%**	**%**

(Note: If you have more than fifteen subcontracting opportunities, a continuation sheet is available online at https://www.comptroller.texas.gov/purchasing/vendor/hub/forms.php).

c. Check the appropriate box (Yes or No) that indicates whether you will be using **only** Texas certified HUBs to perform **all** of the subcontracting opportunities you listed in SECTION 2, Item b.

☐ - *Yes* (If *Yes*, continue to SECTION 4 and complete an "HSP Good Faith Effort - Method A (Attachment A)" for **each** of the subcontracting opportunities you listed.)

☐ - *No* (If *No*, continue to Item d, of this SECTION.)

d. Check the appropriate box (Yes or No) that indicates whether the aggregate expected percentage of the contract you will subcontract **with Texas certified HUBs** with which you **do not** have a **continuous contract*** in place with for **more than five (5) years**, **meets or exceeds** the HUB goal the contracting agency identified on page 1 in the "**Agency Special Instructions/Additional Requirements**."

☐ - *Yes* (If *Yes*, continue to SECTION 4 and complete an "HSP Good Faith Effort - Method A (Attachment A)" for **each** of the subcontracting opportunities you listed.)

☐ - *No* (If *No*, continue to SECTION 4 and complete an "HSP Good Faith Effort - Method B (Attachment B)" for **each** of the subcontracting opportunities you listed.)

***Continuous Contract**: Any existing written agreement (including any renewals that are exercised) between a prime contractor and a HUB vendor, where the HUB vendor provides the prime contractor with goods or service under the same contract for a specified period of time. The frequency the HUB vendor is utilized or paid during the term of the contract is not relevant to whether the contract is considered continuous. Two or more contracts that run concurrently or overlap one another for different periods of time are considered by CPA to be individual contracts rather than renewals or extensions to the original contract. In such situations the prime contractor and HUB vendor are entering (have entered) into "new" contracts.*

Enter your company's name here: _____ Requisition #: _____

SECTION 2: RESPONDENT's SUBCONTRACTING INTENTIONS (CONTINUATION SHEET)

This page can be used as a continuation sheet to the HSP Form's page 2, Section 2, Item b. Continue listing the portions of work (subcontracting opportunities) you will subcontract. Also, based on the total value of the contract, identify the percentages of the contract you expect to award to Texas certified HUBs, and the percentage of the contract you expect to award to vendors that are not a Texas certified HUB (i.e., Non-HUB).

Item #	Subcontracting Opportunity Description	HUBs		Non-HUBs
		Percentage of the contract expected to be subcontracted to HUBs with which you do not have a continuous contract* in place for more than five (5) years.	**Percentage of the contract expected to be subcontracted to HUBs with which you have a continuous contract* in place for more than five (5) years.**	**Percentage of the contract expected to be subcontracted to non-HUBs.**
16		%	%	%
17		%	%	%
18		%	%	%
19		%	%	%
20		%	%	%
21		%	%	%
22		%	%	%
23		%	%	%
24		%	%	%
25		%	%	%
26		%	%	%
27		%	%	%
28		%	%	%
29		%	%	%
30		%	%	%
31		%	%	%
32		%	%	%
33		%	%	%
34		%	%	%
35		%	%	%
36		%	%	%
37		%	%	%
38		%	%	%
39		%	%	%
40		%	%	%
41		%	%	%
42		%	%	%
43		%	%	%
	Aggregate percentages of the contract expected to be subcontracted:	**%**	**%**	**%**

***Continuous Contract**: Any existing written agreement (including any renewals that are exercised) between a prime contractor and a HUB vendor, where the HUB vendor provides the prime contractor with goods or service under the same contract for a specified period of time. The frequency the HUB vendor is utilized or paid during the term of the contract is not relevant to whether the contract is considered continuous. Two or more contracts that run concurrently or overlap one another for different periods of time are considered by CPA to be individual contracts rather than renewals or extensions to the original contract. In such situations the prime contractor and HUB vendor are entering (have entered) into "new" contracts.*

Enter your company's name here: _____ Requisition #: _____

SECTION 3: SELF PERFORMING JUSTIFICATION (If you responded "No" to SECTION 2, Item a, you must complete this SECTION and continue to SECTION 4.) If you responded "No" to SECTION 2, Item a, in the space provided below **explain how** your company will perform the entire contract with its own employees, supplies, materials and/or equipment.

SECTION 4: AFFIRMATION

As evidenced by my signature below, I affirm that I am an authorized representative of the respondent listed in SECTION 1, and that the information and supporting documentation submitted with the HSP is true and correct. Respondent understands and agrees that, if awarded any portion of the requisition:

- The respondent will provide notice as soon as practical to all the subcontractors (HUBs and Non-HUBs) of their selection as a subcontractor for the awarded contract. The notice must specify at a minimum the contracting agency's name and its point of contact for the contract, the contract award number, the subcontracting opportunity they (the subcontractor) will perform, the approximate dollar value of the subcontracting opportunity and the expected percentage of the total contract that the subcontracting opportunity represents. A copy of the notice required by this section must also be provided to the contracting agency's point of contact for the contract no later than ten (10) working days after the contract is awarded.
- The respondent must submit monthly compliance reports (Prime Contractor Progress Assessment Report – PAR) to the contracting agency, verifying its compliance with the HSP, including the use of and expenditures made to its subcontractors (HUBs and Non-HUBs). (The PAR is available at https://www.comptroller.texas.gov/purchasing/docs/hub-forms/ProgressAssessmentReportForm.xls).
- The respondent must seek approval from the contracting agency prior to making any modifications to its HSP, including the hiring of additional or different subcontractors and the termination of a subcontractor the respondent identified in its HSP. If the HSP is modified without the contracting agency's prior approval, respondent may be subject to any and all enforcement remedies available under the contract or otherwise available by law, up to and including debarment from all state contracting.
- The respondent must, upon request, allow the contracting agency to perform on-site reviews of the company's headquarters and/or work-site where services are being performed and must provide documentation regarding staffing and other resources.

Signature	Printed Name	Title	Date (mm/dd/yyyy)

Reminder:

- If you responded "Yes" to SECTION 2, Items c or d, you must complete an "HSP Good Faith Effort - Method A (Attachment A)" for each of the subcontracting opportunities you listed in SECTION 2, Item b.
- If you responded "No" SECTION 2, Items c and d, you must complete an "HSP Good Faith Effort - Method B (Attachment B)" for each of the subcontracting opportunities you listed in SECTION 2, Item b.

HSP Good Faith Effort - Method A (Attachment A)

Rev. 2/17

Enter your company's name here: ______________________ Requisition #: ____________

IMPORTANT: If you responded "*Yes*" to **SECTION 2, Items c** or **d** of the completed HSP form, you must submit a completed "HSP Good Faith Effort - Method A (Attachment A)" for each of the subcontracting opportunities you listed in **SECTION 2, Item b** of the completed HSP form. You may photo-copy this page or download the form at https://www.comptroller.texas.gov/purchasing/docs/hub-forms/hub-sbcont-plan-gfe-achm-a.pdf

SECTION A-1: SUBCONTRACTING OPPORTUNITY

Enter the item number and description of the subcontracting opportunity you listed in SECTION 2, Item b, of the completed HSP form for which you are completing the attachment.

Item Number: _____ Description: ______________________________

SECTION A-2: SUBCONTRACTOR SELECTION

List the subcontractor(s) you selected to perform the subcontracting opportunity you listed above in SECTION A-1. Also identify whether they are a Texas certified HUB and their Texas Vendor Identification (VID) Number or federal Employer Identification Number (EIN), the approximate dollar value of the work to be subcontracted, and the expected percentage of work to be subcontracted. When searching for Texas certified HUBs and verifying their HUB status, ensure that you use the State of Texas' Centralized Master Bidders List (CMBL) - Historically Underutilized Business (HUB) Directory Search located at http://mycpa.cpa.state.tx.us/tpasscmblsearch/index.jsp. HUB status code "**A**" signifies that the company is a Texas certified HUB.

Company Name	Texas certified HUB	Texas VID or federal EIN Do not enter Social Security Numbers. If you do not know their VID / EIN, leave their VID / EIN field blank.	Approximate Dollar Amount	Expected Percentage of Contract
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%

REMINDER: As specified in SECTION 4 of the completed HSP form, if you (respondent) are awarded any portion of the requisition, you are required to provide notice as soon as practical to all the subcontractors (HUBs and Non-HUBs) of their selection as a subcontractor. The notice must specify at a minimum the contracting agency's name and its point of contact for the contract, the contract award number, the subcontracting opportunity they (the subcontractor) will perform, the approximate dollar value of the subcontracting opportunity and the expected percentage of the total contract that the subcontracting opportunity represents. A copy of the notice required by this section must also be provided to the contracting agency's point of contact for the contract no later than ten (10) working days after the contract is awarded.

HSP Good Faith Effort - Method B (Attachment B)

Rev. 2/17

Enter your company's name here: _____ Requisition #: _____

IMPORTANT*:** If you responded "No***" to **SECTION 2, Items c** and **d** of the completed HSP form, you must submit a completed "HSP Good Faith Effort - Method B (Attachment B)" for **each** of the subcontracting opportunities you listed in **SECTION 2, Item b** of the completed HSP form. You may photo-copy this page or download the form at https://www.comptroller.texas.gov/purchasing/docs/hub-forms/hub-sbcont-plan-gfe-achm-b.pdf..

SECTION B-1: SUBCONTRACTING OPPORTUNITY

Enter the item number and description of the subcontracting opportunity you listed in SECTION 2, Item b, of the completed HSP form for which you are completing the attachment.

Item Number: _____ Description: _____

SECTION B-2: MENTOR PROTÉGÉ PROGRAM

If respondent is participating as a Mentor in a State of Texas Mentor Protégé Program, submitting its Protégé (Protégé must be a State of Texas certified HUB) as a subcontractor to perform the subcontracting opportunity listed in **SECTION B-1**, constitutes a good faith effort to subcontract with a Texas certified HUB towards that specific portion of work.

Check the appropriate box (Yes or No) that indicates whether you will be subcontracting the portion of work you listed in SECTION B-1 to your Protégé.

☐ - Yes (If *Yes*, continue to SECTION B-4.)

☐ - No / Not Applicable (If *No* or *Not Applicable*, continue to SECTION B-3 and SECTION B-4.)

SECTION B-3: NOTIFICATION OF SUBCONTRACTING OPPORTUNITY

When completing this section you MUST comply with items a, b, c and d, thereby demonstrating your Good Faith Effort of having notified Texas certified HUBs and trade organizations or development centers about the subcontracting opportunity you listed in SECTION B-1. Your notice should include the scope of work, information regarding the location to review plans and specifications, bonding and insurance requirements, required qualifications, and identify a contact person. When sending notice of your subcontracting opportunity, you are encouraged to use the attached HUB Subcontracting Opportunity Notice form, which is also available online at https://www.comptroller.texas.gov/purchasing/docs/hub-forms/HUBSubcontractingOpportunityNotificationForm.pdf.

Retain supporting documentation (i.e., certified letter, fax, e-mail) demonstrating evidence of your good faith effort to notify the Texas certified HUBs and trade organizations or development centers. Also, be mindful that a working day is considered a normal business day of a state agency, not including weekends, federal or state holidays, or days the agency is declared closed by its executive officer. The initial day the subcontracting opportunity notice is sent/provided to the HUBs and to the trade organizations or development centers is considered to be "day zero" and does not count as one of the seven (7) working days.

a. Provide written notification of the subcontracting opportunity you listed in SECTION B-1, to three (3) or more Texas certified HUBs. Unless the contracting agency specified a different time period, you must allow the HUBs at least seven (7) working days to respond to the notice prior to you submitting your bid response to the contracting agency. When searching for Texas certified HUBs and verifying their HUB status, ensure that you use the State of Texas' Centralized Master Bidders List (CMBL) - Historically Underutilized Business (HUB) Directory Search located at http://mycpa.cpa.state.tx.us/tpasscmblsearch/index.jsp. HUB status code "**A**" signifies that the company is a Texas certified HUB.

b. List the **three (3) Texas certified HUBs** you notified regarding the subcontracting opportunity you listed in SECTION B-1. Include the company's Texas Vendor Identification (VID) Number, the date you sent notice to that company, and indicate whether it was responsive or non-responsive to your subcontracting opportunity notice.

Company Name	Texas VID (Do not enter Social Security Numbers.)	Date Notice Sent (mm/dd/yyyy)	Did the HUB Respond?
			☐ - Yes ☐ - No
			☐ - Yes ☐ - No
			☐ - Yes ☐ - No

c. Provide written notification of the subcontracting opportunity you listed in SECTION B-1 to two (2) or more trade organizations or development centers in Texas to assist in identifying potential HUBs by disseminating the subcontracting opportunity to their members/participants. Unless the contracting agency specified a different time period, you must provide your subcontracting opportunity notice to trade organizations or development centers at least seven (7) working days prior to submitting your bid response to the contracting agency. A list of trade organizations and development centers that have expressed an interest in receiving notices of subcontracting opportunities is available on the Statewide HUB Program's webpage at https://www.comptroller.texas.gov/purchasing/vendor/hub/resources.php.

d. List **two (2) trade organizations or development centers** you notified regarding the subcontracting opportunity you listed in SECTION B-1. Include the date when you sent notice to it and indicate if it accepted or rejected your notice.

Trade Organizations or Development Centers	Date Notice Sent (mm/dd/yyyy)	Was the Notice Accepted?
		☐ - Yes ☐ - No
		☐ - Yes ☐ - No

HSP Good Faith Effort - Method B (Attachment B) Cont.

Rev. 2/17

Enter your company's name here: _____ Requisition #: _____

SECTION B-4: SUBCONTRACTOR SELECTION

Enter the item number and description of the subcontracting opportunity you listed in **SECTION 2, Item b,** of the completed HSP form for which you are completing the attachment.

a. Enter the item number and description of the subcontracting opportunity for which you are completing this Attachment B continuation page.

Item Number: _____ Description: _____

b. List the subcontractor(s) you selected to perform the subcontracting opportunity you listed in **SECTION B-1**. Also identify whether they are a Texas certified HUB and their Texas Vendor Identification (VID) Number or federal Emplioyer Identification Number (EIN), the approximate dollar value of the work to be subcontracted, and the expected percentage of work to be subcontracted. When searching for Texas certified HUBs and verifying their HUB status, ensure that you use the State of Texas' Centralized Master Bidders List (CMBL) - Historically Underutilized Business (HUB) Directory Search located at http://mycpa.cpa.state.tx.us/tpasscmblsearch/index.jsp. HUB status code "**A**" signifies that the company is a Texas certified HUB.

Company Name	Texas certified HUB	Texas VID or federal EIN Do not enter Social Security Numbers. If you do not know their VID / EIN, leave their VID / EIN field blank.	Approximate Dollar Amount	Expected Percentage of Contract
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%

c. If any of the subcontractors you have selected to perform the subcontracting opportunity you listed in **SECTION B-1** is **not** a Texas certified HUB, provide written justification for your selection process (attach additional page if necessary):

REMINDER: As specified in SECTION 4 of the completed HSP form, if you (respondent) are awarded any portion of the requisition, you are required to provide notice as soon as practical to **all** the subcontractors (HUBs and Non-HUBs) of their selection as a subcontractor. The notice must specify at a minimum the contracting agency's name and its point of contact for the contract, the contract award number, the subcontracting opportunity it (the subcontractor) will perform, the approximate dollar value of the subcontracting opportunity and the expected percentage of the total contract that the subcontracting opportunity represents. A copy of the notice required by this section must also be provided to the contracting agency's point of contact for the contract no later than ten (10) working days after the contract is awarded.

Rev. 2/17

HUB Subcontracting Opportunity Notification Form

In accordance with Texas Gov't Code, Chapter 2161, each state agency that considers entering into a contract with an expected value of $100,000 or more shall, before the agency solicits bids, proposals, offers, or other applicable expressions of interest, determine whether subcontracting opportunities are probable under the contract. The state agency I have identified below in Section B has determined that subcontracting opportunities are probable under the requisition to which my company will be responding.

34 Texas Administrative Code, §20.285 requires all respondents (prime contractors) bidding on the contract to provide notice of each of their subcontracting opportunities to at least three (3) Texas certified HUBs (who work within the respective industry applicable to the subcontracting opportunity), and allow the HUBs at least seven (7) working days to respond to the notice prior to the respondent submitting its bid response to the contracting agency. In addition, at least seven (7) working days prior to submitting its bid response to the contracting agency, the respondent must provide notice of each of its subcontracting opportunities to two (2) or more trade organizations or development centers (in Texas) that serves members of groups (i.e., Asian Pacific American, Black American, Hispanic American, Native American, Woman, Service Disabled Veteran) identified in Texas Administrative Code §20.282(19)(C).

We respectfully request that vendors interested in bidding on the subcontracting opportunity scope of work identified in Section C, Item 2, reply no later than the date and time identified in Section C, Item 1. Submit your response to the point-of-contact referenced in Section A.

SECTION A: PRIME CONTRACTOR'S INFORMATION

Company Name: _____ State of Texas VID #: _____

Point-of-Contact: _____ Phone #: _____

E-mail Address: _____ Fax #: _____

SECTION B: CONTRACTING STATE AGENCY AND REQUISITION INFORMATION

Agency Name: _____

Point-of-Contact: _____ Phone #: _____

Requisition #: _____ Bid Open Date: _____ (mm/dd/yyyy)

SECTION C: SUBCONTRACTING OPPORTUNITY RESPONSE DUE DATE, DESCRIPTION, REQUIREMENTS AND RELATED INFORMATION

1. Potential Subcontractor's Bid Response Due Date:

If you would like for our company to consider your company's bid for the subcontracting opportunity identified below in Item 2,

we must receive your bid response no later than _____ (Central Time) on _____ (Date (mm/dd/yyyy)).

In accordance with 34 TAC §20.285, each notice of subcontracting opportunity shall be provided to at least three (3) Texas certified HUBs, and allow the HUBs at least seven (7) working days to respond to the notice prior to submitting our bid response to the contracting agency. In addition, at least seven (7) working days prior to us submitting our bid response to the contracting agency, we must provide notice of each of our subcontracting opportunities to two (2) or more trade organizations or development centers (in Texas) that serves members of groups (i.e., Asian Pacific American, Black American, Hispanic American, Native American, Woman, Service Disabled Veteran) identified in Texas Administrative Code, §20.282(19)(C).

(A working day is considered a normal business day of a state agency, not including weekends, federal or state holidays, or days the agency is declared closed by its executive officer. The initial day the subcontracting opportunity notice is sent/provided to the HUBs and to the trade organizations or development centers is considered to be "day zero" and does not count as one of the seven (7) working days.)

2. Subcontracting Opportunity Scope of Work:

3. Required Qualifications: ☐ - Not Applicable

4. Bonding/Insurance Requirements: ☐ - Not Applicable

5. Location to review plans/specifications: ☐ - Not Applicable

INDUSTRIAL HYGIENE AND
SAFETY TECHNOLOGY, INC.

August 3, 2018

Ms. Jill Holmes
Fannin County Purchasing
101 East Sam Rayburn Drive
Suite 304
Bonham, Texas 75418

RE: Asbestos Building Materials Survey
Location: Fannin County Courthouse Exterior - Lead
Sample Date: July 25, 2018
IHST Project Number: 21787

Dear Ms. Holmes,

Mr. Michael Gange representing Industrial Hygiene and Safety Technology, Inc. performed a visual inspection and collected bulk samples of suspect lead based paint at the address listed above.

Two (2) suspect lead based painted materials were identified during the visual inspection of the structure. Table 1 list the materials sampled and the results of the lead based paint analysis. EMSL Analytical Inc. was contracted to perform the laboratory analysis. A copy of the original laboratory report is included as Appendix A to this report. The samples were analyzed utilizing SW 846 3050B/7000B method for lead analysis.

Table 1, Results of Lead Based Paint Testing

Sample ID	Material Tested	Location	Results
NORTH-001	Off-White Paint	Building Exterior	15 % wt
SOUTH-002	Off-White Paint	Building Exterior	22 % wt

In reviewing the results of the lead based paint sampling, both samples are considered lead based paint and are in excess of the HUD/EPA standard of paint equal to or greater than 0.5% by weight.

Should you or your staff have any questions regarding the content of this report, please do not hesitate to contact our office at your convenience.

Sincerely,

Tracy K. Bramlett

Tracy Bramlett, CIH, CSP
President

Appendix A – Laboratory Report

Appendix A – Laboratory Report

EMSL Analytical, Inc.
200 Route 130 North, Cinnaminson, NJ 08077
Phone/Fax: (856) 303-2500 / (856) 786-5974
http://www.EMSL.com cinnaminsonleadlab@emsl.com

EMSL Order:	201808216
CustomerID:	INDU60
CustomerPO:	
ProjectID:	

Attn: **Michael Gange**
Industrial Hygiene & Safety Technology
2235 Keller Way
Carrollton, TX 75006

Phone:	(972) 478-7415
Fax:	(972) 478-7615
Received:	07/26/18 10:15 AM
Collected:	7/25/2018

Project: **Fannin County Courthouse / 21787**

Test Report: Lead in Paint Chips by Flame AAS (SW 846 3050B/7000B)*

Client Sample Description	*Lab ID*	*Collected*	*Analyzed*	*Weight*	*Lead Concentration*
North-001	*201808216-0001*	7/25/2018	7/31/2018	0.2529 g	15 % wt
	Site: Off-White Paint				
South-002	*201808216-0002*	7/25/2018	7/31/2018	0.2538 g	22 % wt
	Site: Off-White Paint				

Phillip Worby, Lead Laboratory Manager
or other approved signatory

*Analysis following Lead in Paint by EMSL SOP/Determination of Environmental Lead by FLAA. Reporting limit is 0.008 % wt based on the minimum sample weight per our SOP. Unless noted, results in this report are not blank corrected. This report relates only to the samples reported above and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities. Samples received in good condition unless otherwise noted. "<" (less than) result signifies that the analyte was not detected at or above the reporting limit. Measurement of uncertainty is available upon request. The QC data associated with the sample results included in this report meet the recovery and precision requirements unless specifically indicated otherwise. Definitions of modifications are available upon request.

Samples analyzed by EMSL Analytical, Inc. Cinnaminson, NJ NELAP Certifications: NJ 03036, NY 10872, PA 68-00367, AIHA-LAP, LLC ELLAP 100194, A2LA 2845.01

Initial report from 08/02/2018 09:46:34

OrderID: 201808216

LEAD

EMSL ANALYTICAL, INC.
LABORATORY • PRODUCTS • TRAINING

Lead (Pb) Chain of Custody
EMSL Order ID *(Lab Use Only)*: 201808216

EMSL Analytical, Inc.
200 Route 130 North
Cinnaminson, NJ 08077
PHONE: 1-800-220-3675
FAX: (856) 786-5974

Company : IHST, Inc.	**EMSL-Bill to:** Same Different If Bill to is Different note instructions in Comments** *Third Party Billing requires written authorization from third party*
Street: 2235 Keller Way	
City: Carrollton **State/Province:** TX	**Zip/Postal Code:** 75006 **Country:** USA
Report To (Name): Michael Gange	**Telephone #:** 972-478-7415
Email Address: labresults@ihst.com	**Fax #:** 972-478-7615 **Purchase Order:**
Project Name/Number: Fannin County Courthouse / 21787	**Please Provide Results:** Fax (Email)
U.S. State Samples Taken: TX	**CT Samples:** Commercial/Taxable Residential/Tax Exempt

Turnaround Time (TAT) Options* - Please Check

3 Hour	6 Hour	24 Hour	48 Hour	72 Hour	96 Hour	(1 Week)	2 Week

**Analysis completed in accordance with EMSL's Terms and Conditions located in the Price Guide*

Matrix	Method	Instrument	Reporting Limit	Check
Chips % by wt.	SW846-7000B	Flame Atomic Absorption	0.01%	

Name of Sampler: **Signature of Sampler:**

	Sample ID	Sample Description	Date Sampled
1.	NORTH - 001	Off-white Paint	7/25/2018
2.	SOUTH - 002	Off-white Paint	7/25/2018

Client Sample #'s **Total # of Samples:** 2

Relinquished (Client):		**Date:**	7/25/18	**Time:**	
Received (Lab):		**Date:**	7/26/18	**Time:**	1015 MK

Comments:

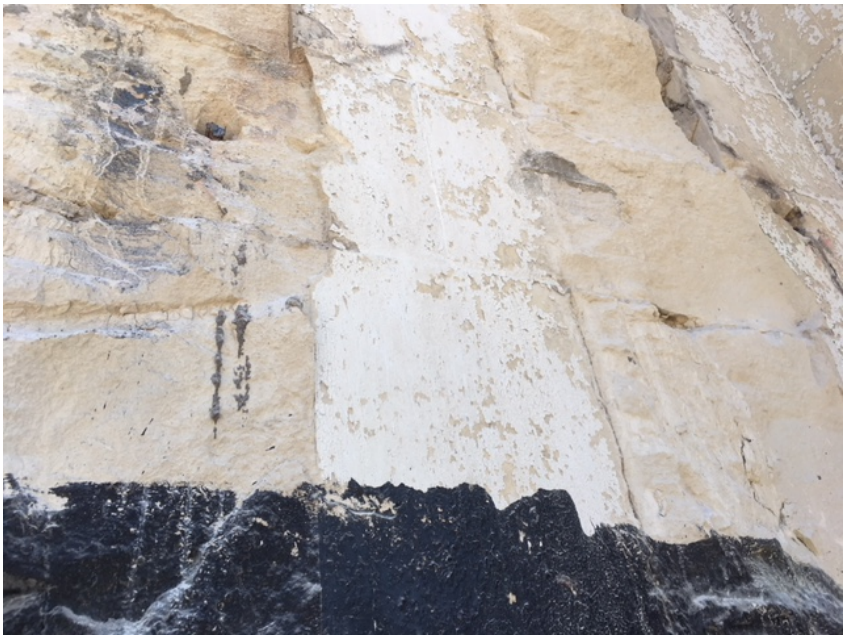
Appendix B – Photographs

Fannin County Courthouse

Lead Based Paint - 07/25/2018

Fannin County Courthouse

Lead Based Paint - 07/25/2018



INDUSTRIAL HYGIENE AND
SAFETY TECHNOLOGY, INC.

September 4, 2018

Ms. Jill Holmes
Fannin County Purchasing
101 East Sam Rayburn Drive
Suite 304
Bonham, Texas 75418

RE: Asbestos Building Materials Survey
Location: Fannin County Courthouse Ceiling - Lead
Sample Date: August 23, 2018
IHST Project Number: 21787

Dear Ms. Holmes,

Mr. Doug Easley representing Industrial Hygiene and Safety Technology, Inc. performed a visual inspection and collected bulk samples of suspect lead based paint at the address listed above.

One (1) suspect lead based painted material was identified during the visual inspection of the structure. Table 1 list the material sampled and the results of the lead based paint analysis. EMSL Analytical Inc. was contracted to perform the laboratory analysis. A copy of the original laboratory report is included as Appendix A to this report. The samples were analyzed utilizing SW 846 3050B/7000B method for lead analysis.

Table 1, Results of Lead Based Paint Testing

Sample ID	Material Tested	Location	Results
CEILING-001	Gray/Green Paint	Ceiling	23% wt

In reviewing the results of the lead based paint sampling, sample CEILING-001 is considered lead based paint and in excess of the HUD/EPA standard of paint equal to or greater than 0.5% by weight.

Should you or your staff have any questions regarding the content of this report, please do not hesitate to contact our office at your convenience.

Sincerely,

Tracy K. Bramlett

Tracy Bramlett, CIH, CSP
President

Appendix A – Laboratory Report

Appendix A – Laboratory Report

EMSL Analytical, Inc.
200 Route 130 North, Cinnaminson, NJ 08077
Phone/Fax: (856) 303-2500 / (856) 786-5974
http://www.EMSL.com cinnaminsonleadlab@emsl.com

EMSL Order:	201809735
CustomerID:	INDU60
CustomerPO:	
ProjectID:	

Attn: **Michael Gange**
Industrial Hygiene & Safety Technology
2235 Keller Way
Carrollton, TX 75006

Phone:	(972) 478-7415
Fax:	(972) 478-7615
Received:	08/30/18 10:10 AM
Collected:	8/23/2018

Project: **21787**

Test Report: Lead in Paint Chips by Flame AAS (SW 846 3050B/7000B)*

Client Sample Description	*Lab ID*	*Collected*	*Analyzed*	*Weight*	*Lead* ***Concentration***
CEILING-001	*201809735-0001*	8/23/2018	8/30/2018	0.2597 g	23 % wt
	Site: Gray/Green Paint				

Phillip Worby, Lead Laboratory Manager
or other approved signatory

*Analysis following Lead in Paint by EMSL SOP/Determination of Environmental Lead by FLAA. Reporting limit is 0.008 % wt based on the minimum sample weight per our SOP. Unless noted, results in this report are not blank corrected. This report relates only to the samples reported above and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities. Samples received in good condition unless otherwise noted. "<" (less than) result signifies that the analyte was not detected at or above the reporting limit. Measurement of uncertainty is available upon request. The QC data associated with the sample results included in this report meet the recovery and precision requirements unless specifically indicated otherwise. Definitions of modifications are available upon request.

Samples analyzed by EMSL Analytical, Inc. Cinnaminson, NJ NELAP Certifications: NJ 03036, NY 10872, PA 68-00367, AIHA-LAP, LLC ELLAP 100194, A2LA 2845.01

Initial report from 09/01/2018 10:54:42

OrderID: 201809735

LEAD

EMSL ANALYTICAL, INC.
LABORATORY • PRODUCTS • TRAINING

Lead (Pb) Chain of Custody
EMSL Order ID *(Lab Use Only)*: 201809735

EMSL Analytical, Inc.
200 Route 130 North
Cinnaminson, NJ 08077
PHONE: 1-800-220-3675
FAX: (856) 786-5974

Company : IHST, Inc.	**EMSL-Bill to:** Same Different If Bill to is Different note instructions in Comments** *Third Party Billing requires written authorization from third party*
Street: 2235 Keller Way	
City: Carrollton **State/Province:** TX	**Zip/Postal Code:** 75006 **Country:** USA
Report To (Name): Michael Gange	**Telephone #:** 972-478-7415
Email Address: labresults@ihst.com	**Fax #:** 972-478-7615 **Purchase Order:**
Project Name/Number: 21787	**Please Provide Results:** Fax (Email)
U.S. State Samples Taken: TX	**CT Samples:** Commercial/Taxable Residential/Tax Exempt

Turnaround Time (TAT) Options* - Please Check

~~3 Hour~~ | ~~6 Hour~~ | ~~24 Hour~~ | (48 Hour) | ~~72 Hour~~ | ~~96 Hour~~ | ~~1 Week~~ | ~~2 Week~~

**Analysis completed in accordance with EMSL's Terms and Conditions located in the Price Guide*

Matrix	Method	Instrument	Reporting Limit	Check
Chips % by wt.	SW846-7000B	Flame Atomic Absorption	0.01%	

Name of Sampler: DOUG EASLEY **Signature of Sampler:** Doug Easley

	Sample ID	Sample Description	Date Sampled
1	CEILING - 001	Gray / Green Paint	8/23/18

Client Sample #'s | **Total # of Samples:** 1

Relinquished (Client):	Doug Easley	**Date:**	8/29/2018	**Time:**	
Received (Lab):	[illegible] MK	**Date:**	8/30/18	**Time:** 1010	EMSL

Comments:

1pd

GEOTECHNICAL ENGINEERING REPORT

FANNIN COUNTY COURTHOUSE RESTORATION
101 W. SAM RAYBURN DRIVE
BONHAM, TEXAS

TERRACON PROJECT NO. 94095056
April 7, 2009

Prepared for:

KSA Engineers, Inc.
McKinney, Texas

Prepared by:

Terracon Consultants, Inc.
Dallas, Texas

Terracon

Consulting Engineers & Scientists

Terracon Consultants, Inc.
8901 Carpenter Frwy., Ste. 100
Dallas, TX 75247
Phone (214) 630-1010
Fax (214) 630-7070
www.terracon.com

April 7, 2009

KSA Engineers, Inc.
8875 Synergy Drive
McKinney, Texas 75070

Attn: Mr. Bob Jutton, P.E.

RE: Geotechnical Engineering Report
Fannin County Courthouse Restoration
101 W. Sam Rayburn Drive
Bonham, Texas
Terracon Project No. 94095056

Gentlemen:

Attached is our geotechnical report for the planned additions and modifications to the Fannin County Courthouse located in Bonham, Texas. The accompanying report presents the findings of the subsurface exploration and geotechnical recommendations regarding the design and construction of foundations, floor slabs, pavements, and earthwork for the proposed construction.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

STATE OF TEXAS
DANIEL L. FRANKLIN, JR.
87430
LICENSED
PROFESSIONAL ENGINEER
4/7/09

Daniel L. Franklin, Jr., P.E.
Senior Geotechnical Engineer

Ralph B. Barnes, Jr., P.E.
Principal

Copies to: Addressee (2)
Mr. Stephen Lucy, P.E. – Jaster-Quintanilla Dallas, LLP (1)

TABLE OF CONTENTS

Page

INTRODUCTION **1**
PROJECT DESCRIPTION **1**
SUBSURFACE EXPLORATION AND LABORATORY PROCEDURES **1**
Field Exploration 1
Laboratory Testing 2
SITE AND SUBSURFACE CONDITIONS **3**
Soil Conditions 3
Groundwater Conditions 3
ANALYSES AND RECOMMENDATIONS **4**
Geotechnical Considerations 4
Drilled Shafts Design Recommendations 5
Underreamed Shafts 5
Underreamed Shafts - Lateral Capacity 5
Underreamed Shafts - Uplift Resistance 5
Underreamed Shaft Construction 6
Grade Beams/Pier Caps 6
Seismic Considerations 6
Floor Systems 7
Structural Floor Slabs 7
Slabs/Flatwork on Grade 7
Earthwork 9
Excavation and Replacement 9
Select Fill 9
Building Area Drainage 9
Site Grading 10
Utilities 10
Below Grade Walls/Retaining Walls 10
Pavements 12
Pavement Subgrade Treatment 12
Design Traffic 12
Pavement Sections 13
Preventative Maintenance 13
GENERAL COMMENTS **14**

APPENDIX **Figure**

Boring Location Diagram 1

Boring Logs ..... 2 & 3

General Notes 4

Unified Soil Classification System 5

GEOTECHNICAL ENGINEERING REPORT

FANNIN COUNTY COURTHOUSE RESTORATION
101 W. SAM RAYBURN DRIVE
BONHAM, TEXAS

TERRACON PROJECT NO. 94095056
April 7, 2009

INTRODUCTION

Terracon has completed the geotechnical engineering services for the planned additions and modifications to the Fannin County Courthouse located in Bonham, Texas. The purpose of this report is to describe the subsurface conditions encountered in the borings, analyze and evaluate the test data, and provide geotechnical recommendations regarding the design and construction of foundations, floor slabs, subgrades, pavements, and earthwork for the project. Additionally, we were asked to excavate two test pits adjacent to exterior walls in an attempt to examine below grade foundations. Our scope of services included drilling and sampling two borings, excavation of two test pits, laboratory testing, and engineering analyses.

PROJECT DESCRIPTION

The site is located at northeast corner of N. Main Street and W. Sam Rayburn Drive in Bonham, Texas. The historic Fannin County Courthouse was built in 1889. Historic documents indicate that the three-story structure was supported by continuous strip footings founded on fifteen foot long Bois d'Arc timber piles. In 1929 a fire destroyed the roof and tower structure. It was later rebuilt without the clock tower. In 1965 the courthouse was remodeled by covering the exterior with marble. A crawl space exists beneath portions of the basement floor.

We understand that the courthouse will be restored to its pre-fire appearance, including the clock tower. It is envisioned that a new foundation may be required in the cross corridor to support steel framing forming the restored clock tower. Loads on the order of 10 to 80 kips for columns and 1 to 5 kips per foot of wall are anticipated.

SUBSURFACE EXPLORATION AND LABORATORY PROCEDURES

Field Exploration

The subsurface conditions were explored by drilling two borings at the approximate locations indicated on the Boring Location Diagram on Figure 1 in the Appendix. The field exploration was performed on March 17, 2009. The boring locations were chosen by the structural engineer. The boring locations were established in the field by measuring from available reference features and estimating right angles. The boring locations should be considered accurate only to the degree implied by the methods employed to determine them.

The borings were performed using a truck-mounted drill rig. Continuous-flight augers were used to advance the boreholes. Samples of the soils encountered in the borings were obtained

using thin-walled tube sampling procedures. In the thin-walled tube sampling procedure, a seamless steel tube with a sharp cutting edge is pushed hydraulically into the soil to obtain a relatively undisturbed sample. The soil samples were tagged for identification, sealed to reduce moisture loss, and taken to the laboratory for further examination, testing, and classification.

Field logs of the borings were prepared by the drill crew. The logs included visual classifications of the materials encountered as well as interpretation of the subsurface conditions between samples. The boring logs included with this report represent the engineer's interpretation of the field logs and include modifications based on laboratory evaluation of the samples. Logs of the borings are presented on Figures 2 and 3 in the Appendix. General notes to log terms and symbols are presented on Figure 4.

Laboratory Testing

The boring logs and samples were reviewed by a geotechnical engineer who selected soil samples for testing. Tests were performed by technicians working under the direction of the engineer. A brief description of the tests performed follows.

Liquid and Plastic Limit tests and moisture content measurements were performed to aid in classifying the soils in accordance with the Unified Soil Classification System (USCS). The USCS is summarized on Figure 5. These tests were also used for evaluating soil volume change potential. Absorption swell tests were performed on selected samples of the cohesive materials. These tests were used to more quantitatively evaluate volume change potential at in-situ moisture levels. Unconfined compression and hand penetrometer tests were performed on samples of the cohesive soils to evaluate the strength and consistency of these materials.

The results of the laboratory tests are presented on the Logs of Boring. Results of the swell tests are presented in Table 1.

TABLE 1 – SUMMARY OF SWELL TESTS

Boring No.	Depth (feet)	Surcharge (psf)	Initial Moisture (%)	Final Moisture (%)	Swell (%)
B-1	6 – 8	750	21.2	22.5	0.5
B-2	4 – 6	500	17.3	21.0	0.5
B-2	8 – 10	1,000	17.5	20.2	2.0

SITE AND SUBSURFACE CONDITIONS

Soil Conditions

The subsurface conditions encountered at the individual test locations are indicated on the attached boring logs. The stratification boundaries on the boring logs represent the approximate location of changes in soil types; in-situ, the transition between materials may be gradual. A brief discussion of the stratigraphy indicated by the exploration program is presented below.

Fill materials consisting of dark brown, brown, tan and gray sandy lean clays (CL) were encountered at the ground surface and continued to depths of about 2 to 3 feet. Dark brown sandy lean clays were encountered below the fill soils to depths of about 4 feet. The Liquid Limit (LL) of these soils was 39 percent with a corresponding Plasticity Index (PI) of 19. These clay soils were medium stiff to very stiff in consistency.

Orange and gray fat clay (CH) with sand traces was next encountered. These clays extended to depths of about 22 feet below grade. These fat clays had LL's ranging from 51 to 57 percent with PI's of 31 to 37. They were very stiff to hard in consistency.

Tan and gray fat clay (CH) was found at depths of 22 feet. These very stiff to hard soils continued to the 40 foot termination depth of the borings. These soils were very stiff to hard in consistency.

The clays encountered at this site are considered to be highly active with respect to moisture induced volume changes. Active clays can experience significant volume changes (expansion or shrinkage) with fluctuations in their moisture content.

Groundwater Conditions

Groundwater seepage was not observed during drilling or at the completion of drilling in either of the borings. These groundwater level observations provide an indication of the groundwater conditions present at the time the borings were drilled. Groundwater levels may be different at the time of construction. Groundwater conditions may change because of seasonal variations in rainfall, landscape irrigation, and runoff.

Test Pits

On March 19, 2009 Weaver and Associates, a contractor hired by Terracon, began the excavation of two test pits for the purpose of allowing a representative from Jaster-Quintanilla, KSA Engineering and Architexas to view and document the type and the condition of the existing foundation.

On Monday March 23, 2009 the excavation test pits were completed to a depth of 7 feet as per our agreement. The bottom of the foundation was not visible at this depth.

On Thursday March 26, 2009 additional excavation was provide to reach the bottom of the foundation. Approximately 12 inches of additional soil was required to be removed to reach the bottom of the foundation. Weaver and Associates also excavated approximately 16 inches under the foundation searching for existing wood piles (post). In the southwest corner test pit it was reported by employees of Weaver and Associates that small pieces of wood were seen floating in water which flowed from under the structure once soil was removed from under the foundation.

At approximately 2:30 PM on March 26, 2009 Mark LaMay from Jaster-Quintanilla arrived on site to collect data from the test pits regarding the courthouse foundation. When Mr. LaMay finished viewing the pits he instructed Weaver and Associates to fill in the test pits and replace the concrete sidewalk.

ANALYSES AND RECOMMENDATIONS

Geotechnical Considerations

Expansive soils are present on this site. This report provides recommendations to help mitigate the effects of soil shrinkage and expansion. However, even if these procedures are followed, some movement and cracking in the structure should be anticipated. The severity of cracking and other damage such as uneven floor slabs will increase if wetting or drying of the expansive soils occurs.

The expansive soils can subject lightly loaded shallow foundations to significant differential soil movements. Based on the conditions encountered in the borings, underreamed drilled shafts should be used to transfer new foundation loads to the clays at a depth of about 20 feet below grade.

In conjunction with drilled shafts, the building floor slabs should be structurally supported above existing grade if slab movements are to be limited to less than one inch. It should be noted that there is a risk that even ½ inch of movement can result in unsatisfactory building performance. Some of the risks that can affect building performance include uneven floors, floor and wall cracking, and sticking doors.

Asphaltic concrete pavement or Portland cement concrete pavement can be used at this site. However, due to the highly active clays, the Portland cement concrete pavement is expected to require less maintenance.

Geotechnical recommendations for building foundation, floor slab subgrade preparation, pavement, and earthwork are presented in the following report sections.

Drilled Shafts Design Recommendations

Underreamed Shafts

Drilled and underreamed shafts should be situated in the clay soils at depths of about 20 feet below existing grade. The bearing level should be reviewed when the project grading plan is available. An allowable net bearing pressure of 4,000 psf can be used to proportion underreams. This value contains a safety factor of about three with respect to a bearing failure.

Underreamed shafts should have a minimum base to shaft diameter ratio of 2 to 1 to resist the uplift loads described below. In addition, the underream diameter should be a minimum of 30 inches larger than the straight shaft portion.

We recommend underreamed shafts maintain a minimum edge to edge spacing of one underream diameter, based on the larger of the two. Closer drilled shaft spacing should be evaluated to determine if reductions in the allowable bearing pressures should be made to control settlement.

Seventy to 80 percent of the foundation settlement of properly constructed underreamed shafts is expected to occur as the shafts are loaded. The total settlement is estimated to range from ½ to 1 percent of the underream diameter. Differential settlements of equally loaded drilled shafts are expected to range from ½ to ¾ of the total settlements.

Underreamed Shafts - Lateral Capacity

The shafts may be subject to lateral loads. Recommendations for design of laterally loaded drilled shafts are presented in this report section.

An allowable passive resistance of 1,000 psf is recommended in the overburden soils. If a shaft is not surrounded by paving or flatwork, the upper 5 feet should be neglected. This value may be increased by 20 percent when considering wind loads.

These recommended lateral earth pressures apply to shafts spaced at 5 or more shaft diameters, center to center. This office should review the lateral earth pressure recommendations for shafts spaced closer than 5 shaft diameters.

Underreamed Shafts - Uplift Resistance

Drilled and underreamed shafts will be subject to uplift as a result of heave in the overlying clay soils. The magnitude of these loads varies with the shaft diameter, soil parameters, and particularly the in-situ moisture levels at the time of construction. For the conditions

encountered at this site, the uplift load can be approximated by assuming a uniform uplift of 2,000 psf over the shaft perimeter for a depth of 8 feet. Uplift may be reduced to 1,200 psf if moisture conditioned soils are placed as discussed in the "Floor Slabs" section of this report. The shafts must contain sufficient continuous vertical reinforcing to resist the net tensile load.

Underreamed Shaft Construction

The underreamed shafts should be installed in accordance with the American Concrete Institute's Specification ACI 336. Excavation for the shafts should be maintained in the dry. Concreting should closely follow excavation to reduce potential caving and/or seepage problems. Some field adjustments in the underream depths may be necessary to keep shafts above groundwater.

The concrete should have a slump of 6 inches plus or minus 1 inch and be placed in a manner to avoid striking the reinforcing steel during placement. The top of the drilled shafts should not be allowed to have an enlarged "mushroom" shaped top.

The drilled shaft design recommendations provided in this report are based on proper construction procedures, including maintaining a dry shaft excavation and proper cleaning of bearing surfaces prior to placing reinforcing steel and concrete. All drilled shaft installations should be inspected by qualified geotechnical personnel to help verify the bearing stratum, the design penetration, and perform related duties.

Grade Beams/Pier Caps

All grade beams or wall panels should be supported by the drilled shafts. A minimum void space of 8 inches is recommended between the bottom of grade beams, pier cap extensions or wall panels and the subgrade. This void will serve to reduce distress resulting from swell pressures generated by the clays. Structural cardboard forms are one acceptable means of providing this void beneath cast-in-place elements. A soil retainer should be used to help prevent soil infilling of the void space.

The grade beams should be formed rather than cast against earth trenches. Backfill against the exterior face of grade beams, wall panels and pier caps should be properly compacted onsite clays. Compaction should be a minimum of 92 percent of ASTM D698, at a minimum of +3 percent above the optimum moisture content determined by that test.

Seismic Considerations

Based on the 2006 International Building Code, Table 1615.1.1 Site Class Definitions, the site soils can be characterized as Site Class C. Site Class C is described as stiff soil and soft rock for the top 100 feet of the site soil profile.

Floor Systems

Lightly loaded floor slabs placed on-grade will be subject to movement because of moisture induced volume changes in the site soils. The clays expand (heave) with increases in moisture and contract (shrink) with decreases in moisture.

The potential magnitude of the moisture-induced movements is rather indeterminate at this site. It is influenced by the soil properties, overburden pressures, and by soil moisture levels at the time of construction and following construction. The greatest potential for post-construction upward movement occurs when the soils are in dry condition at the time of construction. Based on the soil types encountered in the borings and a dry moisture state, movements in slabs-on-grade placed near existing grades are estimated to on the order of 3 inches.

A structural slab is recommended if foundation movements are to be limited to less than 1 inch. The building slabs can be supported on a modified subgrade to reduce soil movements to about 1 inch. Note that movements of ½ inch can result in uneven floors, sticking doors, and cracking of floor slabs and wall partitions. If the risk of these movements is unacceptable, the floor slab should be structural.

Structural Floor Slabs

If floor slab movement cannot be tolerated, a floor system structurally suspended above the subgrade is recommended. A minimum void space of 12 inches is recommended beneath the slabs.

The minimum void space can be provided by the use of cardboard carton forms, or a deeper crawl space. The bottom of the void should preferably be higher than adjacent exterior grades. A ventilated and drained crawl space is preferred for several reasons, including the following:

- Ground movements will affect the project utilities, which can cause breaks in the lines and distress to interior fixtures.
- A crawl space permits utilities to be hung from the superstructure, which greatly reduces the possibility of distress due to ground movements. It also can provide ready access in the event repairs are necessary.
- Ground movements are uneven. A crawl space can be positively drained preventing the ponding of water and reducing the possibility of distress due to unexpected ground movements.

Slabs/Flatwork on Grade

Slab-on-grade construction should only be considered if slab movements and potential building distress are acceptable. The active clay subgrade will need to be modified to reduce potential

slab movements. The level of acceptable movement will vary with the user. The following recommendations should be reviewed when the grading plan is available.

Reductions in anticipated movements can be achieved by using methods developed in this area to reduce slab-on-grade floor movements. The more commonly used method of subgrade preparation consists of moisture conditioning the site soils using either water pressure injection or excavation and replacement. Water pressure injection is not recommended for this project due to the existing site improvements. The moisture conditioning process should extend beyond the building line to include entrances, sidewalks, and other areas sensitive to movement that are located adjacent to the building.

Moisture conditioning the soils to a depth of 10 feet is estimated to result in slab movements are on the order of 1 inch. The moisture conditioned soils should be capped with one foot of select fill or moist cured until concrete is placed. Recommendations for excavation and replacement are presented in the "Earthwork" section of the report. The ground surface around the building should be sloped to prevent water from ponding next the building. Drainage recommendations are also presented in the "Earthwork" section of the report.

Slabs placed at the basement level, 6 to 7 feet below grade, may be designed to limit movements to about 1 inch by excavating the soils to a depth of 12 feet below grade and replacing the remaining 5 to 6 feet with moisture conditioned fill and a one foot cap of non-expansive, select fill.

Excavation adjacent to or beneath the existing structure should proceed with caution. The structural engineer should be consulted for safety and protection of the existing building.

It should be realized that slab movements of even ½ inch could result in drywall and slab cracks as well as sticking doors. Designs should be such that the movement discussed above can be accommodated.

The use of a vapor retarder should be considered beneath concrete slabs on grade that will be covered with wood, tile, or carpet with a water soluble adhesive. A vapor retarder should be used for other moisture sensitive coverings, impervious coverings, or when the slab will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer and slab contractor should refer to ACI 302 for procedures and cautions regarding the use and placement of a vapor retarder.

Earthwork

Excavation and Replacement

The area to be treated should be undercut to provide 10 feet of reworked soils beneath the select fill pad for ground level slabs. The exposed soil subgrade should then be scarified to a depth of 8 inches and re-compacted to a minimum of 92 percent of Standard Proctor (ASTM D698) at a minimum of +4 percentage points above the soil's optimum moisture content. The soils can then be replaced in loose lifts, less than 9 inches thick, and uniformly compacted to the same criteria. Care should be taken that a lift is not allowed to desiccate prior to placing a subsequent lift. The select fill should then be placed above the reworked subgrade within 48 hours of completing the installation of the moisture conditioned soils.

Select Fill

The material used as select fill should be a silty or sandy clay with a Liquid Limit less than 35 percent, a Plasticity Index between 6 and 15, and no less than 60 percent passing the No. 200 sieve. It should be spread in loose lifts, not exceeding 9 inches thick, and uniformly compacted to a minimum of 95 percent of ASTM D698 at -1 to +2 percentage points of the soil's optimum moisture content. The first lift of select fill should be placed wet of optimum to prevent drying the underlying subgrade.

As an alternate to select fill, flexible base can be used. The base should meet the requirements of TxDOT Item 247, Type A, Grade 1 or 2. Recycled concrete meeting these requirements is acceptable.

Positive drainage must be provided away from the structures to prevent the ponding of water in the select fill, during and following construction. Care must be taken that backfill against the exterior face of grade beams is properly compacted onsite clay as discussed in the section "Grade Beams/Pier Caps". Leave-outs in the floor slab should be protected from ponding water during construction.

Building Area Drainage

All grades must be adjusted to provide positive drainage away from the structure. Water permitted to pond near or adjacent to the perimeter of the structure can result in soil movements that exceed those discussed in this report. Open ground should preferably be sloped at a minimum of 5 percent grade 10 feet beyond the perimeter of the building.

Flatwork and pavement will be subject to post construction movement. Maximum grades practical should be used for paving and flatwork to prevent areas where water can pond. In addition, allowances in final grades should take into consideration post-construction movement of flatwork, particularly if such movement would be critical. Flatwork sensitive to subgrade movements should be prepared as discussed in the "Earthwork" section of this report. Where

paving or flatwork abuts the structure, the pavement should be sloped down away from the building and joints properly sealed and maintained to prevent the infiltration of surface water.

Planters located adjacent to the structure should preferably be self-contained. Sprinkler mains should be located a minimum of 5 feet away from the building line. If heads must be located adjacent to the structure, then service lines off the main should be provided. Roof drains should discharge on pavement or be extended away from the structure. Ideally roof drains should discharge by closed pipe to storm drain systems.

Site Grading

The on-site soils, free of vegetation, debris, and rocks greater than 4 inches in maximum dimension, are generally suitable for site grading. If imported fill materials are used, they should be clean soil with a Liquid Limit preferably less than 60 percent and no rock greater than 4 inches in maximum dimension.

Prior to placing any fill, the areas to receive fill will need to be stripped and grubbed. It should then be proof rolled with heavy pneumatic equipment. Any soft or pumping areas should be excavated to a firm subgrade and properly backfilled.

The subgrade should then be scarified to a minimum depth of 6 inches and compacted to a minimum of 95 percent of the Standard Proctor (ASTM D698) maximum dry density. The subgrade should be compacted at moisture contents at moisture contents a minimum of +2 percent above the optimum moisture content. The fill materials should then be spread in loose lifts, less than 9 inches thick, and uniformly compacted to the same criteria.

Utilities

Care should be taken that utility trenches are not left open for extended periods, and they are properly backfilled. Backfilling should be accomplished with properly compacted on-site soils, rather than granular materials. A positive cut-off at the building line is recommended to help prevent water from migrating in the utility trench backfill.

Below Grade Walls/Retaining Walls

Retaining walls may be required at this site. Walls associated with the structure or walls that are sensitive to movements should be supported by drilled shafts as previously discussed in the "Drilled Shaft Design Recommendations" section of this report. A void of 6 inches should be provided beneath the wall and the clay subgrade, if drilled shafts are used.

Site walls that can tolerate movements can be supported by continuous footings founded in natural soils or properly compacted fill. Footings situated a minimum of 2 feet below finished grade may be proportioned with a maximum allowable bearing pressure of 1,500 pound per

square foot. A coefficient of friction of 0.35 is recommended for evaluating sliding resistance. Additional passive resistance can be developed by using a key beneath the wall footing. An allowable passive pressure of 500 psf may be considered against the face of the key.

Lateral earth pressures acting on the walls will depend on the type of backfill material used and drainage conditions behind the wall. Recommended lateral earth pressures expressed as equivalent fluid pressures are presented below in Table 3 for rigid and flexible walls for drained conditions. Rigid walls are not anticipated to deflect sufficiently to mobilize active earth pressures. Structure walls should be considered rigid. Active earth pressures can be used where the top of the wall will deflect on the order of 0.5 percent of the wall height.

TABLE 3 - EQUIVALENT FLUID PRESSURES

Backfill Material	Active (Flexible)	At-Rest (Rigid)
On-site soils	95 pcf	110 pcf
Select Fill, with Liquid Limit less than 35 and Plasticity Index less than 15	50 pcf	65 pcf
Granular backfill, less than 3% passing No. 200 sieve and less than 30% passing No. 40. Non-plastic	35 pcf	50 pcf

The wall backfill limits should extend outward at least 3 feet from the base of the wall and then upward on a 1H:2V slope. For narrower backfill widths of granular or select fill soils, the equivalent fluid pressures for the on-site soils should be used.

The lateral earth pressure values do not include surcharge loads due to overburden, traffic, equipment, etc. Surcharge loads should be considered if they apply at the surface above the wall within areas defined by an angle of 45 degrees from the base of the wall. A lateral pressure coefficient of 0.5 is recommended for uniformly distributed surcharge loads.

Wall backfill materials should be placed in loose lifts, less than 9 inches thick, and uniformly compacted to a minimum density of 95 percent of ASTM D 698. Moisture content during placement of cohesive backfill should be within 0 to +5 percentage points of the optimum moisture content as measured in test method ASTM D 698. Granular backfill should not be water jetted to achieve compaction and should be placed at a moisture content to allow the desired density to be achieved.

Care should be taken that backfill is not over compacted, which could increase the lateral pressures on the walls. The top of the backfill should be protected by flatwork, paving or for granular backfill a minimum of 2 feet of clay fill to prevent surface infiltration.

The design recommendations presented above assume hydrostatic pressures will not develop behind the wall. For structure walls, the drains should be a minimum of 12 inches lower than the adjacent slab. Drainage for free standing walls can be provided by using a collector pipe or weep holes near the base of the wall. Drains should be properly filtered to minimize the potential for erosion through these drains and/or plugging of drain lines.

Settlement of the wall backfill should be anticipated.. Piping and conduits through the fill should be designed for potential soil loading due to fill settlement. Flatwork, sidewalks and pavements over fills may also settle. Backfill compacted to the density recommended above is anticipated to settle on the order of one to two percent of the fill thickness.

Pavements

Pavement Subgrade Treatment

Subgrade materials at this site are anticipated to consist of clays. These soils are subject to loss in support value with the moisture increases, which occur beneath pavement sections. They react with hydrated lime, which serves to improve and maintain their support value. Lime stabilization is recommended beneath flexible (asphalt) pavement sections. Rigid (concrete) pavements may be placed on an unstabilized, properly compacted subgrade.

A minimum of 8 percent hydrated lime (TxDOT Item 264), by dry weight, should be used. The lime should be thoroughly mixed and blended with the top 6 inches of the subgrade (TxDOT, Item 260). Stabilization should extend a minimum of one foot beyond the edge of the pavement.

The subgrade, stabilized or unstabilized, should then be uniformly compacted to a minimum of 95 percent of ASTM D698 maximum dry density between -1 to +3 percentage points of the optimum moisture content. The subgrade should be protected and maintained in a moist condition until the pavement is placed. Pavement subgrades should be graded to prevent ponding and infiltration of excessive moisture on or adjacent to the pavement subgrade surface.

Design Traffic

Traffic patterns and anticipated loading conditions were not available; however, we anticipate that traffic loads will be produced primarily by automobile traffic, service trucks and school buses. Two pavement section alternatives are provided: Light Duty Pavements and Medium Duty Pavements. A design life of 20 years was assumed to develop the total traffic used in the thickness design.

Light Duty Pavements were designed for automobile traffic only. Medium Duty Pavements were designed for automobiles, 2 two axle 10-ton trucks per day, 2 two axle 20-ton trucks and 10 school bus per day for a total of about fifteen 18-kip Equivalent Single Axle Loads (ESAL's) per day. The Medium Duty Pavement is also appropriate for fire lanes. If the pavements are subject to heavier loading and higher traffic counts than the assumed values, this office should be notified and provided with the information so that we may review these pavement sections and make revisions if necessary.

Pavement Sections

Five inches of asphaltic concrete should be adequate in light duty traffic areas. This should be increased to six inches for medium duty traffic. The section should consist of a two-inch surface course similar to TxDOT Type D and a base course similar to Type B. The coarse aggregate in the surface course should be crushed limestone rather than gravel.

Portland cement concrete is recommended in areas subject to truck and dumpster traffic and is suitable for automobile drives and parking lots. Five inches of concrete is recommended for light duty areas and six inches in medium duty traffic. Dumpster aprons should be a minimum of 7 inches thick.

The concrete should have a minimum 28-day compressive strength of 3,000 psi in automobile lots and 3,500 psi in truck and dumpster areas. It should contain a minimum of 6 ±2.5 percent entrained air for a one-inch maximum aggregate size. As a minimum, the section should be reinforced with No. 3 bars on 18-inch centers in both directions.

Flat grades should be avoided with positive drainage provided away from the pavement edges. Backfilling of curbs should be accomplished as soon as practical to prevent ponding of water.

Openings in pavement, such as landscape islands, are sources for water infiltration into surrounding pavements. Water collects in the islands and migrates into the surrounding subgrade soils thereby degrading support of the pavement. This is especially applicable for islands with raised concrete curbs, irrigated foliage, and low permeability near-surface soils. The civil design for the pavements with these conditions should include features to restrict or to collect and discharge excess water from the islands. Examples of features are edge drains connected to the storm water collection system or other suitable outlet and impermeable barriers preventing lateral migration of water such as a cutoff wall installed to a depth below the pavement structure.

Preventative Maintenance

Preventative maintenance should be planned and provided for through and on-going pavement management program in order 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 consists of both localized maintenance (e.g. crack and joint sealing and patching) and global maintenance (e.g. surface sealing). Preventative maintenance is usually the first priority when implementing a planned pavement maintenance program and provides the highest return on investment for pavements. Prior to implementing any maintenance, additional engineering observation is recommended to determine the type and extent of preventative maintenance.

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.

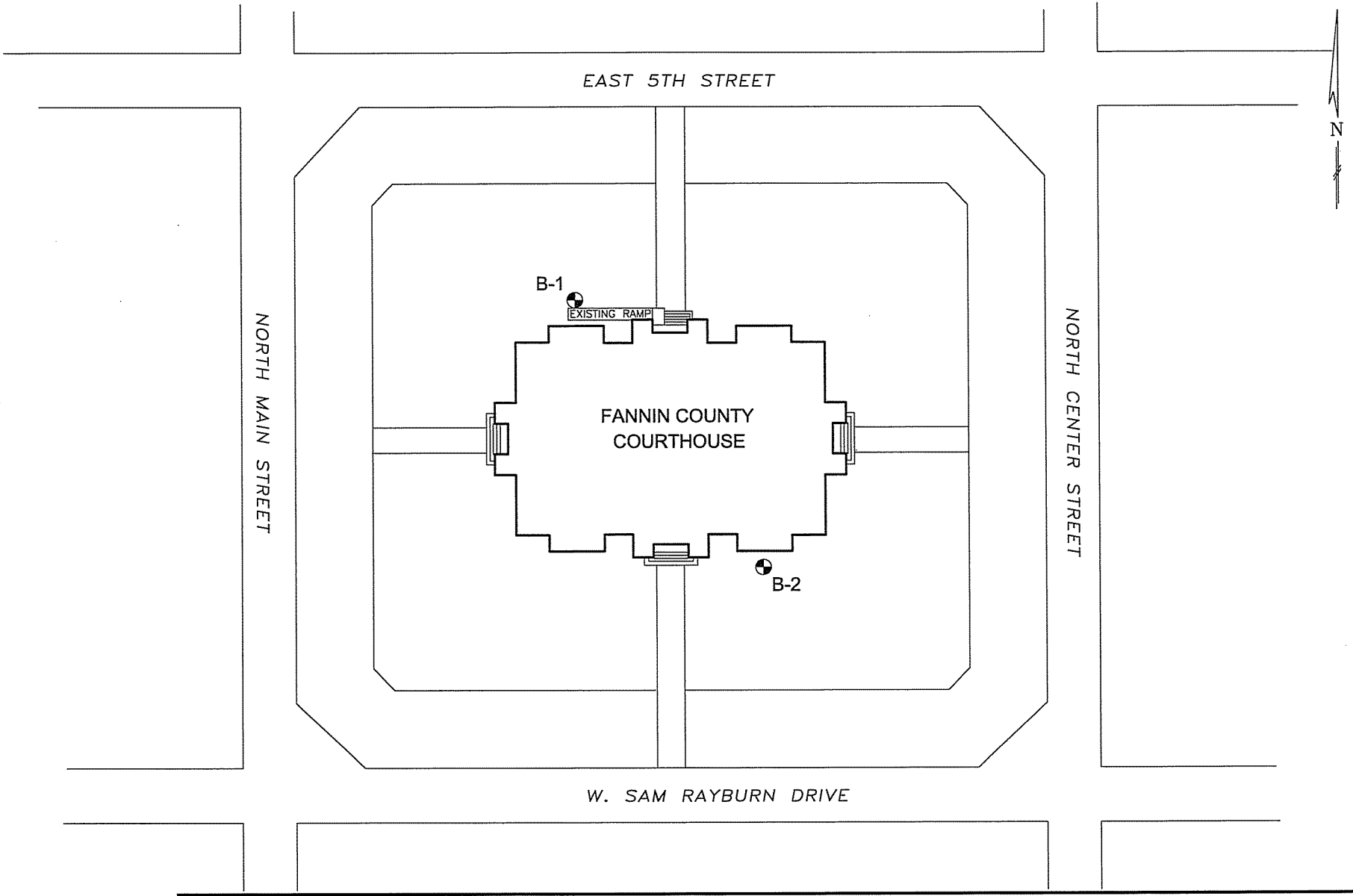
The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of 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

Date: 04/07/09 N:\Projects\2009\94095056\94095056.dwg Layout: Layout1



Project Mngr: DF	Project No. 94095056	Terracon	**BORING LOCATION DIAGRAM**
Drawn By: CDD	Scale: NOT TO SCALE	Consulting Engineers and Scientists	FANNIN COUNTY COURTHOUSE RESTORATION
Checked By: -	Date: 3/25/09	8901 CARPENTER FREEWAY DALLAS, TEXAS 75247	BONHAM, TEXAS
Approved By: -		PH. (214) 630-1010 FAX. (214) 630-7070	FIG. No. 1

LOG OF BORING NO. B- 1

CLIENT: **KSA Engineers, Inc.**
McKinney, Texas

PROJECT: **FANNIN COUNTY COURTHOUSE RESTORATION**

BORING LOCATION: **See Figure 1**

SITE: **101 W. Sam Rayburn Drive**
Bonham, Texas

Approx. Surface Elevation: ±600* ft

Graphic Log	DESCRIPTION	DEPTH, FEET	USCS SYMBOL	TYPE	SPT OR TXDOT CPT BLOWS/INCH	CALIBRATED HAND PENETROM., TSF	RECOVERY, % / RQD, %	MOISTURE CONTENT, %	DRY DENSITY, PCF	LIQUID LIMIT, %	PLASTICITY INDEX	MINUS #200 SIEVE, %	COMPRESSIVE STRENGTH, KSF	FAILURE STRAIN, %
					SAMPLES			TESTS						
	FILL, SANDY LEAN CLAY, Dark brown and tan — 2.0 — 598.0		CL	ST		1.5								
	SANDY LEAN CLAY, Dark brown, medium stiff — 4.0 — 596.0		CL	ST		1.25		24		39	19			
	FAT CLAY, Orange and gray, marl, very stiff	5	CH	ST		2.5								
			CH	ST		2.75		21	108	57	37			
			CH	ST		4.5								
		10		CF										
			CH	ST		2.25		25	101				2.7	3.7
		15		CF										
			CH	ST		4.5								
		20		CF										
	22.0 — 578.0													
	FAT CLAY, Tan and gray, marl, very stiff to hard		CH	ST		4.5								
		25		CF										
			CH	ST		4.5								
		30		CF										
			CH	ST		4.0		27	99				3.4	1.1
		35		CF										
	40.0 — 560.0		CH	ST		4.0								
	B.H. at 40.0'	40												

STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES BETWEEN SOIL AND ROCK TYPES. IN SITU, THE TRANSITION BETWEEN STRATA MAY BE MORE GRADUAL.

REMARKS: *Groundsurface elevation estimated from USGS topographic map, Bonham, Texas

WATER LEVEL OBSERVATIONS, FEET

No seepage observed.

Terracon

DATE DRILLED 3/17/2009

PROJECT NUMBER 94095056

FIGURE 2

LOB 94095056.GPJ 4/6/09

LOG OF BORING NO. B- 2

CLIENT: **KSA Engineers, Inc.**
McKinney, Texas

PROJECT: **FANNIN COUNTY COURTHOUSE RESTORATION**

BORING LOCATION: **See Figure 1**

SITE: **101 W. Sam Rayburn Drive**
Bonham, Texas

Graphic Log	DESCRIPTION	DEPTH, FEET	USCS SYMBOL	TYPE	SPT OR TXDOT CPT BLOWS/INCH	CALIBRATED HAND PENETROM., TSF	RECOVERY, % / RQD, %	MOISTURE CONTENT, %	DRY DENSITY, PCF	LIQUID LIMIT, %	PLASTICITY INDEX	MINUS #200 SIEVE, %	COMPRESSIVE STRENGTH, KSF	FAILURE STRAIN, %
	Approx. Surface Elevation: ±600* ft													
	FILL, SANDY LEAN CLAY, Brown, tan and gray, with bricks		CL	ST		1.75								
	3.0 597.0		CL	ST		4.25								
	4.0 **SANDY LEAN CLAY,** 596.0 Dark brown, very stiff	5	CH	ST		4.5+		17	115	57	37			
	FAT CLAY, Gray and orange, marl, with sand traces, hard		CH	ST		4.5								
		10	CH	ST		4.5+		18	115	51	31			
				CF										
		15	CH	ST		2.75								
				CF										
		20	CH	ST		4.5								
				CF										
	22.0 578.0													
	FAT CLAY, Tan and gray, marl, very stiff to hard	25	CH	ST		4.5+		22	107				2.6	1.3
				CF										
		30	CH	ST		4.5+								
				CF										
		35	CH	ST		4.25								
				CF										
	40.0 560.0	40	CH	ST		4.5								
	B.H. at 40.0'													

STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES BETWEEN SOIL AND ROCK TYPES. IN SITU, THE TRANSITION BETWEEN STRATA MAY BE MORE GRADUAL.

REMARKS: *Groundsurface elevation estimated from USGS topographic map, Bonham, Texas

WATER LEVEL OBSERVATIONS, FEET

No seepage observed.

Terracon

DATE DRILLED 3/17/2009

PROJECT NUMBER 94095056

FIGURE 3

LOB 94095056.GPJ 4/7/09

GENERAL NOTES

DRILLING & SAMPLING SYMBOLS:

SS:	Split Spoon - 1-3/8" I.D., 2" O.D., unless otherwise noted	HS:	Hollow Stem Auger
ST:	Thin-Walled Tube - 2" O.D., unless otherwise noted	PA:	Power Auger
RS:	Ring Sampler - 2.42" I.D., 3" O.D., unless otherwise noted	HA:	Hand Auger
DB:	Diamond Bit Coring - 4", N, B	RB:	Rock Bit
BS:	Bulk Sample or Auger Sample	WB:	Wash Boring or Mud Rotary

The number of blows required to advance a standard 2-inch O.D. split-spoon sampler (SS) the last 12 inches of the total 18-inch penetration with a 140-pound hammer falling 30 inches is considered the "Standard Penetration" or "N-value". For 3" O.D. ring samplers (RS) the penetration value is reported as the number of blows required to advance the sampler 12 inches using a 140-pound hammer falling 30 inches, reported as "blows per foot," and is not considered equivalent to the "Standard Penetration"or "N-value".

WATER LEVEL MEASUREMENT SYMBOLS:

WL:	Water Level	WS:	While Sampling	N/E:	Not Encountered
WCI:	Wet Cave in	WD:	While Drilling		
DCI:	Dry Cave in	BCR:	Before Casing Removal		
AB:	After Boring	ACR:	After Casing Removal		

Water levels indicated on the boring logs are the levels measured in the borings at the times indicated. Groundwater levels at other times and other locations across the site could vary. In pervious soils, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels may not be possible with only short-term observations.

DESCRIPTIVE SOIL CLASSIFICATION: Soil classification is based on the Unified 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.

CONSISTENCY OF FINE-GRAINED SOILS

Unconfined Compressive Strength, Qu, psf	Standard Penetration or N-value (SS) Blows/Ft.	Consistency
< 500	0 - 1	Very Soft
500 – 1,000	2 - 4	Soft
1,000 – 2,000	4 - 8	Medium Stiff
2,000 – 4,000	8 -15	Stiff
4,000 – 8,000	15 - 30	Very Stiff
8,000+	> 30	Hard

RELATIVE DENSITY OF COARSE-GRAINED SOILS

Standard Penetration or N-value (SS) Blows/Ft.	Ring Sampler (RS) Blows/Ft.	Relative Density
0 – 3	0-6	Very Loose
4 – 9	7-18	Loose
10 – 29	19-58	Medium Dense
30 – 49	59-98	Dense
> 50	> 99	Very Dense

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. (300mm)
Cobbles	12 in. to 3 in. (300mm to 75 mm)
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
Modifiers	> 12

PLASTICITY DESCRIPTION

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

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FIGURE 4

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 the 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 / Liquid limit - not dried	< 0.75	OL	Organic clay[K,L,M,N] / 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 lots below "A" line		MH	Elastic Silt[K,L,M]
		organic	Liquid limit - oven dried / Liquid limit - not dried	< 0.75	OH	Organic clay[K,L,M,P] / 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-in. (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.

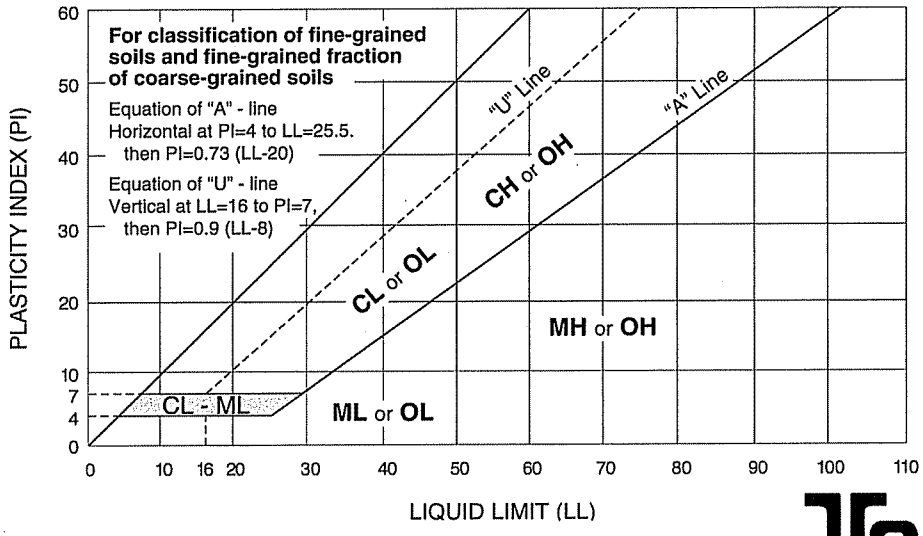

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FIGURE 5

Terracon
Consulting Engineers & Scientists

Terracon Consultants, Inc.
8901 Carpenter Frwy., Ste. 100
Dallas, TX 75247
Phone (214) 630-1010
Fax (214) 630-7070
www.terracon.com

May 19, 2009

KSA Engineers, Inc.
8875 Synergy Drive
McKinney, Texas 75070

Attn: Mr. Bob Jutton, P.E.

RE: Fannin County Courthouse Restoration
Bonham, Texas
Terracon Project No. 94095056

Gentlemen:

Based on discussions with Mr. Steve Lucy with Jaster-Quintanilla, we have further evaluated slab-on-grade construction at the basement level of the referenced project. This evaluation was based on placing the slabs-on-grade without the additional 5 to 6 feet of moisture conditioning discussed in the report.

Additional absorption swell tests were conducted to assist in the evaluation. The results of these tests are presented below.

Boring No.	Depth (feet)	Surcharge (psf)	Initial Moisture (%)	Final Moisture (%)	Swell (%)
B-1	14 – 15	1,125	21.7	23.6	0.9
B-1	19 – 20	1,750	22.0	24.1	0.3
B-2	19 – 20	1,750	20.9	22.9	0.6

Based on the original and supplemental data above, potential slab movements at the basement level are estimated to be on the order of 1½ inches at the location of Boring B-1 and 2 inches at the location of Boring B-2. These estimates are based on the moisture levels in the borings. Conditions beneath the structure may be different. Typically they would tend to be more favorable.

In the course of excavating the soils in the crawl space to create the basement, care should be taken not to disturb the existing foundations. Completion of the excavations and construction of the new slabs should proceed in a reasonably continuous manner. Consideration should be given to using a mud slab to reduce desiccation of the exposed soils.

It is planned to expose the exterior of the existing basement walls and waterproof them. In order to reduce potential seepage, excavated clays will be used for backfill. These should be placed in loose lifts, less than 9 inches thick, and uniformly compacted to a minimum of 94 percent of ASTM D698 at a minimum of +1 percent above optimum moisture. A drain is recommended at the bottom of the wall. The drain should be placed in about an 18 inch square zone of drainage rock, which is wrapped in filter fabric. The invert of the drain line should be lower than the basement slab. An equivalent fluid pressure of 110 pcf is recommended for this condition.

Please contact us if there are any questions or if we can be further assistance.

Sincerely,
Terracon Consultants, Inc.

Daniel L. Franklin, Jr., P.E.
Senior Geotechnical Engineer

Ralph B. Barnes, Jr., P.E.
Principal

STATE OF TEXAS
R.B. BARNES, JR.
36389
5-19-09
REGISTERED PROFESSIONAL ENGINEER

cc: Mr. Stephen Lucy, P.E. – Jaster-Quintanilla Dallas, LLP

Fannin County Courthouse Paint and Finish Analysis

Compiled By
Jhonny Langer
March 18, 2009

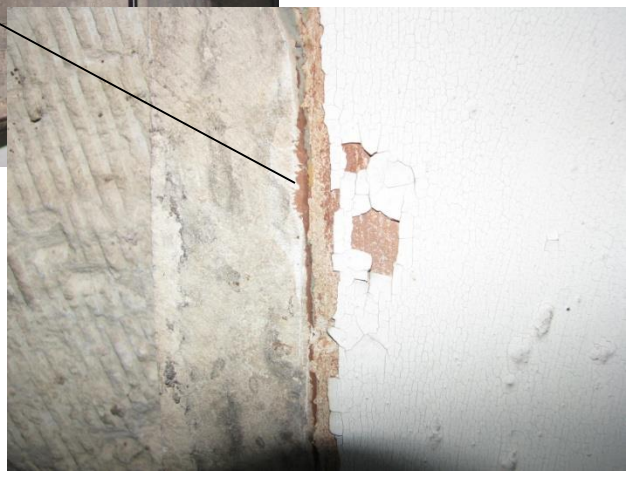
ADDITONAL INFORMATION ADDED AT REAR OF REPORT FROM POST DEMOLITION FOLLOW-UP 06/15/18.

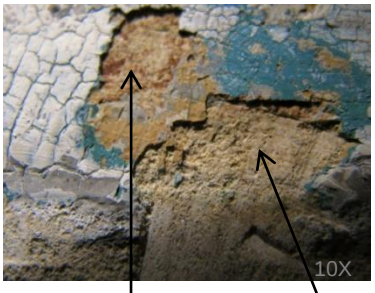
ADDITIONAL REMARKS ADDED PER THC REQUEST -9/10/2018- IN THE CONCLUSION OF REPORT.

Foreword

The Fannin County Courthouse was originally built in 1889 with extensive remodels in 1929,and again in 1965. Source was contacted by Architexas to discern whether any finishes from the completion date of the courthouse were extant for sampling. We were supplied with a list of rooms and spaces where historic plaster was visible as well as the 1889 exterior stonework. These areas were sampled as well as other adjacent areas. Many of these areas were difficult to get to, having been entombed behind the 1929 metal lathed and sanded plaster. The ceilings were dropped during this period and walls were reconfigured. The ceilings were later dropped again, most likely during the 1965 remodel. More information may become available during future demolitions. NEW INFORAMTION IS INCLUDED IN POST DEMOLITION FOLLOW-UP AT REAR OF THE REPORT> PLEASE REVIEW THOUROUGHLY

Observation and Light microscopy was used 20X where necessary. Please review the additional photos on the cd supplied with this report.

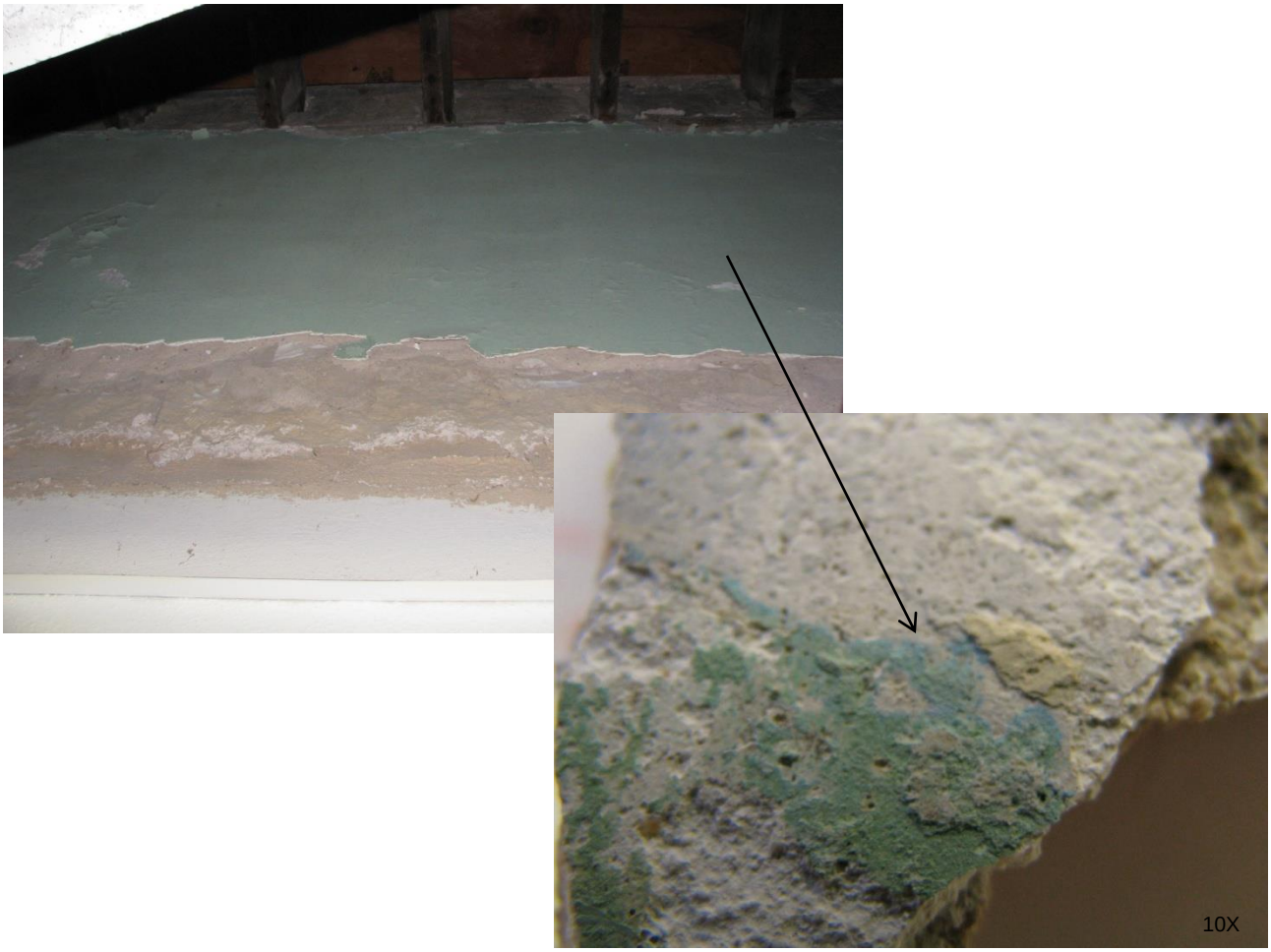




Red paint

Stone substrate

Room 1-15 Jury room, and the bank of windows on the North corridor, 2-8, of the second floor were tested near the ghosting of the placement of the 1889 windows in the hopes of finding over paint from the first generation. We found no concrete evidence of paint near this area but it was discovered that, early on, the stone window casings were painted a dark red. The quoins were most likely painted judging from the overlap of paint around the front edge, but I was unable to view this area because of the 1929 stone facing. The oil paint was applied directly onto the stone with no primer. Subsequent coats of paint were applied as well indicating a long history of being painted. This color might have been applied to the exterior widow jambs and sashes. I will include this as an exterior color.



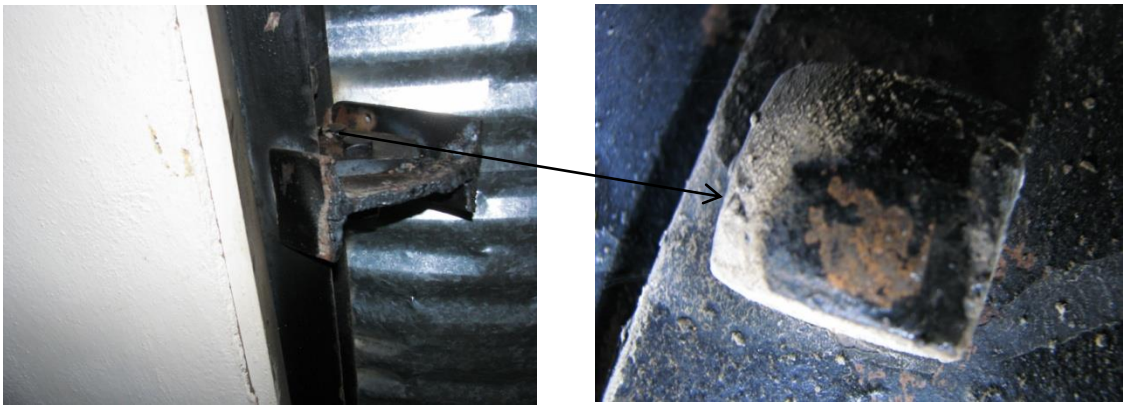
Room 1-15 also held samples of smooth plaster. A calcimine green paint was ubiquitous, but hints of an earlier blue calcimine imbedded in the plaster were available for viewing under a microscope.

Room 2-19 held several samples of intact smooth plaster with a first generation of the same calcimine blue found on the first floor. This was applied over the raw plaster. The ceiling is wide corrugated metal with a first generation of off white oil based paint over a black primer.

The first floor West corridor 1-24, near where the historic staircase once stood, are some holes in the 1929 plaster ceiling which allowed us to sample a wide corrugated ceiling. The first generation was oil based off white. The second generation was oil based yellow with a vanish applied over the top. This varnish may have been an attempt at consolidating flaking paint. It does not appear to have a decorative purpose, but these areas should be uncovered fully for viewing.

A small chase was accessible in the South side of room 3-17 mechanical. Above it was found some sections of small width corrugated metal ceiling with a black factory primer, red metal primer and then off-white as a first generation finish coat still visible above. This is the only room where this style of corrugated metal was found.

The area shown above is from corridor 1-24. There is a ghosting from where the historic stair once stood in place. A small area of smooth plaster shows evidence of a red primer and some specks of black, which might have been the top coat of the metal staircase. No calcimine was evident on the plaster, most likely because this area was inconvenient to paint.



An intact portion of the stringer in corridor 2-27 upstairs was sampled and found to have a red primer and an intact visible first generation of black

The room marked ‘Ducts” behind the current elevator on the first floor revealed that this room once held wainscoting, baseboards, and chair rail-the nailers are still visible above.

Conclusion

The areas we were able to sample indicate that the interior walls of the 1889 structure had smooth plaster with a first generation of calcimine blue. The vaulted corrugated metal ceilings and their metal bands were painted a first generation of off-white with no color differentiation. The corrugated ceiling in the corridor 1-24 as well as the corrugated ceiling in 2-19 are the same wide width indicating that the corridors and at least this room has this style of ceiling. Only one area so far has been sampled with the smaller corrugated ceiling on the 3rd floor, however, it has the same first generation of off-white indicating that all the ceilings were off-white. I have found no confirmed color for any of the exterior except the paint applied to the stone interior of the windows. I only have a low-res photo, shown below, but it is possible to make out a dark band on the inside of the windows where the red was found. It could have been possible that this area was painted red, as well as the jambs and sashes. This could tie into the roof which appears to be a red as well. It also appears that the stonework around the windows is lighter –this could be paint as well or a lighter stone. More research needs to be done after demolition to view the front portion of the stonework shown below.

1898 Colors-
PLEASE REVIEW REVISED COLORS AT END OF REPORT

First generation blue calcimine- Sherwin Williams 6793-Blue Bell---flat sheen

First generation off-white found on metal ceilings- Sherwin Williams 6119- Antique white- Satin or Eggshell sheen

Red sampled on stone adjacent to windows -Sherwin Williams 6054-Canyon Clay- eggshell. NOTE: This color has most likely faded having been painted on the stone. It should be cross referenced with other colors (if found) on the exterior for verification and hue.

Layer Worksheets

Interior	Room:	Corridor 2-25 Five light window	Floor:	2

wall		North		East	x	West		South

Floor

		a	B	c	d	e
Stone window casing		1. stonework-painted red	gray	Gold-yellow	Green-modern paint	Off-white
		2.				
		3				
		4				
		5				
Wainscot		1.				
		2				
		3				
		4				
		5				
Chair rail		1.				
		2				
		3				
		4				
		5				
Wall		1.				
		2				
		3				
		4				
		5				
Molding		1.				
		2				
		3				
		4				
		5				
Other		1.				
		2				
		3				
		4				
		5				
Ceiling		1.				
		2				
		3				
		4				
		5				
Other		1				
		2				
		3				
		4				
		5				

notes

Stone window casing were continuously painted

Interior	Room:	2-19 District Clerk storage	Floor:	2

wall		North	x	East		West		South

Floor

		a	B	c	d	e
WALL		1. blue calcimine	Green calcimine	Modern green latex-unstable and flaking off green calcimine		
		2.				
		3				
		4				
		5				
Metal corrugated ceiling		1. off-white oil	Green oil			
		2				
		3				
		4				
		5				
Chair rail		1.				
		2				
		3				
		4				
		5				
Wall		1.				
		2				
		3				
		4				
		5				
Molding		1.				
		2				
		3				
		4				
		5				
Other		1.				
		2				
		3				
		4				
		5				
Ceiling		1.				
		2				
		3				
		4				
		5				
Other		1				
		2				
		3				
		4				
		5				

notes

Stone window casing were continuously painted

Interior		Room:	1-24 Stair stringer area in corridor					Floor:	1
wall		North		East		West	x	South	

		a	B	c	d	e
Underside of stair stringer		1. smooth white plaster with spot of red primer then black	Replastered and primed off white	Spots of red on new plaster indicating metal was primed again-primer matches that of infill 1929 beams?	No indication of color	
		2.				
		3				
		4				
		5				
Corrugated ceiling and beams		1. Primed black and painted off-white	Gloss yellow	Varnish applied liberally		
		2				
		3				
		4				
		5				
Chair rail		1.				
		2				
		3				
		4				
		5				
Wall		1.				
		2				
		3				
		4				
		5				
Molding		1.				
		2				
		3				
		4				
		5				
Other		1.				
		2				
		3				
		4				
		5				
Ceiling		1.				
		2				
		3				
		4				
		5				
Other		1				
		2				
		3				
		4				
		5				

Interior		Room:	1-15 Jury Room			Floor:	1
wall	x	North	x	East		West	x	South

		a	B	c	d	e
Floor						
wall	Over smooth plaster	1. blue calcimine X2	Green calcimine	Yellowish white thick calcimine over heavily cleaned walls	Green-modern paint	
		2.				
		3				
		4				
		5				
Stone window casing		1. red	Taupey gray	Gold-yellow	Gray primer then dark yellow green	Off white –like stone
		2				
		3				
		4				
		5				
Chair rail		1.				
		2				
		3				
		4				
		5				
Wall		1.				
		2				
		3				
		4				
		5				
Molding		1.				
		2				
		3				
		4				
		5				
Other		1.				
		2				
		3				
		4				
		5				
Ceiling		1.				
		2				
		3				
		4				
		5				
Other		1				
		2				
		3				
		4				
		5				

notes

Stone window casing were continuously painted

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Fannin County Courthouse Paint and Finish Analysis
-Post Demolition Follow-Up-
06/15/18

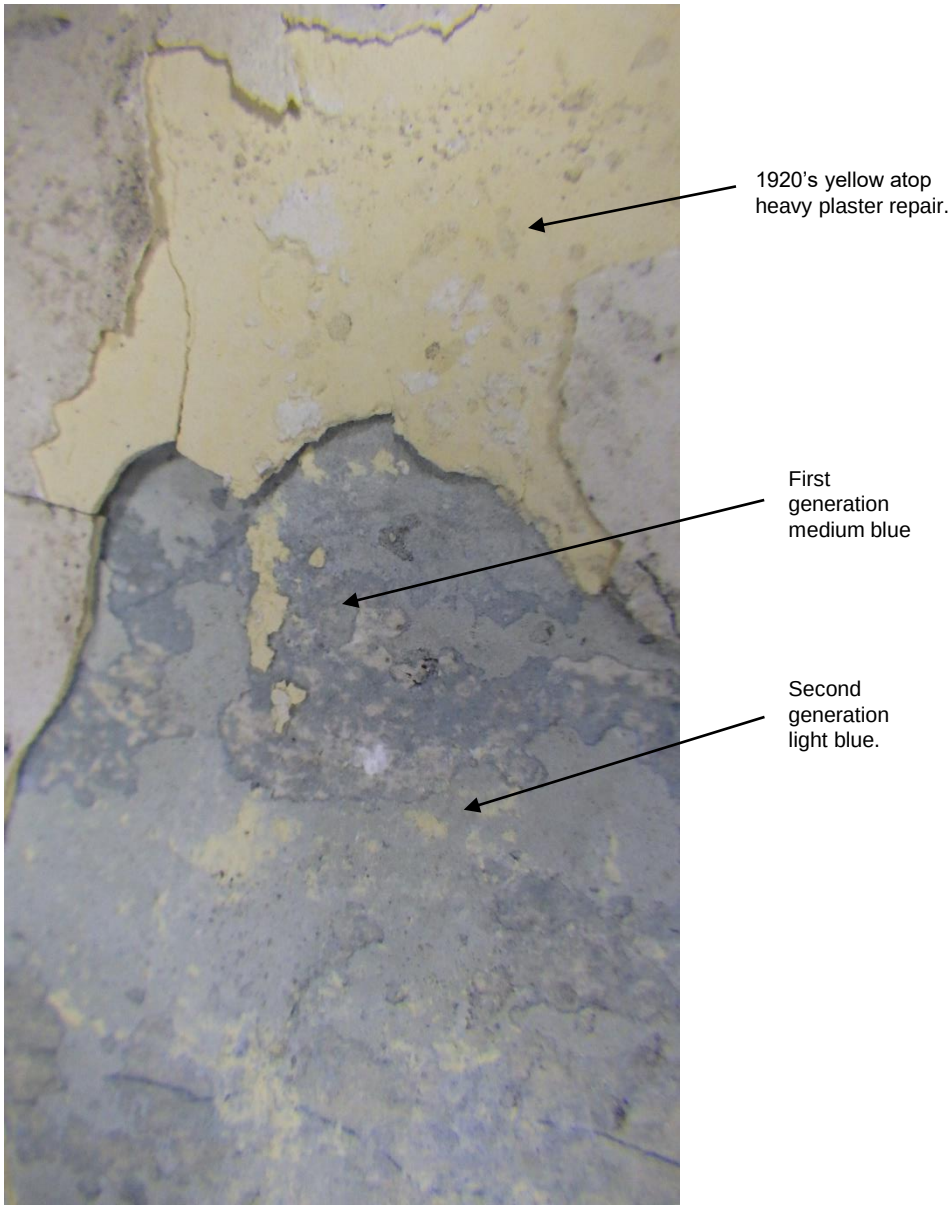
Interior

NW office

NW office

NW office

A smooth gypsum plaster was found on many corners of the first floor offices where they had been entombed. Wood nailers were present indicating that much of the courthouse had wainscoting (above, left). Much of the paint had been encapsulated by later generations of paint. We reviewed several of these locations (above, right) where the wood wainscot cap would have intersected the plaster (above, right) and found vestiges of a warm pigmented shellac that would have been applied to the wood after installation (below, right). This would indicate that the wood was shellaced instead of being painted.



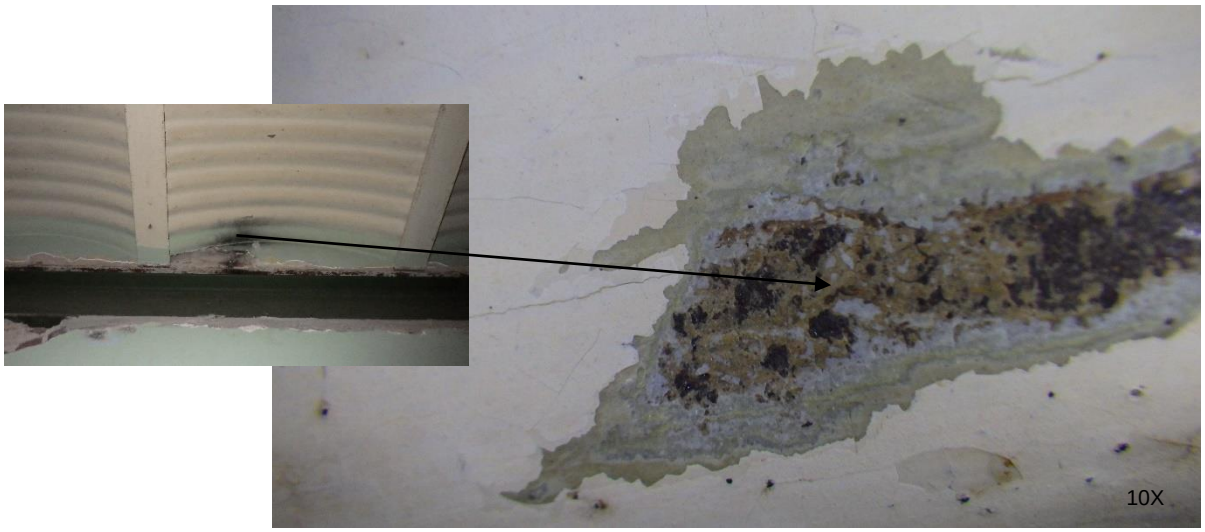
Many of the plaster walls were reused on the first floor after the 1929 fire. We found that these walls, such as the chases shown on the previous page, had a first generation medium tone calcimine blue paint. A shellac primer had been applied over the first generation to accept a second generation of lighter calcimine blue.

First floor, North corridor

The 1920's yellow was ubiquitous and found on the ceilings (above, canopy ghosting) and walls (below).

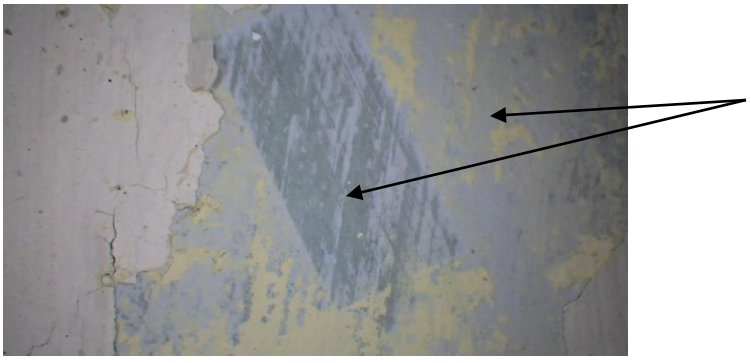
First floor, North corridor.

Raw plaster was found below the red line (above) in the South-west office space on the first floor indicating that possibly built-in furniture was placed here.



This same room had vestiges of the corrugated ceilings used in the courthouse. The first generation was found to be an off-white oil based paint-heavily damaged.

The second floor, South corridor has first generation paint on the walls as well as on the corrugated ceiling. The first generation colors have had a shellac applied over them as a primer for the second generation paint colors; the shellac has heavily discolored the paint films.



In the same corridor an exposure was completed to review the two generations of calcimine blue (above, arrows).

The second floor corridor also retains a few elements of the staircase which were found to have a first generation of black still visible (above, below).

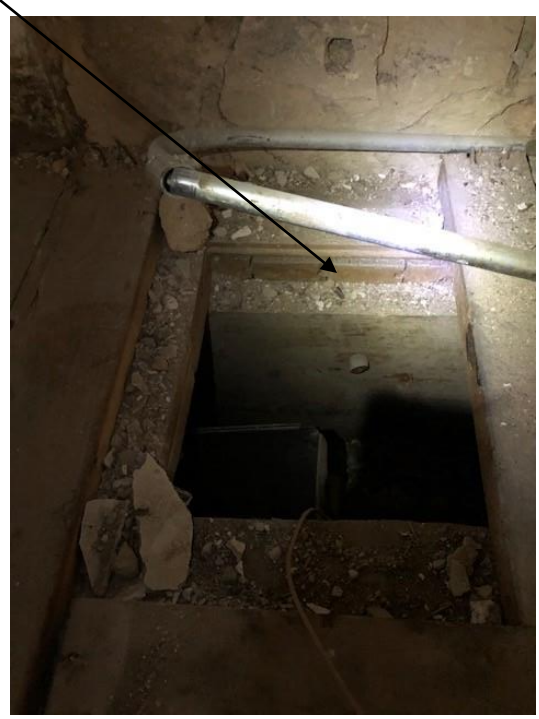
It was noted that the second floor corridor has a stone lentil at the ceiling that has the first generation medium blue calcimine painted over it. It appears no plaster was used over the stone during the finishing stage (above, below, arrow).

First floor ceiling of NW corner office.

Second floor first generation wood flooring of NW corner office.

First floor with typical intact floor boards.

Northeast office on first floor. Additional historic flooring was found under overlay flooring (left, below left). The historic flooring was blind nailed on the side with square nails (below, right). A piece of the flooring was removed and cleaned. Only typical vestiges of oil and wax were found on the otherwise raw wood surface. A Tung oil finish is recommended.

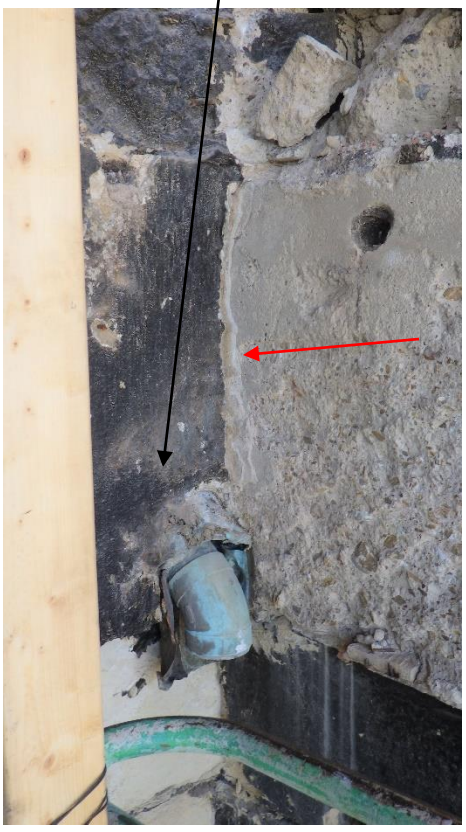


Much of the scored grey concrete floor was reviewed on the first floor corridors and the third floor SW corner room. We found no paint or specialized concrete finish.

Exterior

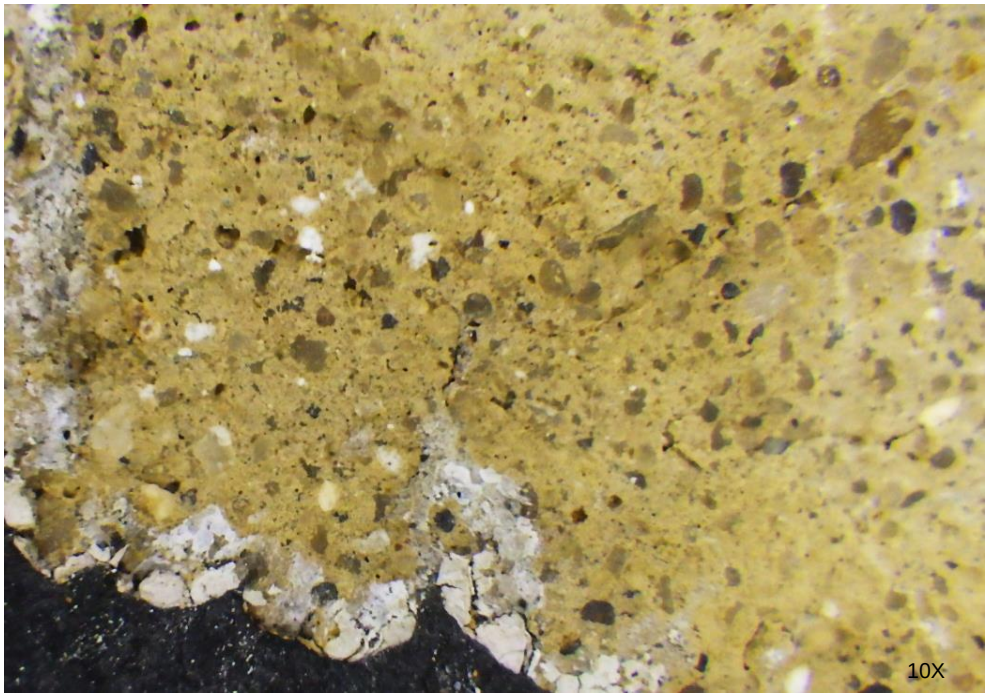
A stringcourse of concrete encircling the building appears to be from the original construction (above, right, red arrows). There is a two part system of dark yellow pigmented concrete applied over the initial pour. (below)

Above this stringcourse is another layer of concrete that has wires that were apparently bent back post fire (above, white arrow). These wires may be how the cornice was attached. If this is the case, then this pigmented concrete was meant to be seen. This also leads credence to the darker of the gold colors (SW 6123-'Baguette' mentioned on page 32.



The historic copper gutter pipe is reused for the newer gutter pipe, (left). The layers of the pigmented concrete can be seen above the gutter pipe (left, red arrow, next page).

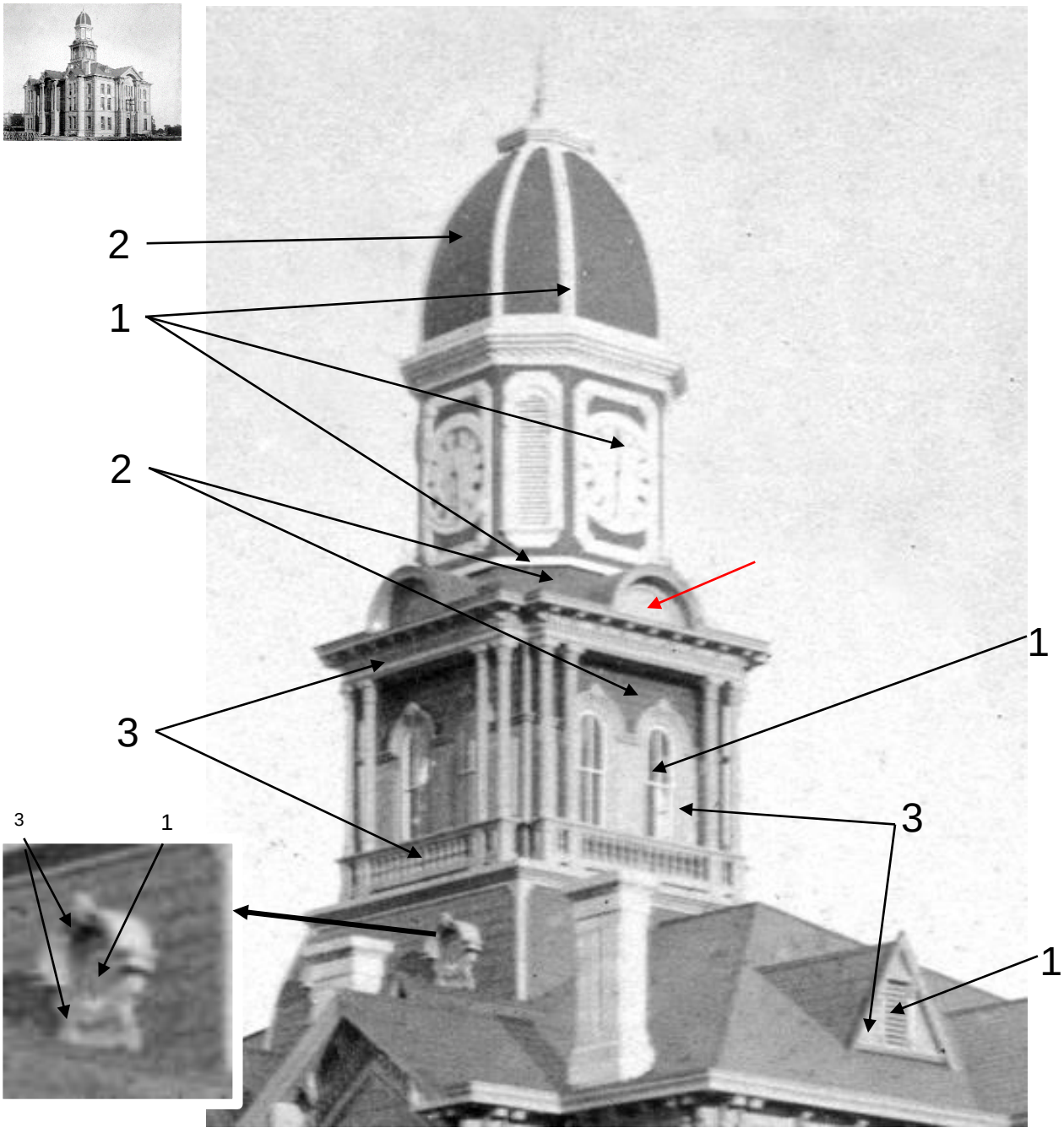
Yellow ochre pigmented concrete.



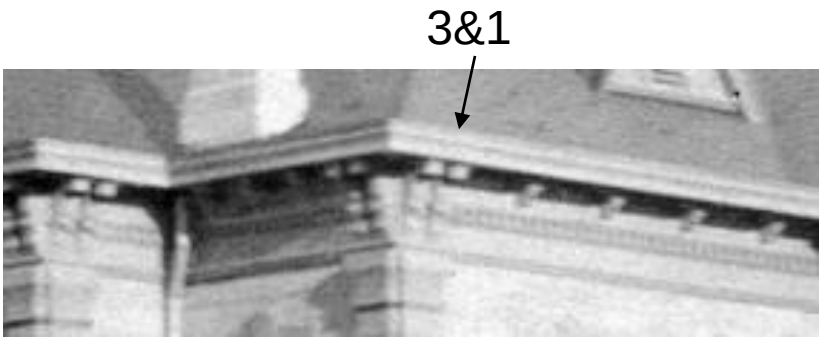
Yellow ochre pigmented concrete

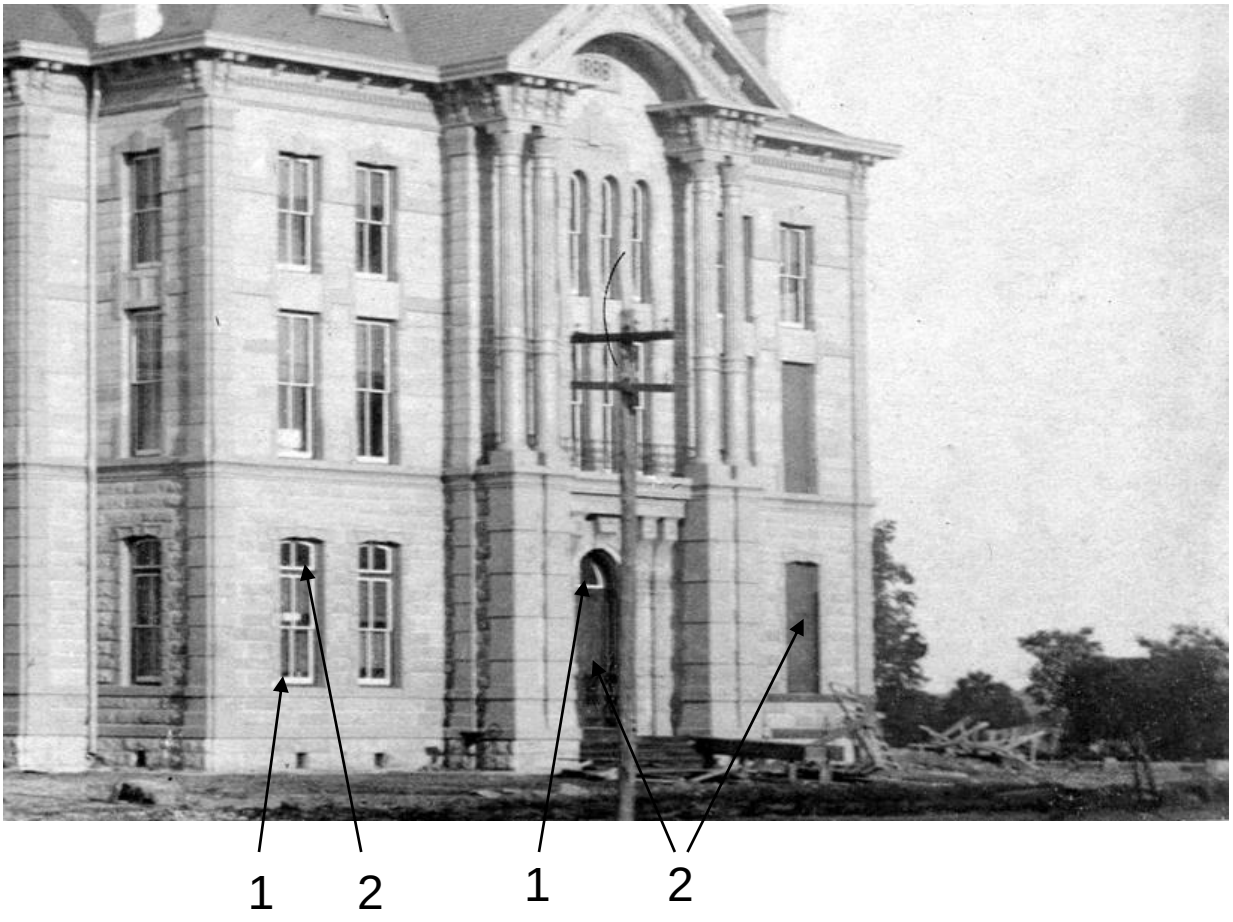
It was noted that the exterior has two defined generations of paint applied to the stone. The first was a two-tone color combination of terracotta-red and cream. The terracotta-red color was used to set off the stringcourses and coins while the cream color was meant to emulate the natural stone color. The colors can still be seen in the post-fire photos (below, right) indicating that it was done previous to 1929-most likely in the late teens or early twenties. The second generation of exterior paint is an off-white applied over the entire surface. This generation most likely came post fire judging by the postcard (below, right).

No colors were extant on the exterior. After reviewing the historic photos we understand there are at least three colors. We have used the off-white **1. (SW 6119 "Antique White")** used on the interior ceilings and extrapolated it onto the tower clock and associated trim, the tower vent and associated trim, ridge caps on dome, pinstripe at the base of the tower, all sashes including entry door transom sashes and the arched insert on the tower colonnade. A dark red color **2. (TBD)** has been extrapolated onto the roof from comparisons to other like courthouses. This red color can also be extrapolated onto the jambs of the first floor as they also appear dark and the upper wall of the interior tower colonnade. It appears there was little to no jamb on the second and third floor windows. This leaves a medium tone color unaccounted for. We have taken the Sherwin Williams color deck and used their system to calculate a medium tone color based upon the 6119 'Antique White' found on the interior. Page 18 of the Sherwin Williams fan deck has two color that might appear to fit within the same value as seen in the historic photos. These two color are **3. (SW 6122 'Camelback, and SW 6123 'Baguette').** One of these colors (or both) would be placed on the tower colonnade, lower portion of the interior tower colonnade, the cornice and brackets. It might be debatable but there appears to be a value differentiation on the cornice as well. Please review the next few pages for clarification



The arched area above the colonnade (red arrow) is debatable on whether there is a color differentiation. It is possible that there were two mid-tone colors but this should be discussed. All of the sashes appear to be the lightest off-white color while the jambs and decorative surrounds appear to be the medium tone color where visible on the upper portions of the roof (inset, right).


3&1


1
2
1
2

Colors

Interior

Sherwin Williams 6485 “Raindrop” flat sheen. First generation calcimine paint found on walls. This color represents the first generation color found in corridors and offices and by extrapolation on courtroom walls.

Sherwin Williams 6119 “Antique White” satin sheen. First generation oil based paint applied to all corrugated ceilings in corridors and offices and by extrapolation on courtroom ceiling.

Sherwin Williams 6258 “Tricorn Black” satin sheen. First generation found on remnants of iron staircase attached to ceiling between first and second floor. By extrapolation any decorative ironwork used on exterior or interior.

Exterior

No Historical color were found. A brief description of theoretical colors are listed on pages 34 and 36.

Conclusion

The pigmented concrete on the exterior leads credence to an ochre color used on the exterior of the courthouse-possibly two ochre colors- but this should be reviewed and discussed. **We have chosen the two colors that seems most likely-but these should be reviewed <u>after</u> the pigmented concrete is exposed.**

The pigmented shellac should be matched to a composite light brown color, or a color found at another of the architects buildings. The samples found were too minute to discern overall color or design.

We were able to find no finish information in the courtroom.

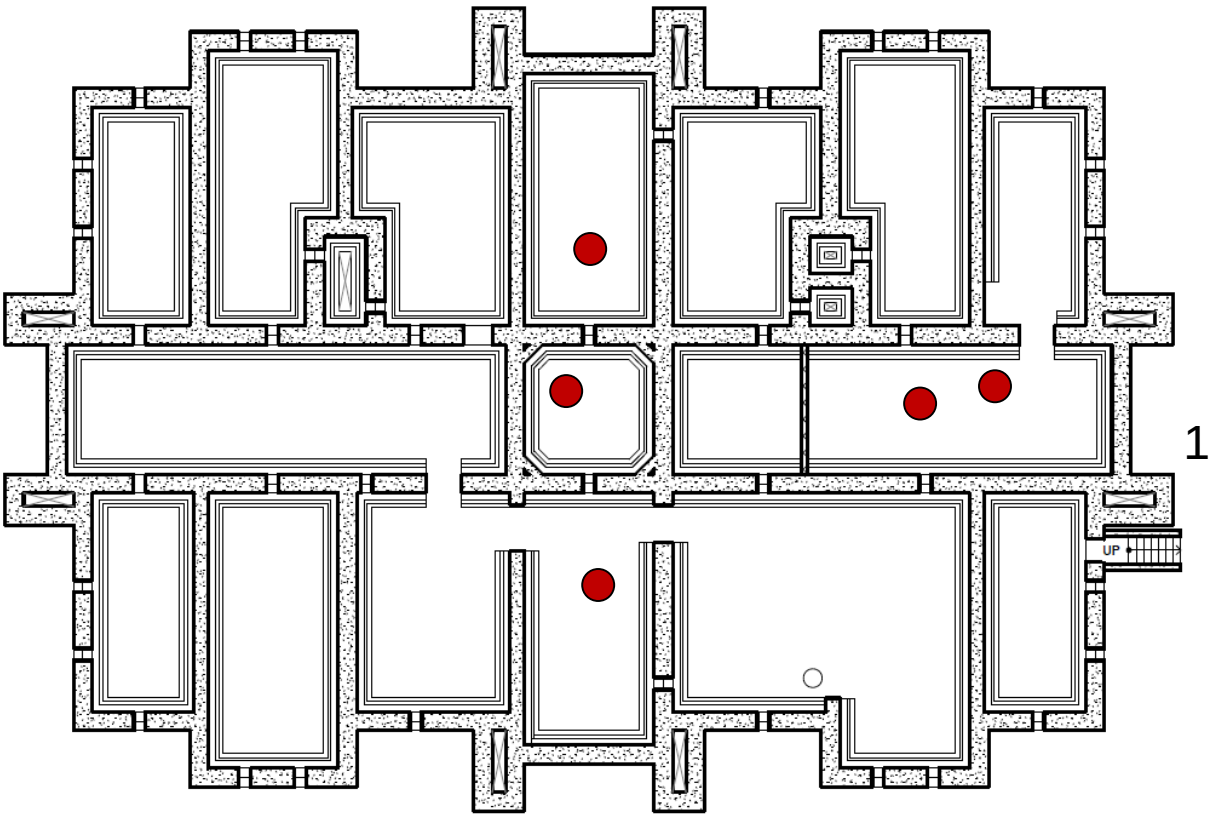
The only item available for sample in the basement was corrugated ceilings. Intact paint samples confirm that an off white was used there as well as the other corrugated ceilings in the courthouse.

Historic wood flooring was found under overlay flooring in various locations in the courthouse. This should be confirmed. Samples were taken to Source studio and found to have a typical oiled finish with extreme wear.

ADDED PER THC REQUEST 9/10/2018. Below is my reply to the concern of the paint applied to the exterior stone as detailed in the body of the report.

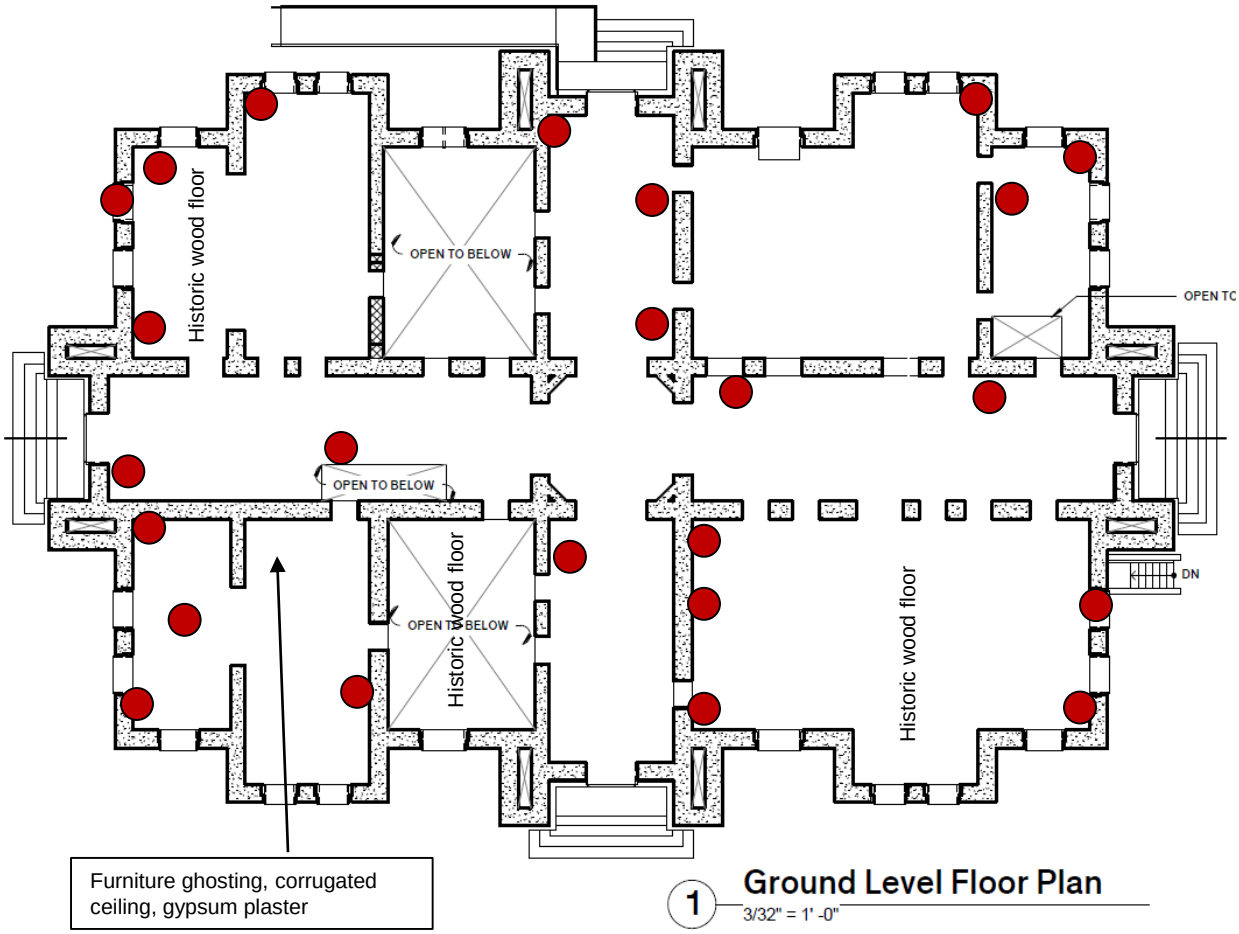
"Page 33 details the two defined painted layers on the exterior of the stone. The last (visible-third generation) layer can be dated to post fire when the entire building was painted off-white. The second generation was a polychrome paint that, judging by the photos, was applied pre-fire. However, it is without a doubt that, judging by all he historical photos we have, that the historic first generation intention was to have an unpainted stone building. These pictures, coupled with the evidence of the pigmented concrete (pages 29-32) points directly to an unpainted building on the first generation. The second-generation polychrome painting most likely appeared somewhere during the teens era when, possibly the building was looking shabby and this type of two tone coloration was popular."

Plans

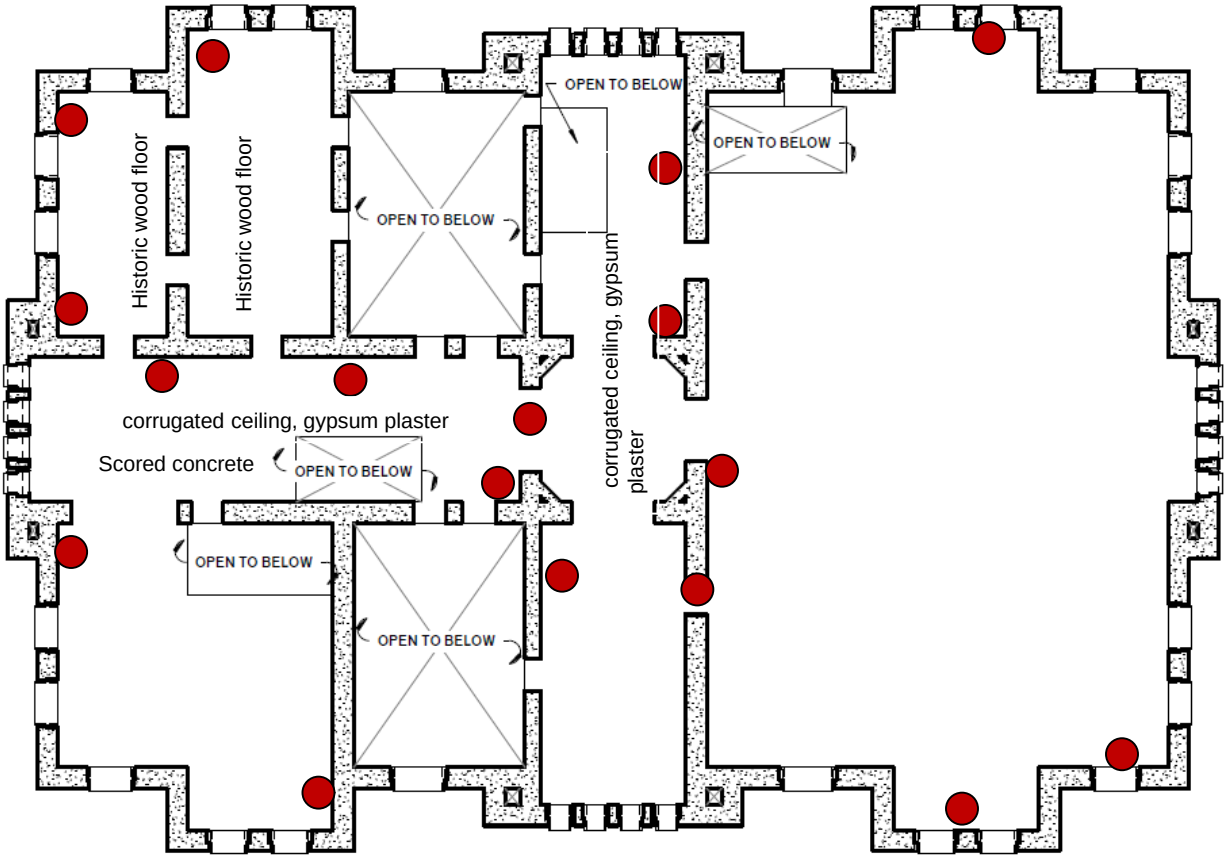


1 **Basement Level Floor Plan**
3/32" = 1' -0"

Areas sampled

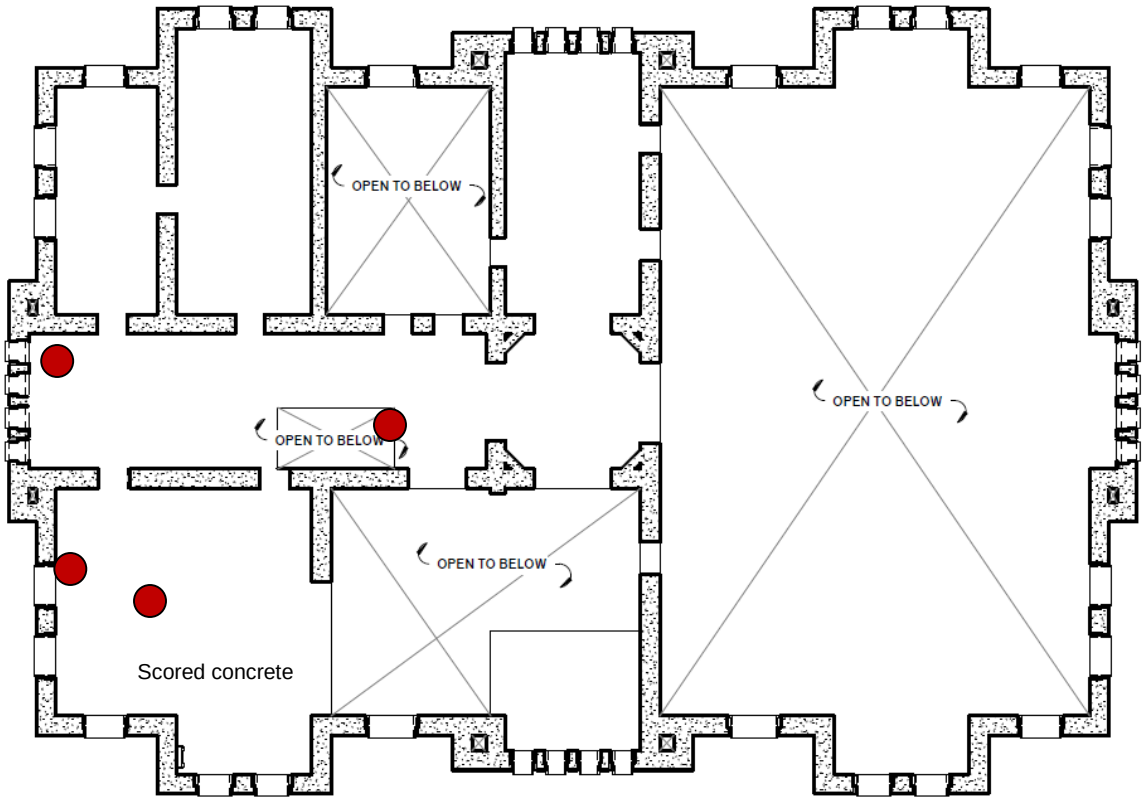


Areas sampled.



1 **Second Level Floor Plan**
3/32" = 1' -0"

Areas sampled



1 Third Level Floor Plan
3/32" = 1' -0"

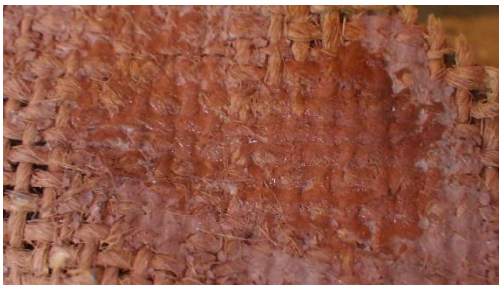
Areas sampled

END OF REPORT

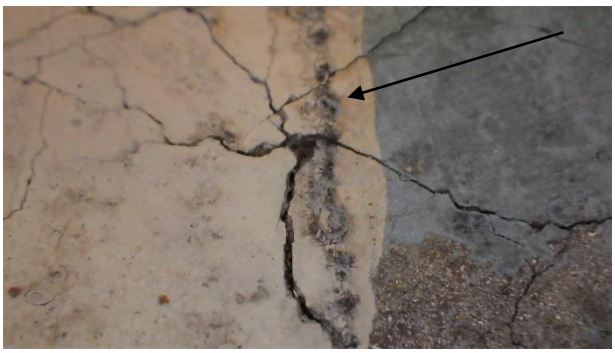
Analysis of Flooring Material from
Fannin County Courthouse
Jhonny Langer
08/06/18

This information is an addendum to the Paint and Finish Analysis Report dated 06/15/18. Please amend your report with this information.

New Information added 8/16/2018

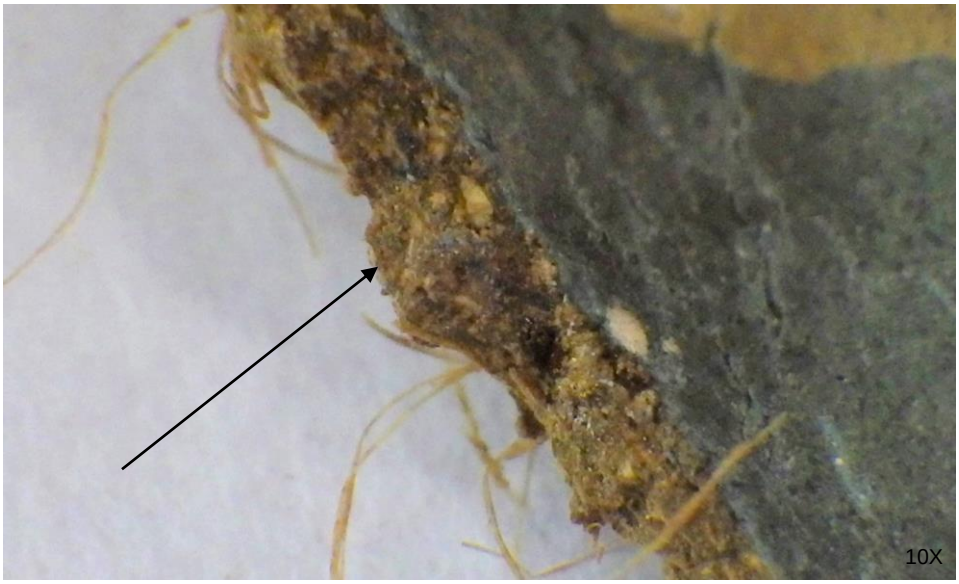


A sample of a fabric mounted floorcovering was recently found in the crawl-space on the first floor of the Fannin county courthouse and sent to SOURCE studio for analysis. The design is created with an oil based paint (top, left and right) that has been block-printed onto the surface. The rear of the artifact has been painted a deep red color (above).

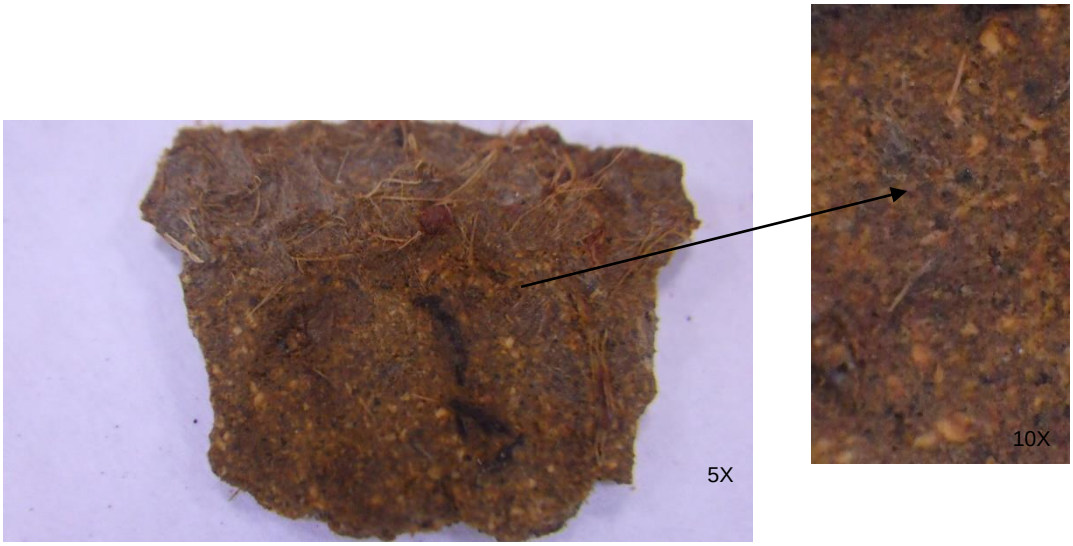


Block printing is an inexpensive and cost effective printing process where each individual color is printed on a surface in stages to create a more intricate design.

After more than a few passes the design can loose its crispness as seen in the photo (left, arrow)



A closer inspection of a cross-section (top, arrow) of the material shows that a ground-up fibrous substance mixed with pliable binder was applied or pressed into the coarse woven fabric. The painted design was applied directly to this applied substrate.



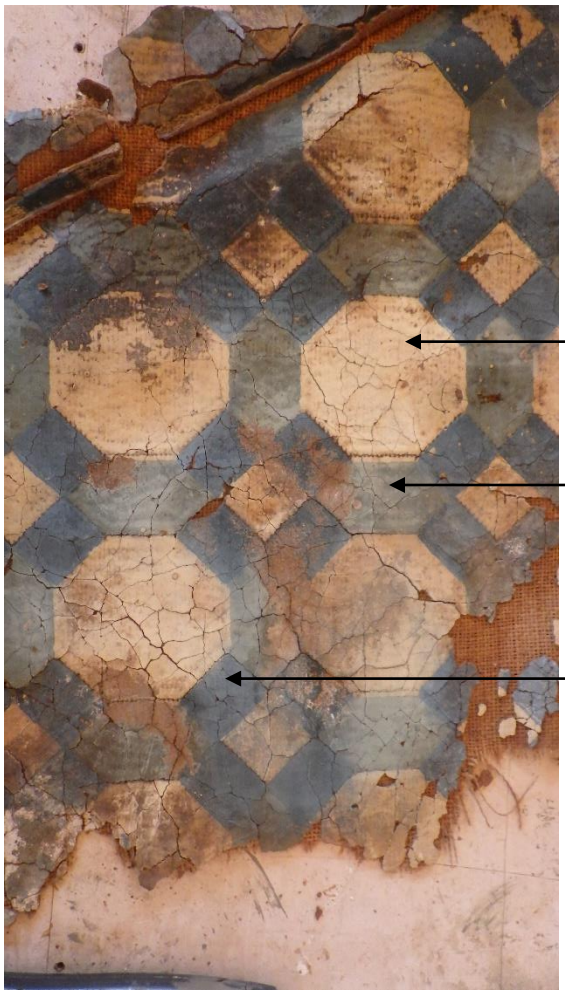
The rear of the floorcovering was stripped of the fabric and a razor was used to expose the fibrous substance (above, left, inset) which appears to be ground cork and a flexible binder. We concluded from this information that the floorcovering is a precursor to Linoleum called Kamptulicon.

Kamptulicon (Kamp-Tu'-Li-Con). A type of floor cloth, invented in 1843, but not generally introduced until about 1862 during the world exhibition in London, where it became a sensation*. The materials and processes employed in its manufacture vary considerably and with differing companies, but it is essentially a preparation of india-rubber ground up with ground cork, the preparation and mixture being effected by repeated passing of the material between heavy grooved metal rollers. When thoroughly mixed it is rolled out into sheets; sometimes over a backing of canvas by passing it between pairs of wide and steam-heated rollers. In addition to the substances above mentioned, gutta-percha, saw-dust, ground leather, boiled oil, resins, pitch, asphalt, and chalk have all been used in Kamptulicon making. The rolled sheets are ornamented by printing simple patterns in oil based paint on their surface and then sometimes over-coated with a varnish on both sides. Kamptulicon forms a warm, pleasant, soft and noiseless floor-cloth, but the higher qualities, in which india-rubber and ground cork are the main ingredients, are rather expensive, and the manufacture has been declined since the introduction of linoleum.
In general oilcloths were in fashion during the 18th century, Kamptulicon in the mid to late 19th century and then Linoleum. All these products were most likely on the market at the same time or had overlapping use as the products were continually either perfected or tinkered with- the goal being a durable floor covering that was easy to clean and fashionable.

Pattern books for Kamptulicon have not been well preserved but most show examples of borders as well as a field design most notably seen in 19th century public buildings in Texas as mosaic encaustic tiles. Indeed Kamptulicon and oilcloths were imitating more expensive products like encaustic tiles, quarry tiles and marble. Kamptulicon was typically used as runners, carpets, and wall to wall floor applications.

(left) This is a more elaborate design of Kamptulicon I found while researching the product. The paint is applied over the cork and India rubber mixture. The whole of the product is applied over a fabric backing (above, arrow)

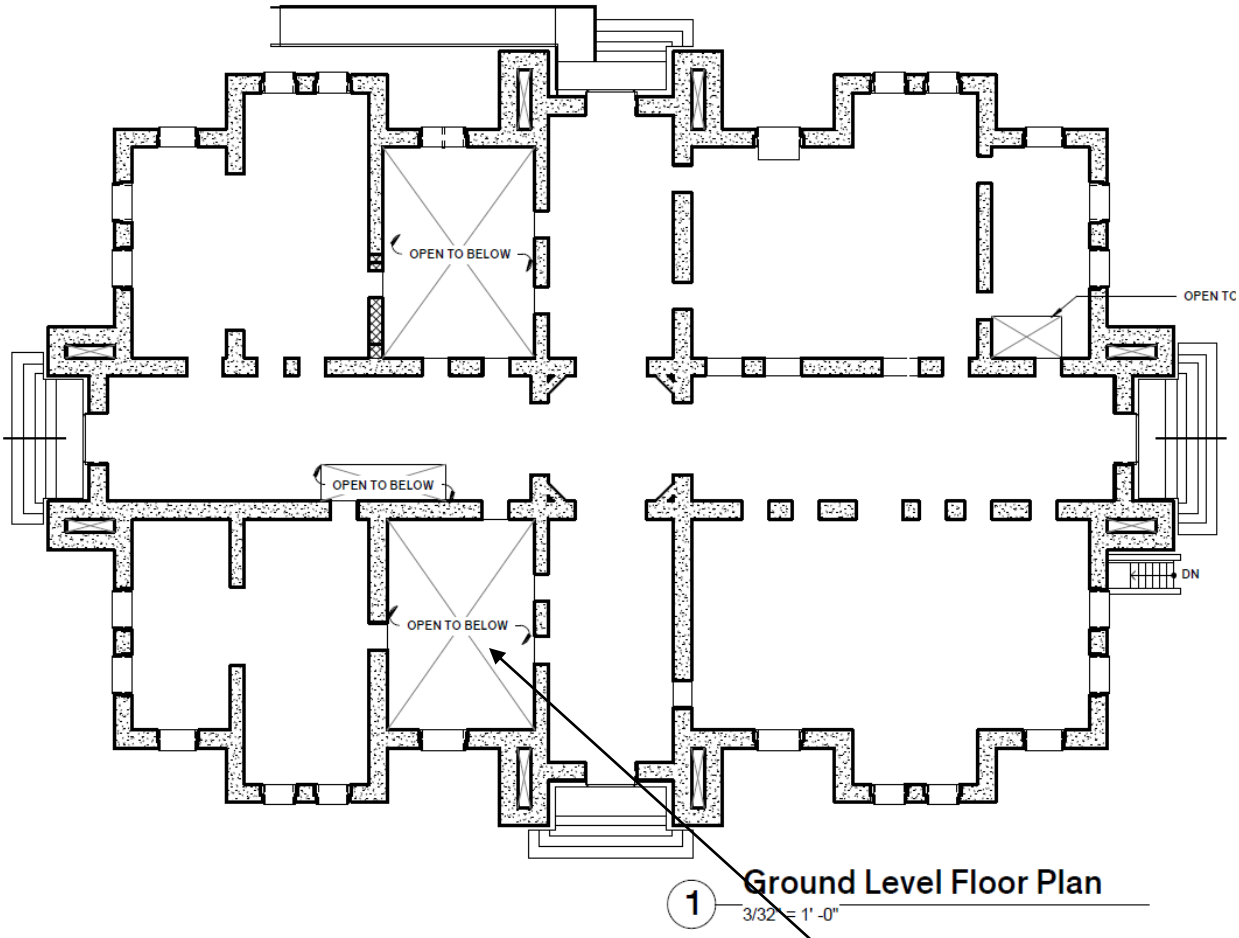
*LINOLEUM-History Design Arhitecture 1882-2000 by Hatje Cantz Publishers, Ostifildern-Ruit.



The oil based colors have darkened on the floor sample. We have cleaned the sample and in choosing colors we have brightened the colors to correspond more with their original intent. A review of the historic blue walls and off-white ceiling color found previously also indicates these colors are very compatible.

CONCLUSION: The first generation wall and ceiling colors found in the courthouse correspond very well with the flooring sample indicating that this was most likely the historic flooring used in the courthouse. Typically this type of floor covering was used over “plain” wood flooring as an overall field sometimes bound with a border along the edges. It could have possibly been installed wall to wall or used simply as carpet or runner in the room. Kamptulicon would be difficult to re-manufacture. There may be suitable reproductions in linoleum from companies like FORBO which could imitate the qualities of Kamptulicon. Another possibility is to custom create a floor cloth with modern materials. Floor cloths recently have become fashionable again.
While common in Great Britain and parts of Europe, as of this writing I have found no specific advertising for Kamptulicon in the Untied States though I have found references of it in the form of receipts on EBAY indicating its use up until 1910.

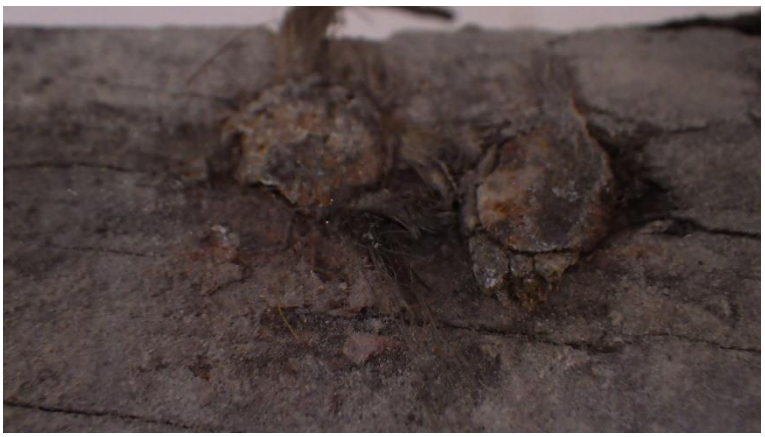
New Information about Kamptulicon added 8/16/2018



Wood flooring was harvested onsite in this area where the floor was being removed.

This Tounge and grove flooring was blind nailed in to the original joist of the courthouse with square nails (arrow).

The fabric and all layers are still intact on this sample.



Several tacks were inserted into the top or face of the flooring boards which held remnants of the Kamptulicon. It was not unusual to install this type of material with tacks in the same way oilcloth and grass matting was applied.

This sample proved to be the same dark blue from the previously excavated Kamptulicon sample (above).. The reverse was also found to have been painted red like our previous sample. Indeed, our sample may have just fallen into the crawlspace where it was discovered during the current demolition. We believe that the Kamptulicon was installed most likely over the entire floor-wall to wall- and either tacked down originally or tacked down at a later date when it possibly was peeling up. **It might be worth while on the architects next trip to review the historic flooring in the other rooms-now that it has been exposed to see if the product was used in all the rooms.**

The following are samples of felt-back linoleum circa 1890-1919. The samples were found at a house in Galveston that had never been remodeled. It's a good reminder of how these products were used as runners and as wall to wall installation.

Wall to wall installation. Notice the doors area faux grained to appear like the shellaced woodwork on the trim and walls.

Close-up of previous wall to wall installation. Note how the product is wearing away into the wood.

Runner

Cross Runner

WJE ENGINEERS ARCHITECTS MATERIALS SCIENTISTS

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Chicago, Illinois 60603
312.372.0555 tel | 312.372.0873 fax
www.wje.com

Via E-mail dchase@architexas.com

July 26, 2018

Mr. David Chase
Architexas
1907 Marilla, 2nd Floor
Dallas, Texas 75201

Re: Fannin County Courthouse - Masonry Conservation
WJE No. 2018.4286

Dear Mr. Chase:

Wiss, Janney, Elstner Associates, Inc. (WJE) has performed a conservation assessment of the cleaning trials of black waterproofing coating and other coatings applied to the limestone at the Fannin County Courthouse in Bonham, Texas.

The Fannin County Courthouse is a Second Empire-style limestone building constructed in the 1880s (Figure 1). We understand that in the 1960s, the exterior masonry surfaces of the courthouse were coated with a waterproof coating, and a new stone cladding was installed. Phoenix 1 has recently removed the stone overcladding and performed demolition work on the interior, as part of a restoration of the courthouse (Figure 2). We understand that Architexas is currently designing a restoration of the historic facade, which includes removal of the waterproof coating and cleaning of the limestone facade. Phoenix 1 Restoration & Construction (Phoenix 1) has performed numerous trials for cleaning/removing the waterproof coating. The trials were summarized in a letter report with attachments issued by Phoenix 1, dated June 6, 2018.

Observations

On July 11, 2018, Joshua Freedland from Wiss, Janney, Elstner Associates, Inc. (WJE) performed a visual survey of the stone facade elements from grade and an aerial lift provided by Phoenix 1. The following notable conditions were observed on the exterior limestone.

1. The limestone is a buff colored limestone with a rock face finish at the first floor and a smooth (honed or cut) surface at the second and third floor. At the corners, there are smooth-faced limestone quoins.
2. Some spalling appears to be present beneath the coating. The pattern suggests that some of the limestone may be face bedded, i.e. the bedding planes are parallel to the exposed face of the stone.
3. There is some light colored veining in the limestone at trial cleaning areas (Figure 3).
4. The black waterproofing coating is present on most surfaces of the facade.
5. Beneath most areas of the black coating, multiple paint layers were present (Figure 4). Close up examination confirmed the presence of the paint beneath the black coating on all facades near grade and throughout the facades on the north and west facades, when viewed up-close from the aerial lift.
6. At some locations, the black coating was easily removed from previous paint layers with adhesive (duct) tape, revealing previous applied coating layers (Figure 5). The tape induced a cohesive failure

within the existing paint layers or an adhesive failure between paint layers. The previous paint layers generally appear buff, but at some locations, a red paint layer is present (Figure 6).
7. Frequent incised graffiti was observed at the cleaning trials in the limestone (Figure 7).
8. A grey grout from the anchors installed for the overcladding was present on the surface of the stone, adjacent to anchor holes drilled into the original stone. Embedded in the adhesive were iron particles which had red surface corrosion present (Figure 8 and Figure 9).
9. There are areas of brick infill, likely from modifications to the size and arrangement of window openings or other modifications to the original masonry (Figure 10).

Cleaning Trials

The following table summarizes the cleaning trials and WJE's observations of trials performed by Phoenix 1. Further details regarding procedures and dwell times for the trials are described in their letter report. Photographs of select trials are provided below.

Table 1. Cleaning Trial Summary

Trial	Product	Observations
1	Prosoco 2010 All Surface Cleaner	Minimal removal of coating.
2	Prosoco Reklaim Prosoco Afterwash	Minimal removal of coating.
3	Abatix AMR 145 Sentinel 805 Afterwash	Slight removal of coating.
4	Abatix AMR180 Sentinel 805 Afterwash	Slight removal of coating.
5	Elephant Snot ShadowMax	Slight removal of coating.
6	PES51 Oil Release Agent	Minimal removal of coating.
7	Dumond Smart Strip Pro	Minimal removal of coating.
8	Dumond PeelAway 1 Dumond Neutralizer	Significant removal of coating. Shorter dwell time than recommended by manufacturer was used (Figure 11 through Figure 13).
9	Cathedral Strone Products MasonRE 301	Slight removal of coating.
10	Cathedral Strone Products MasonRE 305	Slight removal of coating.
11	Arrow Magnolia Strip	Moderate removal of coating.
12	Prosoco Asphalt and Tar Remover	Slight removal of coating.
13	Fiberlock Piranha NexStrip	Minimal removal of coating.
14	PPG Duraprep200	Slight removal of coating.
15	Prosoco Fast Acting Stripper (2 applications) Prosoco Limestone Restorer Prosoco Reklaim Prosoco Afterwash	Majority removed, minor coating remnants in deep pores.
16	Prosoco Fast Acting Stripper (3 applications) Prosoco Limestone Restorer Prosoco Reklaim Prosoco Afterwash	Majority removed, minor coating remnants in deep pores. Surface looks brighter; removed surface patina (Figure 14 and Figure 15).

Trial	Product	Observations
17	Prosoco Fast Acting Stripper (3 applications) Prosoco Limestone Restorer	Majority removed, minor coating remnants in deep pores (Figure 16 and Figure 17).
18	Prosoco Fast Acting Stripper (2 applications)	Majority removed, minor coating remnants in deep pores.
19	Continental Carbonic Dry Ice	Majority removed, minor coating remnants in deep pores. Surface eroded (Figure 18 through Figure 20).
20	Cathedral Strone Products MasonRE308	Minimal improvement
21	Prosoco Limestone Restorer Prosoco Reklaim Prosoco Afterwash	Majority removed, minor coating remnants in deep pores. More successful on smooth stone surfaces. Coatings remain on underside (Figure 21 through Figure 23)

Discussion and Recommendations

There are three general types of cleaning systems available for exterior masonry facades today: water, gentle abrasive techniques, and chemical cleaning systems. Selection of a cleaning system depends on the condition of the substrate and the contaminants (dirt, paint, graffiti, organic growth, etc.) to be removed. Other criteria to be considered include protection requirements, environmental constraints, special application requirements, and cost. For any facade cleaning project, the gentlest cleaning method that is effective should be selected.

The cleaning system or systems to be used must be appropriate for the substrate and conditions to be addressed. Improper cleaning can damage facade materials by causing staining or etching, discoloration, or corrosion of embedded anchorage. Damage, such as surface etching, can increase the likelihood and rate of future dirt accumulation, absorption of moisture, and surface deterioration. Cleaning can also present a potential source of damage to other building elements and materials, nearby structures and the environment, as well as pose a hazard to workers and others in the work area.

The primary visible staining on the Fannin County Courthouse is the black waterproof coating; however, multiple paint layers beneath the black coating appear to be widely present. Due to the age of these coatings, which were applied prior to the overcladding in the 1960s, the paint layers are likely drying oil based and may contain hazardous materials such as lead or other RCRA-8 heavy metals.

Given the multiple types of coatings and soiling, multiple cleaners are likely necessary to remove all the soiling and staining. Further, given the difference in texture, the same cleaning steps may not be necessary at both the rock face stone and smooth stone surfaces.

The chemical paint strippers (Fast Acting Paint Stripper and PeelAway 1) were generally the most effective at removing the coatings. While the trials using Fast Acting Paint Stripper were most effective, the alkaline paint stripper PeelAway1 would be expected to be effective at removing the drying oil coatings that are likely present beneath the black waterproof coating. Given the poor bond of the waterproof coating to the existing paint layers (or poor cohesive strength of the paint layers), we recommend proceeding by using the paint stripper that would be most effective at removing the underlying paint, rather than attempting an initial step to remove the waterproofing coating first. If the paint stripper is effective, the waterproof coating will

be removed at the same time. For this first step, we recommend using Dumond PeelAway 1, an alkaline paint stripper, followed by a weak acid neutralizer. This process should be tested in a large mock-up to determine the amount of coating (paint and waterproofing coating) that is removed. While this process was not the most successful during the trials conducted to date, the relatively short 1 hour dwell time can be extended, and the process will likely be more effective. It is recommended that the dwell time be extended up to 24 hours as recommended by the manufacturer. Further, it is recommended that the large trial be performed both at the rock face area at the first floor, as well as the smooth stone surface above. The PeelAway 1 process will also help contain the chemical cleaners and paint that may contain hazardous materials. If necessary, some areas may require a second application, if significant areas with paint remain.

After the initial paint stripping, Prosoco Fast Acting Paint Stripper, a methylene chloride-based stripper, will likely be necessary to remove any of the black waterproof coating applied directly to the stone (i.e., selected areas where the paint is not present beneath the waterproof coating). It may be possible that this paint stripper will not be required on all areas and may be limited to isolated spots or complex surfaces such as the rock-face areas of masonry. If necessary, some areas may require a second application if the waterproof coating remains.

Following successful removal of the black coating and paint layers, the surface should be evaluated for further cleaning. Isolated paint layers in deep pores should be removed mechanically with dental picks, if significant; however, the expectation should not be to remove all traces of the coating from deep pores or holes in the stone. Small traces of the coating and paint should be left to weather away after the facade has generally been cleaned.

Based on the type and extent of soiling remaining on the surface, a biocide such as Prosoco ReKlaim or D/2 Architectural Microbial could be tested if algae or other organic growth is present after coating removal. Very low pressure (less than 50 psi) water misting may be effective if the soiling is atmospheric soiling. If there are isolated spots of severe soiling or coatings remaining, spot cleaning using a gentle abrasive, low pressure with a fine media such as crushed glass, may be effective. One system used by WJE on other projects has been the Quintec Rotex System or the IBIX cleaning system. The dry ice system tested at 65psi caused unacceptable erosion of the stone surface, likely as a result of the size of the abrasive as well as the comparatively high pressure. This system is not recommended for cleaning the limestone.

Based on the trials and the composition, Prosoco Limestone Restorer is not recommended to clean the limestone facade. Limestone Restorer contains hydrochloric acid, which is aggressive and dissolves the surface of the limestone. While the trials using this cleaner do appear brighter, the cleaner has removed the patina from the limestone. The patina on this stone forms as a result of natural weathering of iron containing minerals in the stone.

Removal of the coatings should be done with the understanding that the stone was painted prior to the overcladding. Therefore, when the waterproof coating and paint layers are removed, damage, soiling, or other conditions will likely be revealed that will require additional cleaning or repair. This damage may be smoke damage from a reported previous fire, metallic stains related to the anchorage of the 1960s overcladding, or spalls and patches.

While we did not see erosion of the surface from the rinse water, which was reportedly used at 750 psi, typically water pressure for cleaning limestone with all cleaning samples should be limited to 400 psi, using a 40 degree stainless steel fan tip. Heated water may help the efficiency of removing the coating and soiling. All cleaning systems should be evaluated as trials and/or mock-ups by the contractor prior to full implementation.

Based on the age of the paint layers, we recommend that the coating be sampled and tested for hazardous materials prior to removal.

Please let us know if there are any questions about the above findings and recommendations.

Thank you for the opportunity to assistance on the preservation of this important building; we look forward to further assisting you with the Fannin County Courthouse project. Please feel free to contact us should you have any questions or comments.

Sincerely,

WISS, JANNEY, ELSTNER ASSOCIATES, INC.

Joshua Freedland, PA AIC
Principal

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Figures

Figure 1. Fannin County Courthouse original appearance.

Figure 2. Current appearance after removal of non-historic stone overcladding.

Figure 3. Light colored veining in the limestone.

Figure 4. Paint layers under black coating.

Figure 5. Black waterproof coating removed with duct tape.

Figure 6. Remnants of red paint layer.

Figure 7. Incised graffiti in the limestone.

Figure 8. Grey grout from the anchors and red surface corrosion.

Figure 9. Grey grout from the anchors with red arrows

Figure 10. Areas of brick infill marked with red arrows.

Figure 11. Dumond PeelAway 1 and Neutralizer: Trial 8.

Figure 12. Photomicrograph of Trial 8.

Figure 13. Photomicrograph of Trial 8 with paint residue in pores.

Figure 14. Prosoco Fast Acting Stripper, Limestone Restorer, Reklaim and Afterwash: Trial 16.

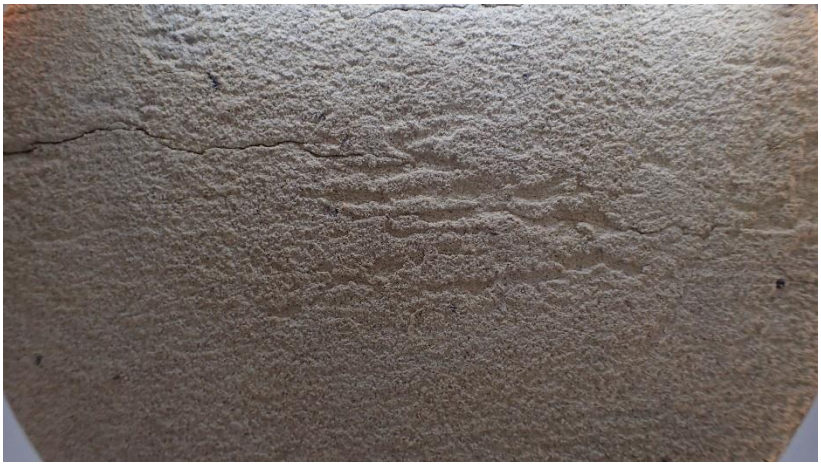


Figure 15. Photomicrograph of Trial 16.

Figure 16. Prosoco Fast Acting Stripper and Limestone Restorer: majority of coating removed: Trial 17.

Figure 17. Photomicrograph of Trial 17.

Figure 18. Continental Dry Ice - majority of coating removed: Trial 19,.

Figure 19. Detail of Trial 19 showing erosion of surface.

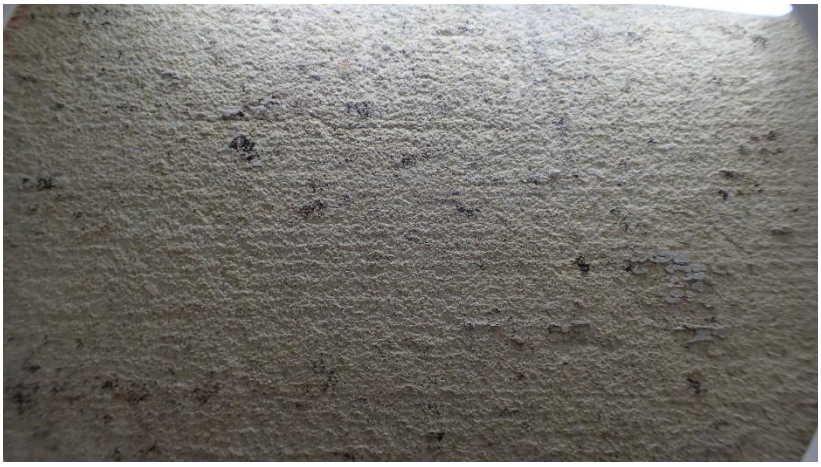


Figure 20. Photomicrograph of Trial 19.

Figure 21. Prosoco Limestone Restorer, Reklaim, and Afterwash: majority of coating removed: Trial 21.

Figure 22. Prosoco Limestone Restorer, Reklaim, and Afterwash: smooth stone surface.

Figure 23. Prosoco Limestone Restorer, Reklaim, and Afterwash: coatings remain on underside.

Wrightson, Johnson, Haddon & Williams, Inc.
Designers and Planners for Sound, Video, Multi-Media
Telecommunications, Broadcast, Theatre & Acoustics
Dallas • San Antonio

6 September 2018

Mr. David Chase, AIA
Architexas
1907 Marilla
Second Floor
Dallas, Texas 75201

Via email: dchase@architexas.com

Re: Fannin County Courthouse
Acoustics Review & Recommendations

Dear Mr. Chase,

This letter presents our recommendations for room acoustics, sound isolation, and MEP noise control considerations for the JP/County Courtroom and Large Courtroom at the renovated Fannin County Courthouse. Included is information on finish materials, partition construction, door/glazing specifications, penetration detailing, and mitigating airborne & vibrational noise due to MEP systems. These recommendations are based on the THC Review Set drawings received 19 July 2018 and mechanical sound power data received 31 August 2018.

Room Acoustics

The intent of the acoustical design is to provide spaces that control excessive reverberation and provide adequate speech intelligibility. The primary metric for measuring and quantifying room acoustics is the reverberation time (RT). RT describes how long, in seconds, sound persists in a room before it decays a certain amount (typically 60 dB). RT is directly proportional to the volume of air in the space and inversely proportional to the total amount of absorptive materials. For example, larger volumes and less absorption correspond to longer RTs and poor speech intelligibility.

Acoustical performance requirements for absorptive materials are generally described in terms of Noise Reduction Coefficient (NRC), which is often used in specifications for these materials. NRC is a single-number rating of the sound absorption properties of a given material/treatment, often used in specifications to define acoustical performance requirements. NRC is the arithmetic mean of the sound absorption coefficients (α's) at the 250 Hz, 500 Hz, 1,000 Hz, and 2,000 Hz 1/3-octave center frequencies, rounded to the nearest 0.05. As this single number rating system does not provide adequate information regarding a material's absorptive efficiency at various frequency bands, it is best used only to compare the absorption performance of similar acoustic materials.

JP/County Courtroom 113 & Large Courtroom 208

To limit noise build-up and preserve speech intelligibility, we recommend an overall reverberation time (RT) of less than 1.0 second for these court rooms. Due to the large volume of these courtrooms, especially Courtroom 208, we can expect longer RTs at low frequencies which subjectively can be perceived as "boomy"; however, this effect generally does not impact speech intelligibility and is not expected to be a major concern in these rooms. Below we provide recommendations for the specified finish materials to maintain a maximum RT of 1.0 second or less at mid-to-high frequencies that typically correspond to speech intelligibility.

Based on an email thread with Architexas on 13 August 2018, we understand that Pyrok Starsilent will be used for the acoustical plaster areas as noted on the drawings for walls in both courtrooms as well as the underside of balcony in the Large Courtroom 208.

- For acoustical plaster on the walls in both courtrooms, we recommend providing utilizing minimum 25mm thick StarSilent acoustic plaster system (minimum NRC 0.80). Acoustic plaster on wall surfaces is recommended to have a clear coat of Valspar applied to the finish. This will allow the end user to be able to clean scuff marks off of the wall.
- For acoustical plaster on the underside of balcony, we recommend providing minimum 25mm thick StarSilent acoustic plaster system with 3/8" hat channels (D mounting), on the underside of a layer of gypsum board (minimum NRC 0.90).
- Attached to this report is information on Valspar and painting procedures for the Pyrok StarSilent product. We do recommend ensuring that the contractor and the end user are aware of these instructions. Improper painting over this material will degrade the acoustical performance.

Based on an email thread with Architexas on 30 August 2018, we understand that Alpro Pattern H perforated metal with acoustical backfill will be used for the acoustical plaster areas as noted on the drawings. This material is recommended to have minimum 2"-thick insulation and provide a minimum NRC 0.95.

Noise Isolation

Noise-sensitive spaces require sound-rated wall construction in order to properly isolate the spaces from adjacent spaces. This is typically accomplished by providing appropriately rated acoustical constructions (walls, doors, windows, etc.). Where critical noise isolation adjacencies occur, high STC rated construction and detailing are necessary to provide appropriate sound isolation.

Sound Transmission Class (STC) is a single-number rating that indicates how well a barrier such as a wall, door, or window reduces the transmission of airborne noise from one space to another. In general, higher STC values relate to better sound isolation. STC is a laboratory measurement conducted under highly controlled conditions which are nearly impossible to

replicate in the field. Unlike laboratory construction, actual building construction has many flanking paths for sound transmission created by wall intersections with floors and ceiling, perimeter gaps at doors and windows, mechanical, electrical, and plumbing penetrations, etc. As a result, a partition's transmission loss capabilities are reduced. Therefore, it can be expected that the STC performance of the as-built construction can be approximately 5 to 10 points, or more, lower than the laboratory ratings.

The following are subjective descriptions of Sound Transmission Class (STC) values. Depending on the quality of construction, we could expect approximate noise isolation as indicated.

STC	**Subjective Noise Isolation**
35	Most normal level voices can be heard and understood clearly with little effort.
40	Normal level voices can be heard with some effort, and individual words and phrases could be clearly understood on occasion. Raised level voices and music could be heard with little effort.
45	Normal level voices could be heard with effort, and could be subjectively described as a murmur. Loud speech could be heard with some effort, and individual words and phrases could be clearly understood on occasion. Music, especially low frequencies, could be heard easily.
50	Normal level speech effectively blocked. Raised voice conversations could be heard with effort, and could be subjectively described as muffled. Music could be heard relatively easily, especially at low frequencies.
55	Loud speech can be heard faintly. Music is audible, with low frequencies considered disturbing.
60	Loud speech is effectively inaudible. Music can be heard faintly, but low frequency sounds expected to still be disturbing.
65	Loud music heard faintly which is problematic if adjoining spaces are highly sensitive to noise. Sound flanking limits most partitions to STC 65 on suspended floor slabs.
70	Most noises effectively blocked. STC 70+ may not be achievable in the field due to sound flanking paths. Exceptional detailing and quality control is required to achieve high noise isolation.

Partition Construction

WJHW has reviewed the partition constructions as provided in the THC Review Set drawings received 19 July 2018 and they are acceptable to provide appropriate noise isolation.

Door/Glazing Construction

Doors and windows are typically considered the weakest sound isolating elements in a wall construction, often compromising the sound isolation between adjoining spaces. As such, great

care should be taken during selection and installation of these units at sound rated partition constructions.

As discussed in a phone conversation with Architexas on 5 September 2018, WJHW has summarized below options of door and glazing construction that provide varying levels of noise isolation performance to help determine the best options for the courtrooms. Where glazing and doors will both be utilized in the same wall construction, we recommend providing a similar level of performance.

For door and glazing constructions in sound rated partitions, frames are recommended to be stuffed with mineral fiber insulation (metal stud framing) or grout filled (CMU) prior to installation. The perimeter of the frame should be sealed to the surrounding wall with non-hardening acoustical sealant on both sides of the partition. Thresholds, where used, should be sealed to the floor with acoustical sealant.

- STC 30-35 door and glazing constructions are recommended where minimal sound isolation is required. Subjectively, most normal level voices can be heard and understood clearly with little effort when standing in the vicinity near the door or glazing construction.
    - At a minimum, we recommend that solid wood core doors be used with fixed bottom seals similar to Zero International's #111A that will seal to a threshold; fixed seals are often more reliable than mechanically operated door bottom seals as automatic or "drop" door bottoms quickly become misaligned and require frequent adjustment and maintenance. Additionally, adjustable frame seals, similar to Zero's 770, are recommended around the perimeter of the doors. These seals will reduce noise transmission through small air gaps around the frame and can be adjusted if the frame is installed out of alignment. For additional noise isolation, we suggest providing acoustical astragals at double door entries; a recommended product is Zero's 555AA. Product sheets are attached to this report for your convenience. This construction would be expected to achieve an approximate STC 30-35.
    - For glazing, minimum 3/8"-thick glazing in insulated metal framing can achieve an estimated STC 34. An optional improvement would be to utilize 3/8"-thick laminated assembly (1/4" glass – 0.060" PVB – 1/8" glass) to achieve an STC 37.
- We recommend STC 45 rated door and glazing constructions for perimeter walls of JP/County Courtroom 113 & Large Courtroom 208 adjacent to public corridors. Subjectively, normal level voices could be heard with effort, and could be subjectively described as a murmur. Loud speech could be heard with some effort, and individual words and phrases could be clearly understood on occasion.
    - STC 45 rated doors should be specified as a complete unit including frames, seals, vision lights (if desired), and hardware. Factory-assembled doors are preferred to field-assembled units. Ambico, Krieger, Overly, Noise Barriers, IAC,

and Wenger each manufacture doors which can meet these minimum STC requirements.
    - For glazing, minimum 2-7/16" thick laminated insulating glass construction (1/4" laminated glass – 2" airspace – 3/16" glass) is recommended to achieve an STC 45.
- STC 53 rated door constructions are recommended for doors providing entry into the Jury Room 112. Subjectively, normal level speech effectively blocked. Raised voice conversations could be heard with some effort and could be subjectively described as muffled.
    - STC 53 rated doors should be specified as a complete unit including frames, seals, vision lights (if desired), and hardware. Factory-assembled doors are preferred to field-assembled units. Ambico, Krieger, Overly, Noise Barriers, IAC, and Wenger each manufacture doors which can meet these minimum STC requirements.

Gypsum Board Ceiling

As discussed in an email with Architexas on 31 August 2018, we recommend providing minimum two (2) layers of 5/8"-thick gypsum board throughout the entire area of Courtroom 208 above the finish ceiling. The construction is necessary to reduce noise from AHUs and EFs located in the Attic space from transferring into the courtroom. Penetrations through this construction should be sealed air tight.

Access panels should be avoided in the gypsum ceiling where possible. Where access panels are necessary, we recommend that they provide a similar amount of mass to the rest of the construction (two layers of 5/8" thick gypsum board) and seal airtight when closed;

MEP Noise Control

Background noise levels associated with building mechanical systems serving courtrooms are recommended to not exceed Noise Criteria (NC) values presented in Table 1. This report provides mechanical systems design recommendations to satisfy the background noise level criteria for the spaces listed below.

Table 1: Recommended Noise Levels

Room Type	Noise Criteria (NC)
Large Courtroom 208	NC 30
JP/County Courtroom 113	NC 30

The recommendations herein are intended to reduce those noise levels to the design values presented above; however, we do expect some areas to have slightly elevated, yet acceptable, noise with these recommendations due to the equipment selections. Other options such as

selecting quieter equipment or relocating noisy equipment away from sensitive spaces should also be considered to further reduce these noise levels, or if any of the recommendations in this report cannot be implemented.

Acoustic Duct Liner

Some ductwork is recommended include internal, acoustic duct liner to meet the recommended background noise level criteria. Table 2 below indicates where internal duct liner is recommended. The duct liner should begin at the unit and continue down each branch including downstream of VAVs serving the spaces listed in Table 1.

Table 2: Recommended Internal Duct Lining

Unit	Minimum Liner Length/Thickness
AHU-1	1" thick liner along first 20' of return duct work.
AHU-4	2" thick liner along entire length of return duct work.
VAV 1-7	2" thick liner along entire length of supply duct work
VAV 4-1	2" thick liner along entire length of rectangular supply duct work; 1" thick liner along entire length of round supply duct work
VAV 4-2	2" thick liner along entire length of rectangular supply duct work; 1" thick liner along entire length of round supply duct work
VAV 4-3	2" thick liner along entire length of rectangular supply duct work; 1" thick liner along entire length of round supply duct work
VAV 4-4	2" thick liner along entire length of rectangular supply duct work; 1" thick liner along entire length of round supply duct work
VAV 4-5	2" thick liner along entire length of rectangular supply duct work; 1" thick liner along entire length of round supply duct work

Casing Radiated Noise

AHUs-2, 3, & 4
A gypsum board ceiling is required to reduce the noise levels from the AHUs in the Attic to the Large Courtroom 208. Please see the Noise Isolation section of this report for the details of this construction.

Vibration Isolation of MEP Equipment

Table 3 below summarizes the vibration isolation recommendations for units throughout the facility as recommended by ASHRAE. These measures are required to mitigate potential structure-borne noise production and transmission, which could contribute significantly to background noise levels if not addressed.

Table 3: Unit-type Vibration Isolation Recommendations

Equipment type	Vibration isolation recommendation
AHUs	Specify internal isolation at the fan/motor assembly as provided by the manufacturer (recommend minimum 1.5" deflection) and place the entire unit casing on Neoprene pads (similar to Mason Super W); use steel distribution plates where necessary to avoid pinching or overloading pads. Should internal isolation at these units not be specified or provided by the manufacturer (or not provide a minimum 1.5" deflection), we recommend placing the units on spring isolators with a minimum deflection of 1.5" on a curb mounted base for units located on the roof as recommended by ASHRAE. Be sure to not include internal spring isolation where external springs are specified as this could interfere with the external isolation and cause resonance issues that could damage the equipment. If springs are included in the unit and cannot be removed (and do not provide adequate deflection), the springs should be rendered inoperable by leaving in the shipping blocks to effectively short circuit the internal isolation.
Chillers	Mount on neoprene pads with a minimum 0.25" deflection
Fans	FCUs, EFs, OAFs, and SFs located in the facility are recommended to be mounted on structural steel rails or base with a spring isolator or hanger that has a minimum 1.5" static deflection.
Pumps	Mount on spring floor isolators with a minimum static deflection of 0.75" on a concrete inertia base.
Transformers	Transformers under 150 kVA mounted slab on grade, should be mounted on 3/4" thick rubber pads with a minimum 0.1" deflection. Transformers under 150 kVA mounted on suspended slabs and transformers rated 150 kVA or greater mounted slab on grade should be mounted on double deflection rubber mounts with a minimum 0.4" deflection. Transformers rated 150 kVA or greater mounted on suspended slabs should be mounted on air springs with $k_x \approx k_y$.
VAVs with greater than 1,100 cfm	Mount on spring hanger that has a minimum 0.75" static deflection.

Connections

Flexible duct connectors similar to Mercer Rubber's flex connections are recommended at the intake and discharge of all rotating and vibrating air handling equipment, such as EFs, AH/ACs, and RTUs, to minimize vibration transmission into the ductwork. Water, condensate, and coil piping should be connected to equipment using twin-sphere connectors similar to Mason Industries' Safeflex connectors. Slack flexible conduit with at least one 90-degree bend should

be used for electrical connections. Care should be taken to ensure there are no rigid connections between the air handlers and the building structure.

Penetrations

Ducts, pipes, conduit, structural steel, and other penetrations through sound rated wall construction and gypsum board ceiling constructions should be centered in the wall cutouts and should be sealed airtight with non-hardening acoustical sealant. Ducts, pipes, and conduit should neither bear upon nor touch the partition they penetrate (i.e., center duct/pipe/conduit through penetration).

Cable trays should be discontinued through sound rated partitions. Cables should be fed through sound isolating partitions at the corridor through intumescent lined pass throughs such as STI's EZ-Path.

Electrical boxes serving opposite sides of a sound isolation partition should be kept at least one insulated stud bay apart. Boxes should be sealed at their drywall cutouts with acoustical sealant, and putty pads, such as 3M Fire Barrier Moldable Putty, should be pressed into place over the back of electrical boxes. Rigid metal conduit should not be used to connect electrical boxes in sound isolating walls.

I trust you will find this information helpful. If you have any questions, please do not hesitate to contact us.

Sincerely,
Wrightson, Johnson, Haddon, & Williams, Inc.

Christopher Ainley

Christopher Ainley
Consultant

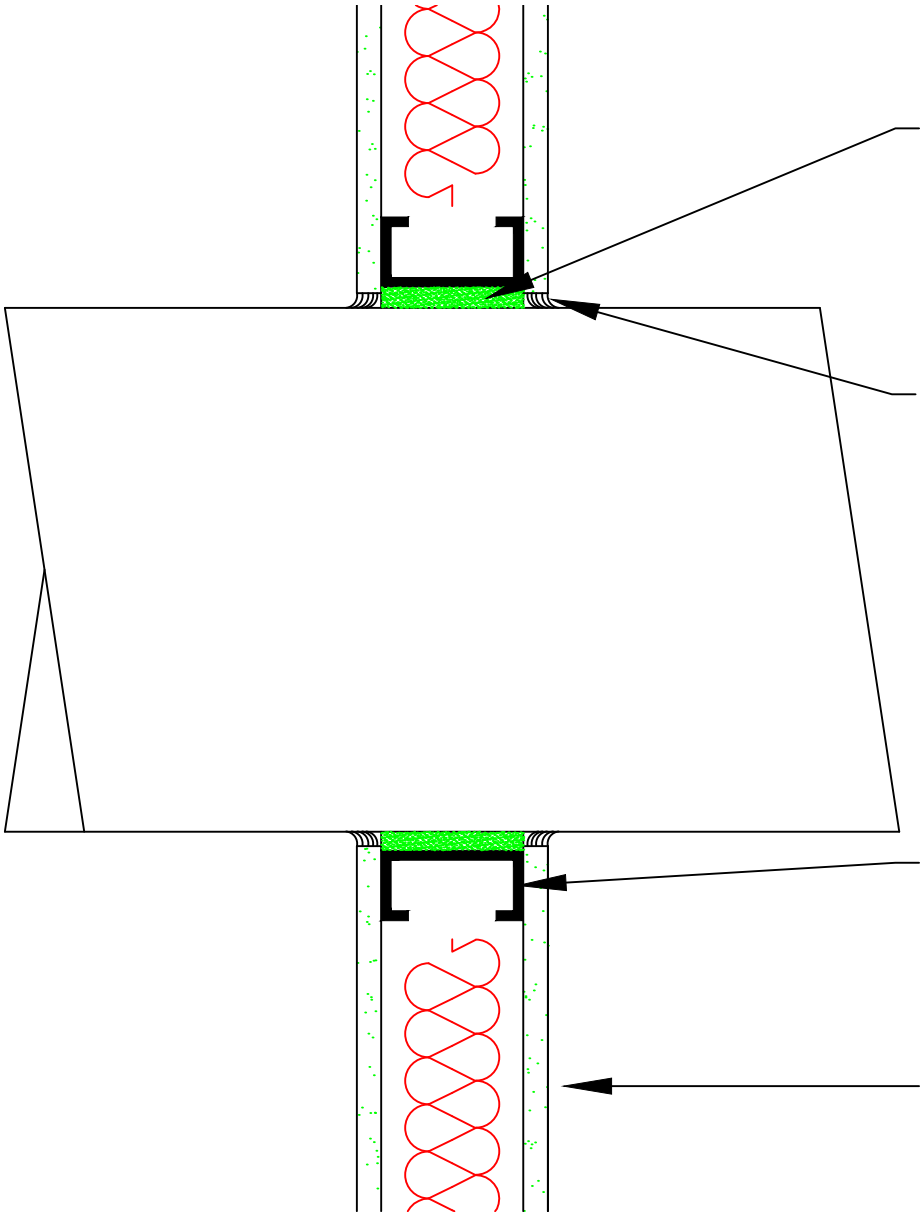
Cc:	*Anne Stimmel*	*Architexas*
	Daniel Escatel	*MEPCE*
	Matthew Manske	*MEPCE*
	Bill Kistler	*WJHW, Inc.*

WJHW Drawing

Consultants in Acoustics & Audio-Video Design

Acoustical Sealing of Penetrations Through Drywall Partitions

FANNIN COUNTY COURTHOUSE



insert resilient filler between studs and penetrating element: mineral or glass wool insulation, Illbruck Will-Seal compressible foam tape, or 12mm (1/2-inch) thick Neoprene sponge rubber

use acoustical drywall sealant (acrylic latex) to seal the gap airtight all the way around the penetration, on both sides

frame or case around the penetration with studs. Hold both the studs and the drywall 6mm (1/4-inch) clear of the penetrating element to avoid transmitting vibration into the drywall structure

partition as sheduled

NOTE: ducts are typically hung prior to erection of drywall. This makes it easier to fame around the ductwork without letting anything touch. Ducts shall neither touch nor bear upon the wall they pass through.

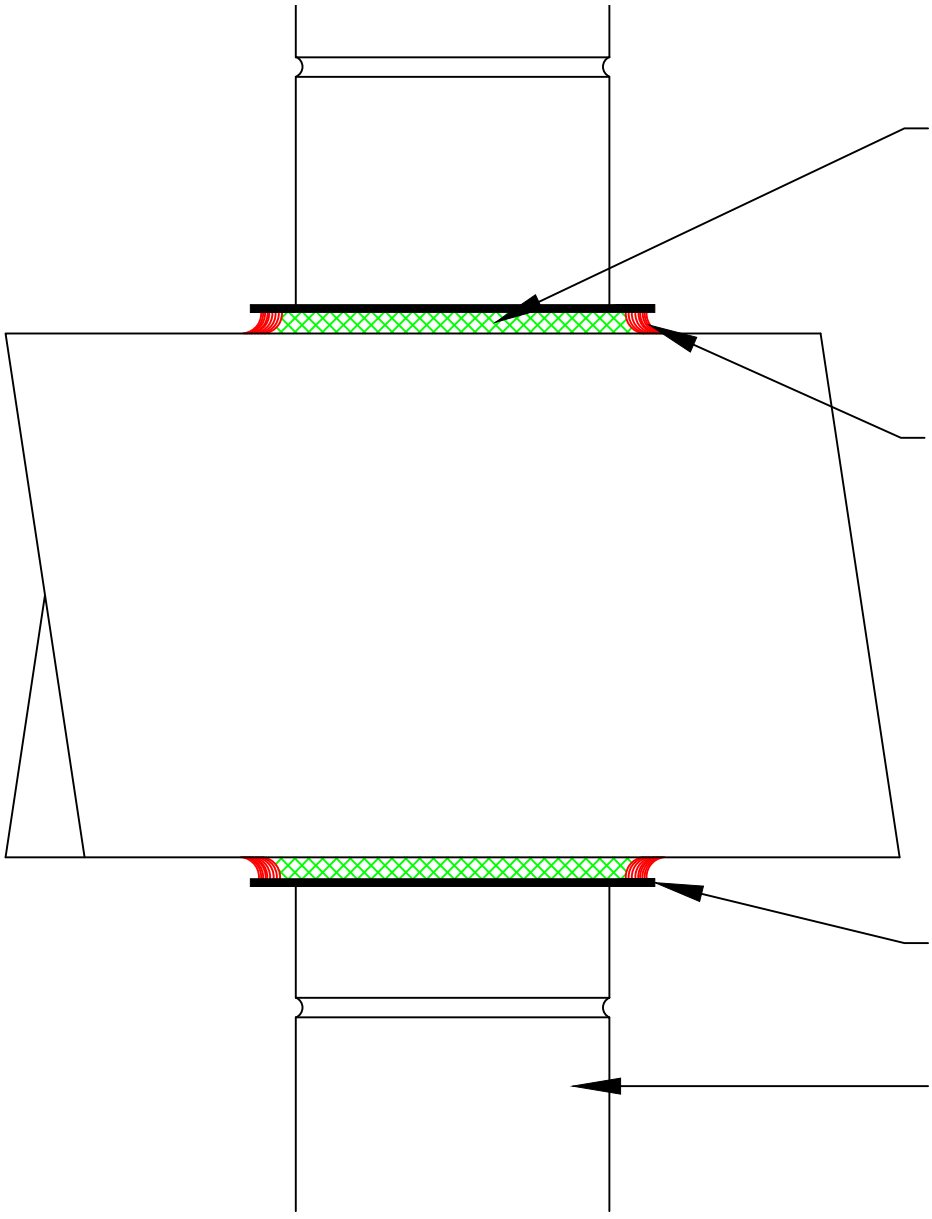
Wrightson, Johnson, Haddon, & Williams, Inc. Dallas, TX (972) 934-3700 / Fax: (972) 934-3720

WJHW Drawing

Consultants in Acoustics & Audio-Video Design

Acoustical Sealing of Penetrations Through CMU Partitions

FANNIN COUNTY COURTHOUSE



insert resilient filler inside pipe sleeve: mineral or glass wool insulation, Illbruck Will-Seal compressible foam tape, or 12mm (1/2-inch) thick Neoprene sponge rubber

use acoustical drywall sealant (acrylic latex) to seal the gap airtight all the way around the penetration, on both sides

metal pipe sleeve grouted into wall with 1/2-inch to 3/4-inch clearance around penetrating element

partition as sheduled

NOTE: support pipe or duct on both sides of the wall so the pipe/duct is centered in sleeve. do not allow pipe or duct to bear on or touch wall.

Wrightson, Johnson, Haddon, & Williams, Inc. Dallas, TX (972) 934-3700 / Fax: (972) 934-3720

Signature Colors® Faux Clear Protector

Product Description

Valspar Faux Clear Protector provides the utmost protection to faux finished surfaces and objects.

Features

- Protects Paint, Faux & Texture Finishes
- Crystal Clear
- Non-Yellowing
- Seals Out Stains and Fingerprints

Recommended Uses

- Metal
- Wood
- Wallpaper
- Furniture
- Cabinets
- Walls
- Decorative Projects
- Children's Toys

Colors and Base Information

	oz./gal.
Clear Satin	128
Clear Gloss	128

Shipping and Packaging

Freight Classification: Paint or Paint Related Material. Protect from freezing.

Packaging: Quart & Gallon – 4 per carton

Typical Properties (93701 Series)

Vehicle Type: Acrylic Resin

Sheen: 20–25 Units @ 60° angle (Satin)
60+ Units @ 60° angle (Gloss)

Solids by Volume: 30%

Solids by Weight: 32%

Weight per Gallon: 8.72 lbs./gal.

VOC: Less than 250 g/L

Viscosity: 90–95 Krebs Units

Dry Time: 77°F @ 50% Relative Humidity
To the touch: 1 hour
Recoat: 4 hours
Washing: Allow at least 7 days before washing. Use mild detergent and sponge.

Surface Coverage:
400 sq. ft./gal.
At: 4.0 mil Wet, 1.2 mil Dry

Storage and Disposal

- Do not freeze.
- Keep container closed when not in use.
- Do not transfer contents to other containers for storage or disposal.
- In case of spillage, absorb with inert material such as sand or kitty litter.
- Dispose of contaminated absorbent, container and/or unused contents in accordance with local, state and federal regulations.

PDS 1104

Surface Preparation

Read the Lead Warning in Cautions section. Valspar® Signature Colors® Faux Clear Protector allows the existing surface to show through. The surface must be prepared and be in satisfactory condition before applying this product. Clean and dry surface thoroughly. Surfaces with unsightly blemishes will show through this finish.

Application and Clean-up

Paint only when surface and air temperatures are 50–90 °F (10–32 °C). Stir product thoroughly. Use a premium quality polyester bristle brush to paint metal and wood trim; short nap woven roller or airless sprayer for walls and large areas. Apply evenly and smooth out in one direction. Do not over brush or overwork this product as bubbles may develop. When rolling, apply in a crisscross pattern with smooth, even strokes. Allow to cure 7 days before washing. Use a mild detergent and sponge when cleaning surface. **Notes about Color:** Generally flat finishes will intensify in color after application of Valspar® Signature Colors® Faux Clear Protector. The approximate level of darkening can be simulated by wetting the surface with water and viewing the effect. Satin and Semi-Gloss sheen faux finishes will not intensify after application. Clean hands and tools with warm, soapy water.

Cautions (93701 Series)

WARNING: May cause eye and skin irritation. Avoid breathing spray mist or dust. If painting indoors, open windows and doors or use other means to ensure fresh air entry during application and drying. If you experience eye watering, headache or dizziness, or if air monitoring demonstrates vapor/mist levels are above applicable limits, wear an appropriate, properly-fitted respirator (NIOSH approved) during and after application. Follow respirator manufacturer's directions for respirator use. AVOID CONTACT WITH THE EYES AND SKIN. Wash thoroughly after use. Close container after each use.

FIRST AID: EYE CONTACT: Flush thoroughly with water for at least 15 minutes. If irritation persists, **get medical attention**. IF INHALED: If affected by vapor or spray mist, move to fresh air. If breathing difficulty continues, **get medical attention**. IF SWALLOWED: Drink 2 glasses of water. **Get medical attention immediately.**

DO NOT TAKE INTERNALLY.
KEEP OUT OF REACH OF CHILDREN.
For additional safety and chronic health hazard information, refer to the Material Safety Data Sheet for this product.

EMERGENCY MEDICAL TELEPHONE:
1-888-345-5732

This product contains less than 250 g/L VOC

WARNING! If you scrape, sand or remove old paint, you may release lead dust. LEAD IS TOXIC. EXPOSURE TO LEAD DUST CAN CAUSE SERIOUS ILLNESS, SUCH AS BRAIN DAMAGE, ESPECIALLY IN CHILDREN. PREGNANT WOMEN SHOULD ALSO AVOID EXPOSURE. Wear a NIOSH-approved respirator to control lead exposure. Clean-up carefully with a HEPA vacuum and a wet mop. Before you start, find out how to protect yourself and your family by contacting the National Lead Information Hotline at 1-800-424-LEAD or log on to www.epa.gov/lead.

PDS 1104

valspar

1191 Wheeling Rd, Wheeling, IL 60090 888-313-5569
www.valsparpaint.com

09/10

PYROK™

Pyrok, Inc.
121 Sunset Road
Mamaroneck, NY 10543
914-777-7070 Tel
914-777-7103 Fax
www.pyrok.com
www.starsilent.com

Pyrok StarSilent Painting Procedures

StarSilent can be painted without degradation of its sound absorbing qualities.

Painting should only be done using a spray applied water based permeable paint such as Procoat Procoustic (www.procoat.com) with a spraying distance that allows a fog rather than a defined pattern. A high volume low pressure (HVLP) air spray equipment is the recommended equipment with a spraying distance of approximately 24" required. StarSilent is a micro-texture, hand applied product, it is recommended to mix 4.8 ounces of H&C® SharkGrip™ Slip Resistant Additive per one gallon of paint to maintain a uniform finish.

Painting in one direction then waiting until dried then spraying perpendicular to the previous. It is critical that the first fog coat of paint is very light and completely dried before a second is applied. If the initial coat is applied too heavy, it is possible that it can soak in non-uniformly and cause a blotching affect.

This is considered one painting. This process can be repeated 1-2 times when necessary with one day between painting.

When painting colors other than white, the finish coat StarSilent plaster should be colored as close as possible to the paint color.

It is highly recommended that before significant painting progresses, a small area or small boards are painted to practice as well as to make sure the painting is approved.

Please contact Pyrok, Inc. if more assistance is required.

Georgia Tech Integrated Acoustics Laboratory
Georgia Institute of Technology, Woodruff School of Mechanical Engineering
Atlanta, GA 30032-0405 (404) 894-4726

The Georgia Institute of Technology
Integrated Acoustics Laboratory

Test report for

Pyrok
121 Sunset Road
Mamaroneck NY 10543
Howard Podolsky (914) 777-7070

Sound Absorption Test
ASTM C423-02a

on

25 mm StarSilent acoustic plaster system, smooth finish,
modified D mount

Test Date: 8/29/2011

Submitted by:

Kenneth A. Cunefare
Professor in Charge
Georgia Tech Integrated Acoustics Laboratory

Georgia Tech Integrated Acoustics Laboratory
Georgia Institute of Technology, Woodruff School of Mechanical Engineering
Atlanta, GA 30032-0405 (404) 894-4726

Test Specification

The test documented in this report was conducted in complete compliance with the procedures and analysis methods detailed in ASTM C423-02a.

Specimen: 25 mm StarSilent acoustic plaster system, smooth finish

Specimen area: 6.69 m^2, 12 panels of equal area

Specimen weight: 1.88 lb per square foot

Mounting: Modified ASTM E795 Type D

Preconditioning: Panels stored in the MaRC building HiBay prior to testing

Specimen Installation Detail:

The specimens were installed on top of 7/8" metal hat channel, spaced 16" on center, laid parallel to the 8' length of the test area. The space between the hat channel was unfilled. A close-fitting wooden frame was constructed around the perimeter of the test area using 1x2" pine boards, such that the perimeter boards were very close to the top of the test specimens. The test specimen panels were laid long-side parallel to the 9' length of the test area. The perimeter frame was sealed to the floor with duct tape, and the gaps between the panels and between the panels and the frame were sealed with duct seal putty.

Temperature, C:	23
Humidity, %:	60.5

Test Facility Qualification

The Georgia Tech Integrated Acoustics Laboratory's reverberation room has been qualified to 100 Hz and above for ASTM C423-02a tests per the procedures in Annex A3 and Appendix X of C423-02a. The reverberation chamber has a volume of 254 m^3.

The results contained in this report are applicable to the specific test article and sample configuration submitted to us for measurement.
The laboratory assumes no responsibility for the performance of the submitted material in any configuration.

Georgia Tech Integrated Acoustics Laboratory
Georgia Institute of Technology, Woodruff School of Mechanical Engineering
Atlanta, GA 30032-0405 (404) 894-4726

C423-02a Sound Absorption Coefficient Results

Report:

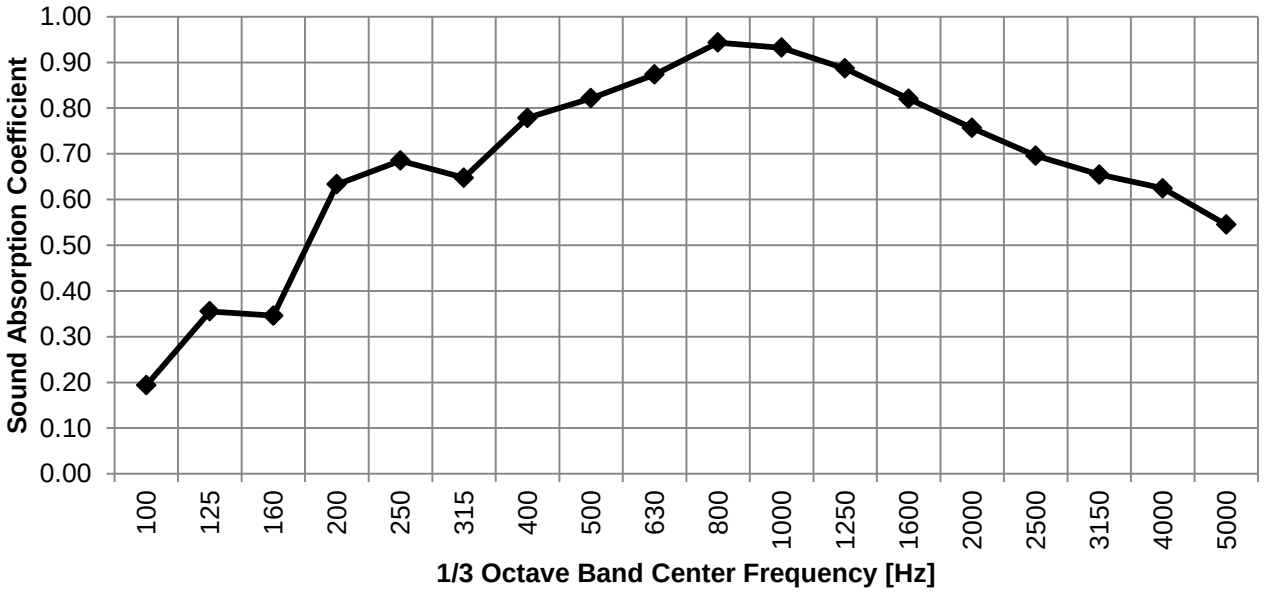
Temperature	23	C
Humidity	60.5	%

95% confidence intervals estimated via 13.3 and 13.6 of ASTM C423-02a.

Note: 95% Uncertainty limits only available when using strict Type A or E-400 mounting per ASTM E795.

Center Frequency	Absorption Coefficient		95% Uncertainty
100	0.19	+/-	-
125	0.36	+/-	-
160	0.35	+/-	-
200	0.63	+/-	-
250	0.69	+/-	-
315	0.65	+/-	-
400	0.78	+/-	-
500	0.82	+/-	-
630	0.87	+/-	-
800	0.94	+/-	-
1000	0.93	+/-	-
1250	0.89	+/-	-
1600	0.82	+/-	-
2000	0.76	+/-	-
2500	0.70	+/-	-
3150	0.65	+/-	-
4000	0.62	+/-	-
5000	0.54	+/-	-

Noise Reduction Coefficient (NRC)	0.80
Sound Absorption Average (SAA)	0.79



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Georgia Tech Integrated Acoustics Laboratory
Georgia Institute of Technology, Woodruff School of Mechanical Engineering
Atlanta, GA 30032-0405 (404) 894-4726

The Georgia Institute of Technology
Integrated Acoustics Laboratory

Test report for

Pyrok
121 Sunset Road
Mamaroneck NY 10543
Howard Podolsky (914) 777-7070

Sound Absorption Test
ASTM C423-02a

on

25 mm StarSilent acoustic plaster system, smooth finish,
modified D mount, with one coat of Valspar clear protector

Test Date: 9/2/2011

Submitted by:

Kenneth A. Cunefare
Professor in Charge
Georgia Tech Integrated Acoustics Laboratory

Georgia Tech Integrated Acoustics Laboratory
Georgia Institute of Technology, Woodruff School of Mechanical Engineering
Atlanta, GA 30032-0405 (404) 894-4726

Test Specification

The test documented in this report was conducted in complete compliance with the procedures and analysis methods detailed in ASTM C423-02a.

Specimen: 25 mm StarSilent acoustic plaster system, smooth finish, with one coat Valspar clear protector

Specimen area: 6.69 m^2, 12 panels of equal area

Specimen weight: 1.88 lb per square foot

Mounting: Modified ASTM E795 Type D

Preconditioning: Panels stored in the MaRC building HiBay prior to testing. One coat of Valspar clear protector was applied by roller and allowed to dry for four days in the Reverberation

Specimen Installation Detail:

The specimens were installed on top of 7/8" metal hat channel, spaced 16" on center, laid parallel to the 8' length of the test area. The space between the hat channel was unfilled. A close-fitting wooden frame was constructed around the perimeter of the test area using 1x2" pine boards, such that the perimeter boards were very close to the top of the test specimens. The test specimen panels were laid long-side parallel to the 9' length of the test area. The perimeter frame was sealed to the floor with duct tape, and the gaps between the panels and between the panels and the frame were sealed with duct seal putty. One coat of Valspar clear protector was hand-rolled on each sample by Tom Miller of Pyrok, Inc., in the presence of Nick Earnhart, the lead technician in the Integrated Acoustics Laboratory at Georgia Tech.

Temperature, C:	22.3
Humidity, %:	63.5

Test Facility Qualification

The Georgia Tech Integrated Acoustics Laboratory's reverberation room has been qualified to 100 Hz and above for ASTM C423-02a tests per the procedures in Annex A3 and Appendix X of C423-02a. The reverberation chamber has a volume of 254 m^3.

The results contained in this report are applicable to the specific test article and sample configuration submitted to us for measurement.
The laboratory assumes no responsibility for the performance of the submitted material in any configuration.

Georgia Tech Integrated Acoustics Laboratory
Georgia Institute of Technology, Woodruff School of Mechanical Engineering
Atlanta, GA 30032-0405 (404) 894-4726

C423-02a Sound Absorption Coefficient Results

Report:

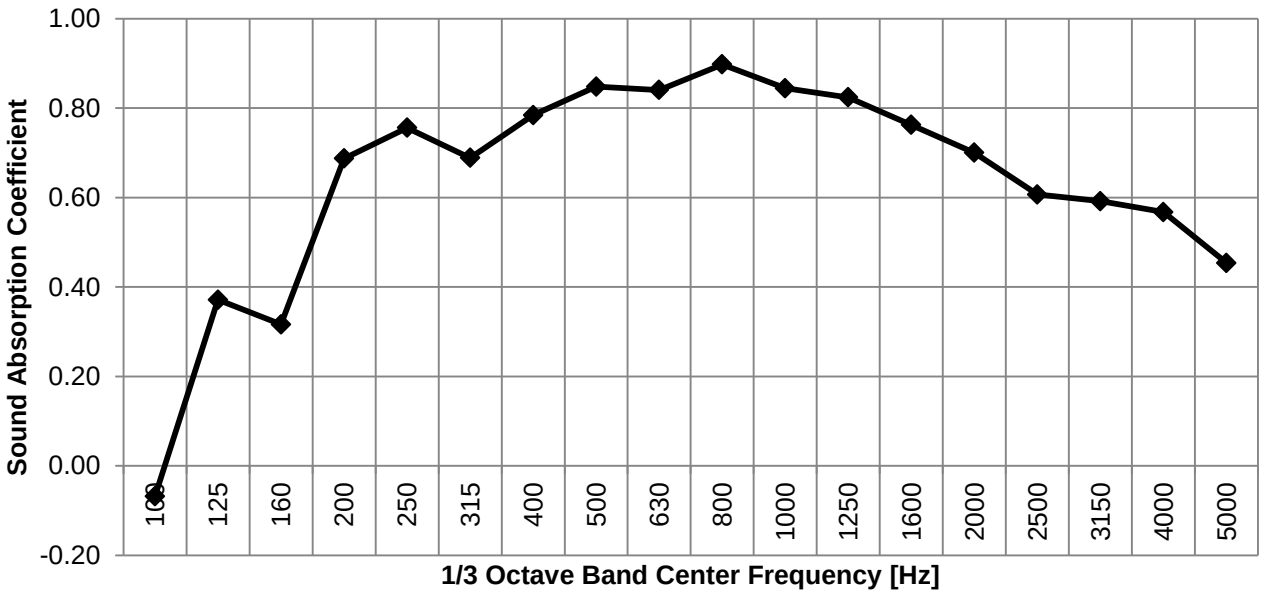
Temperature	22.3	C
Humidity	63.5	%

95% confidence intervals estimated via 13.3 and 13.6 of ASTM C423-02a.

Note: 95% Uncertainty limits only available when using strict Type A or E-400 mounting per ASTM E795.

Center Frequency	Absorption Coefficient		95% Uncertainty
100	-0.07	+/-	-
125	0.37	+/-	-
160	0.32	+/-	-
200	0.69	+/-	-
250	0.76	+/-	-
315	0.69	+/-	-
400	0.78	+/-	-
500	0.85	+/-	-
630	0.84	+/-	-
800	0.90	+/-	-
1000	0.84	+/-	-
1250	0.82	+/-	-
1600	0.76	+/-	-
2000	0.70	+/-	-
2500	0.61	+/-	-
3150	0.59	+/-	-
4000	0.57	+/-	-
5000	0.45	+/-	-

Noise Reduction Coefficient (NRC)	0.80
Sound Absorption Average (SAA)	0.77



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Georgia Tech Integrated Acoustics Laboratory
Georgia Institute of Technology, Woodruff School of Mechanical Engineering
Atlanta, GA 30032-0405 (404) 894-4726

The Georgia Institute of Technology
Integrated Acoustics Laboratory

Test report for

Pyrok
121 Sunset Road
Mamaroneck NY 10543
Howard Podolsky (914) 777-7070

Sound Absorption Test
ASTM C423-02a

on

25 mm StarSilent acoustic plaster system, smooth finish,
modified D mount

Test Date: 10 May 2011

Submitted by:

Kenneth A. Cunefare
Professor in Charge
Georgia Tech Integrated Acoustics Laboratory

Georgia Tech Integrated Acoustics Laboratory
Georgia Institute of Technology, Woodruff School of Mechanical Engineering
Atlanta, GA 30032-0405 (404) 894-4726

Test Specification

The test documented in this report was conducted in complete compliance with the procedures and analysis methods detailed in ASTM C423-02a.

Specimen: 25 mm StarSilent acoustic plaster system, smooth finish

Specimen area: 6.69 m^2, 12 panels of equal area

Specimen weight: 1.88 lb per square foot

Mounting: Modified ASTM E795 Type D

Preconditioning: Panels stored in the MaRC building HiBay prior to testing

Specimen Installation Detail:

The specimens were installed on top of 5/8"x4" plywood strips, spaced 16" on center, laid parallel to the 8' length of the test area. The space between the wood strips was filled with 2" thick 3 lb Johns Manfield fiberglass insulation, ripped in half to 1" thickness. A close-fitting wooden frame was constructed around the perimeter of the test area of 1x2" pine boards, such that the perimeter boards stuck out above the test specimens. The test specimen panels were laid long-side parallel to the 9' length of the test area.

Temperature, C:	22.25
Humidity, %:	63

Test Facility Qualification

The Georgia Tech Integrated Acoustics Laboratory's reverberation room has been qualified to 100 Hz and above for ASTM C423-02a tests per the procedures in Annex A3 and Appendix X of C423-02a. The reverberation chamber has a volume of 254 m^3.

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Georgia Tech Integrated Acoustics Laboratory
Georgia Institute of Technology, Woodruff School of Mechanical Engineering
Atlanta, GA 30032-0405 (404) 894-4726

C423-02a Sound Absorption Coefficient Results

Report: Pyrok_DY25A.pdf

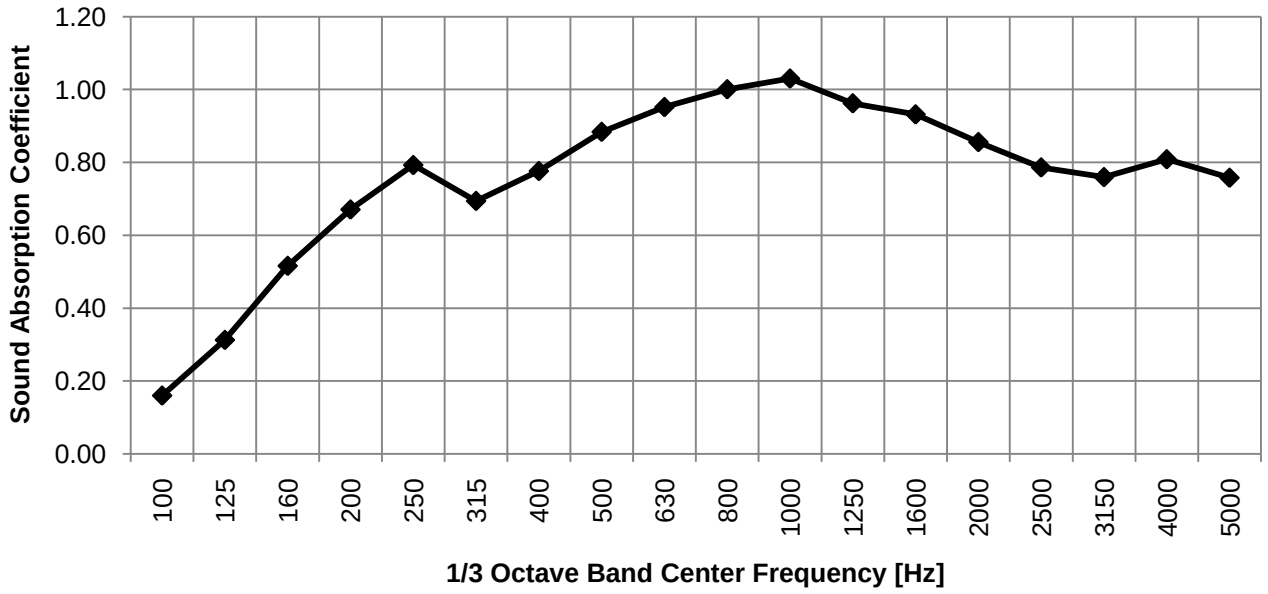
Temperature	22.25	C
Humidity	63	%

95% confidence intervals estimated via 13.3 and 13.6 of ASTM C423-02a.

Note: 95% Uncertainty limits only available when using strict Type A or E-400 mounting per ASTM E795.

Center Frequency	Absorption Coefficient	95% Uncertainty
100	0.16	+/- -
125	0.31	+/- -
160	0.52	+/- -
200	0.67	+/- -
250	0.79	+/- -
315	0.69	+/- -
400	0.78	+/- -
500	0.88	+/- -
630	0.95	+/- -
800	1.00	+/- -
1000	1.03	+/- -
1250	0.96	+/- -
1600	0.93	+/- -
2000	0.86	+/- -
2500	0.79	+/- -
3150	0.76	+/- -
4000	0.81	+/- -
5000	0.76	+/- -

Noise Reduction Coefficient (NRC)	0.90
Sound Absorption Average (SAA)	0.86



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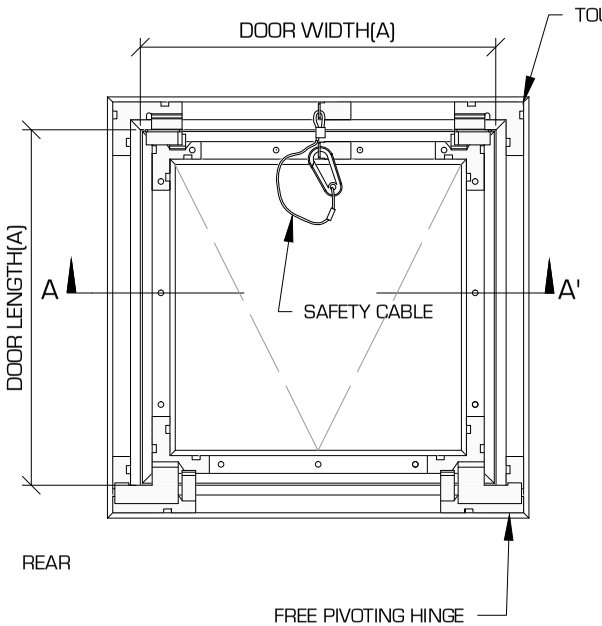
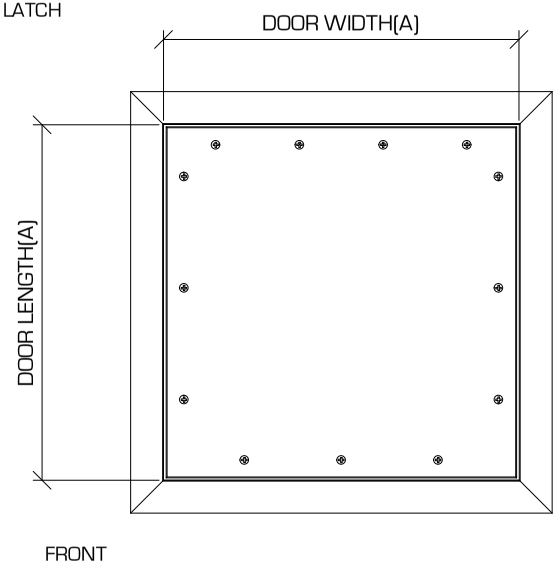
BAUCO PLUS II ACCESS PANEL INSTALLED IN DOUBLE LAYER GWB





FOR USE IN:
- ASSEMBLIES CLAD IN GYPSUM WALL BOARD 1/2" (13 mm) OR 5/8" (16 mm)
- NEW CONSTRUCTION OR REPAIRS
- ROUGH OPENINGS IN GWB WITHOUT ABUTTING STRUCTURES

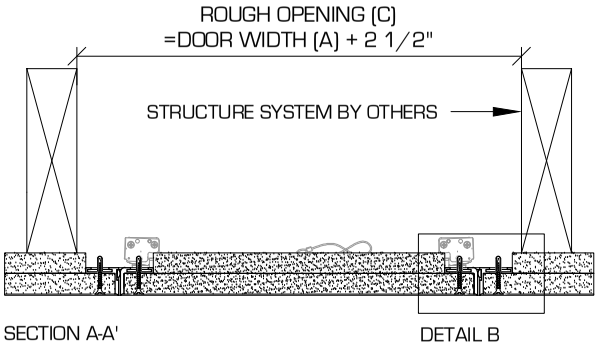
FRAME:
- RECESSED ALUMINUM EXTRUSIONS
- FRAME ACTS AS CORNER BEAD FOR FINISHING
- 1/16" (2mm) GAP BETWEEN FRAME AND DOOR

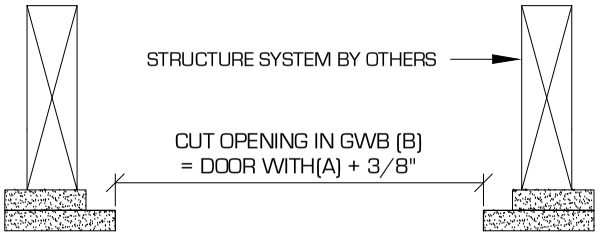
STANDARD FEATURES:
- STRONG CONCEALED ALUMINUM FRAME AND HARDWARE
- CONCEALED MECHANICAL TOUCH-LATCH
- LIFT-OUT DOORS WITH SAFETY CABLES
- MOISTURE RESISTANT GWB INLAY
- PERIMETER GASKET (AIR & SMOKE TIGHT)
- C - CHANNEL BRACING

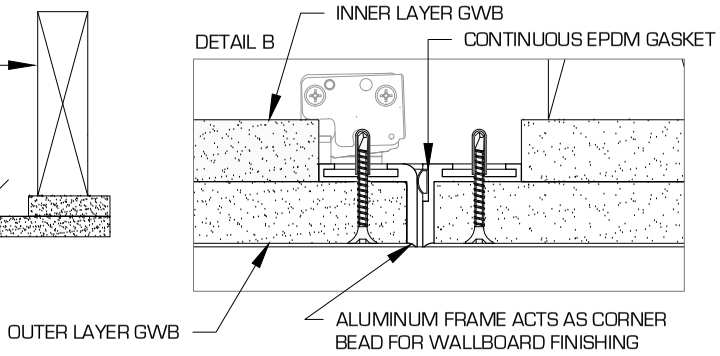
HINGE:
- FREE PIVOTING HINGE
- DOOR CAN BE REMOVED FOR MAXIMUM CLEARANCE

SOUND TRANSMISSION:
- BAUCO PLUS II ACCESS PANELS WILL NOT REDUCE THE STC RATING OF THE ASSEMBLY

LATCH:
- CONCEALED TOUCH LATCH (STANDARD)
- CAM LATCH (OPTIONAL)
- TAMPER RESISTANT CAM LATCH (OPTIONAL)
- KEYED LOCK (OPTIONAL)





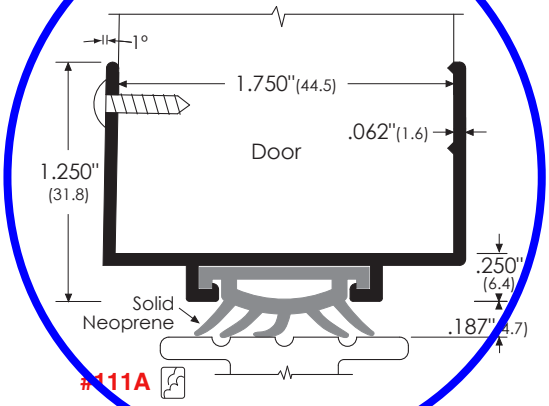


bauco·plus II™ ARCHITECTURAL ACCESS PANEL WITH CONCEALED HARDWARE AND GYPSUM BOARD INLAY

BAUCO
ACCESS PANEL SOLUTIONS INC.
#2 - 835 DEVONSHIRE ROAD VICTORIA,
BRITISH COLUMBIA CANADA V9A 4T5
P - 250.592.0033 / TF - 877.592.0033
F - 250.595.0513 / TF - 877.592.7587
W - www.accesspanelsolutions.com
E - info@accesspanelsolutions.com

PROJECT NAME	APPROVED BY
CLIENT	DATE

Note: A= Aluminum AA= Clear Anodized
D= Dark Bronze Anodized



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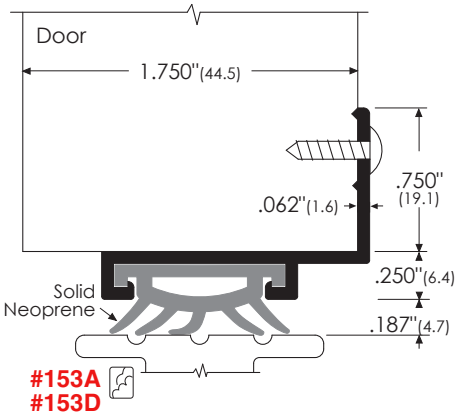

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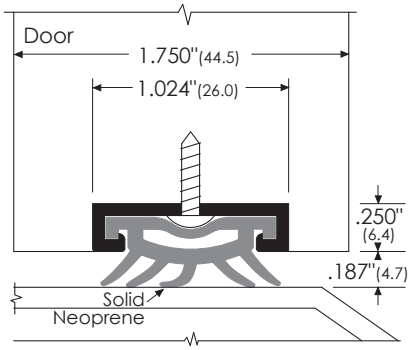

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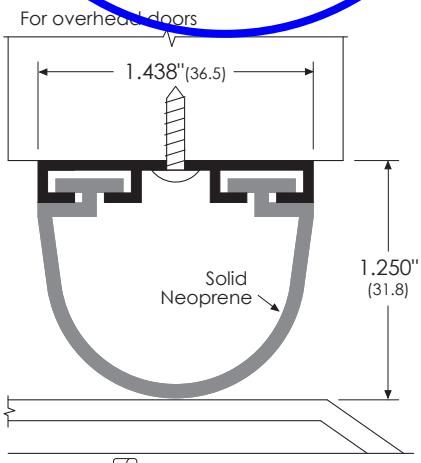

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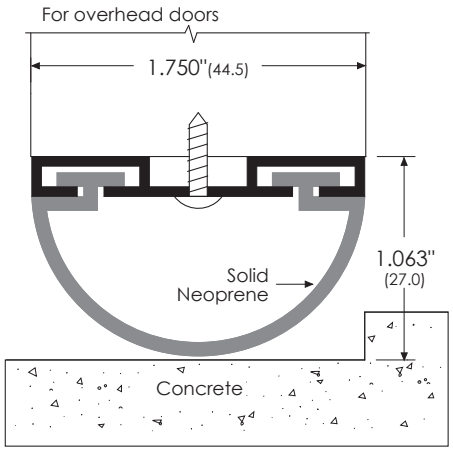

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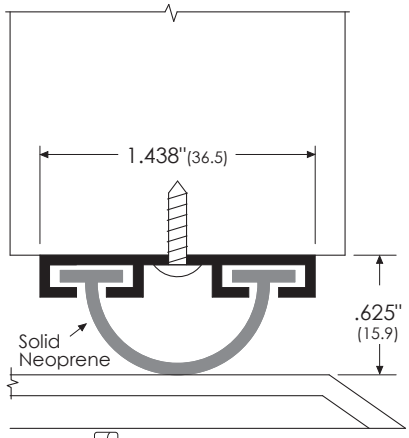

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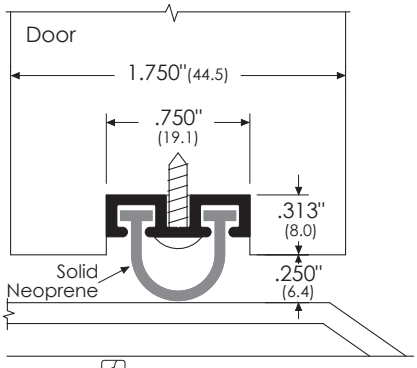

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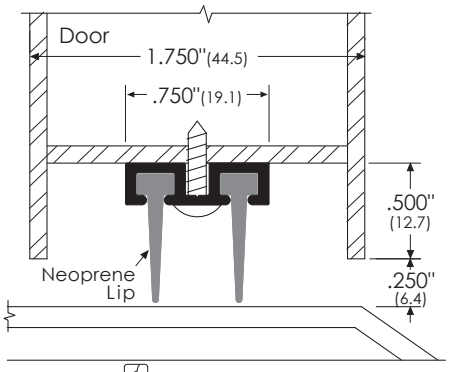

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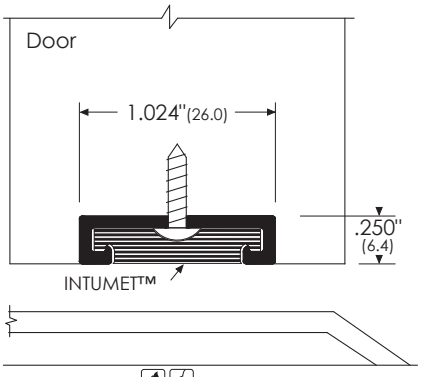
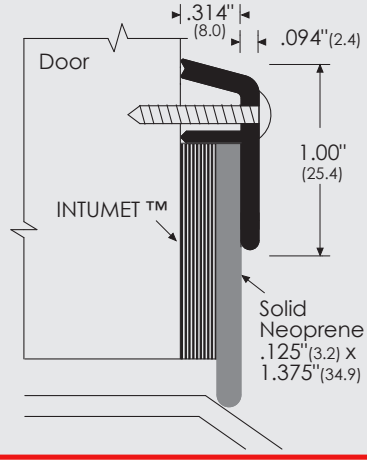


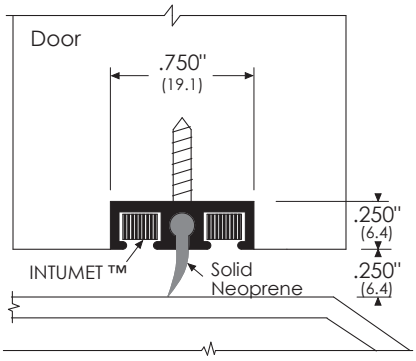
#253FS A



Regain Lost Fire Rating

Approved for 20 minute fire-rated wood doors with excessive undercut up to 1.250". ITS-listed to positive pressure UBC 7-2 1997.

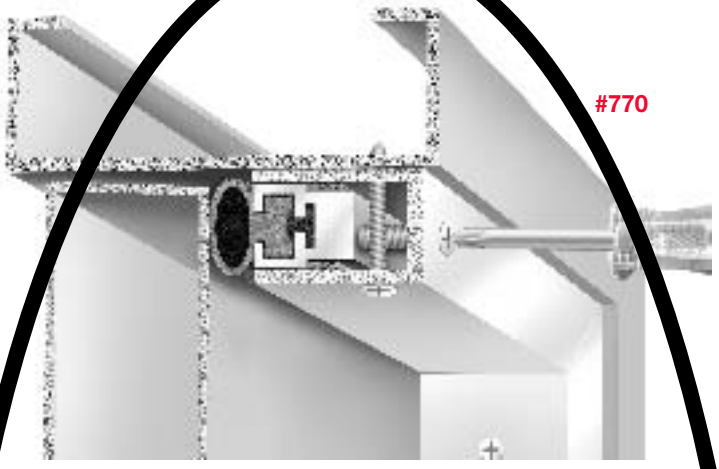
#339FS AA
#339FS D



#59FS A

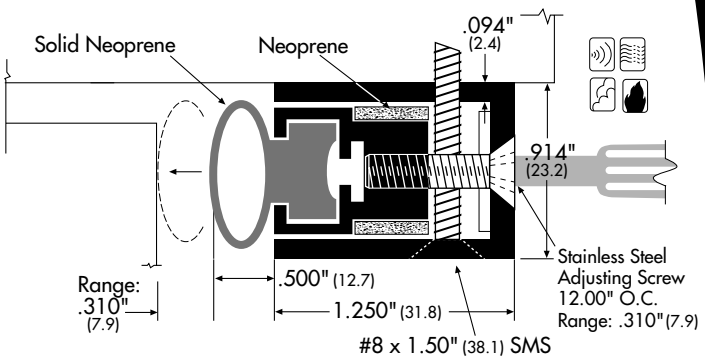
Adjustable Sealing Systems — Jamb Applied

Note: A = Aluminum AA = Anodized Aluminum
G = Simulated Bronze Anodized SP = Steel Primed
D = Dr. Bronze Anodized STST = Stainless Steel



#770

High-Performance Acoustical Gasketing with Negative or Positive Pressure Fire Ratings



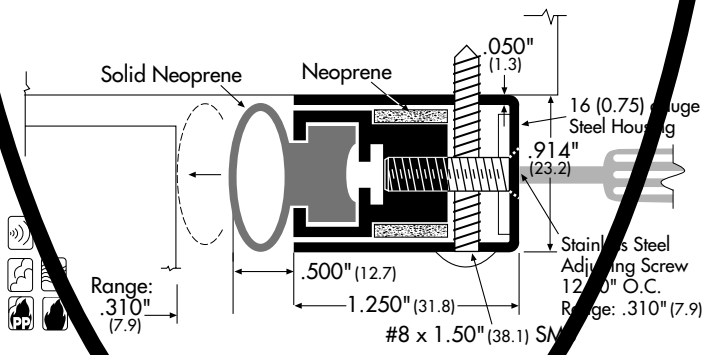
NEGATIVE PRESSURE FIRE RATINGS

#770AA #770D

45 min. as a stop
1-1/2 Hrs. when applied to stop

For Sound (STC) Ratings See Pages 3, 5, 49.

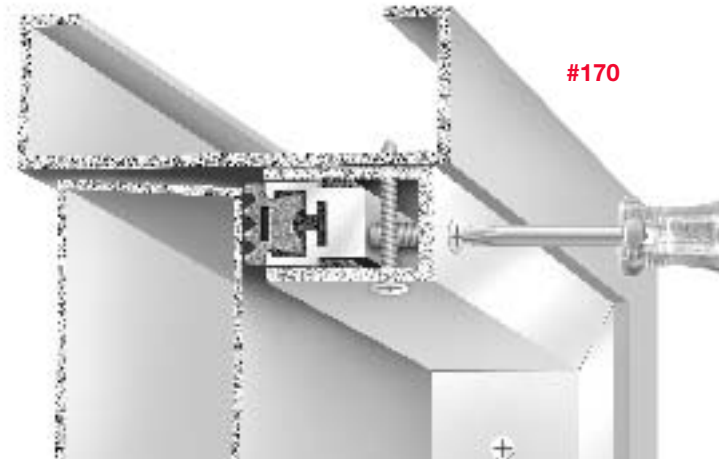
Positive Pressure Listed for 16 gauge steel cased opening. 45 min. pairs or 60 & 90 min. single and pairs. For wood or metal sound-resistant door assemblies.



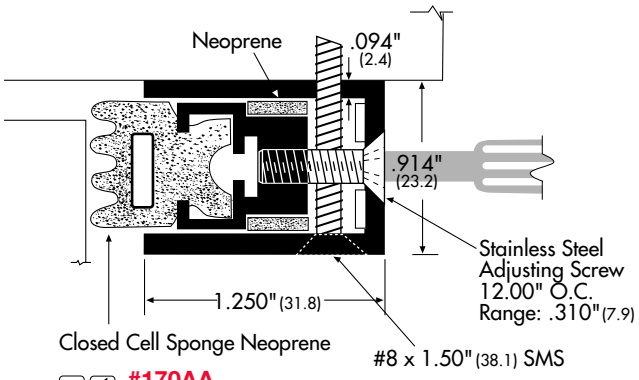
POSITIVE PRESSURE FIRE RATINGS

#770SP #770STST

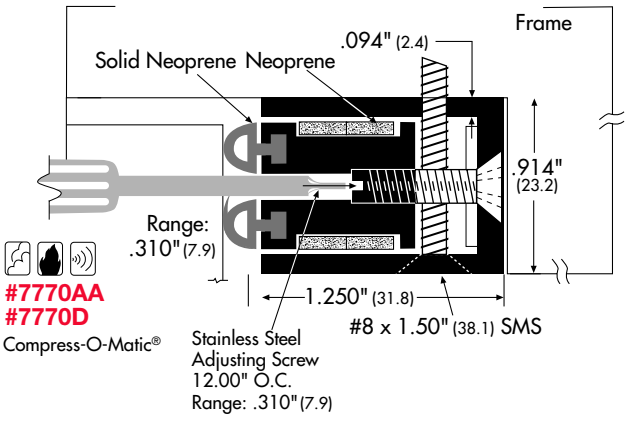
1-1/2 Hrs. Positive Pressure as a stop to wood & metal doors



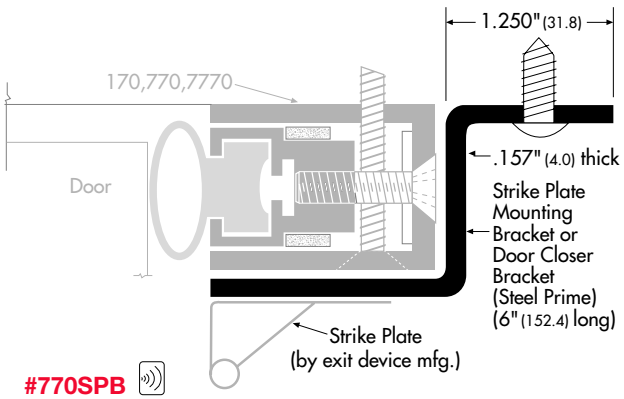
#170



#170AA
#170D

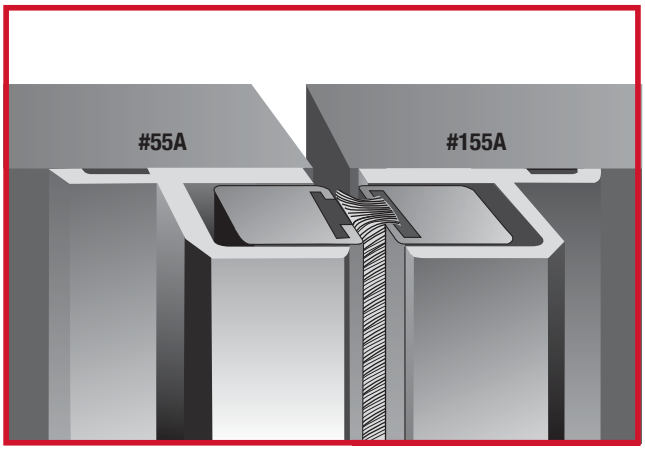


#7770AA
#7770D
Compress-O-Matic®

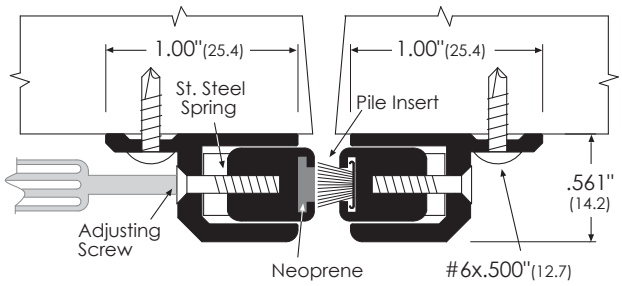


#770SPB

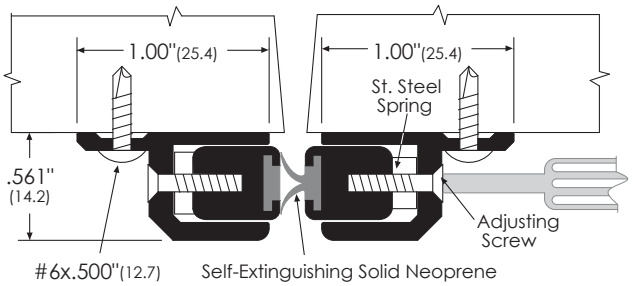
Available full width for use with door coordinator (optional).



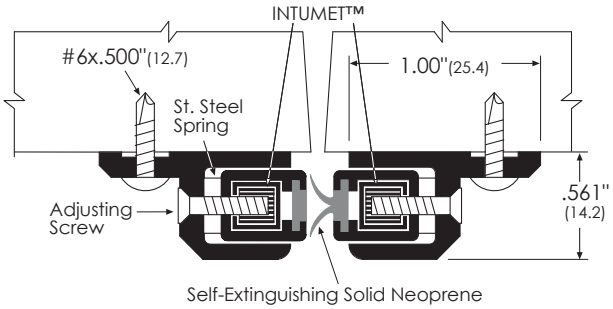
Adjustable Surface Astragal



#55AA **#155AA**

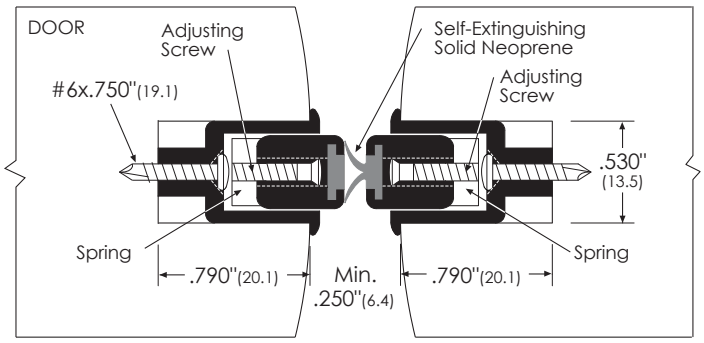


#55AA **#555AA**

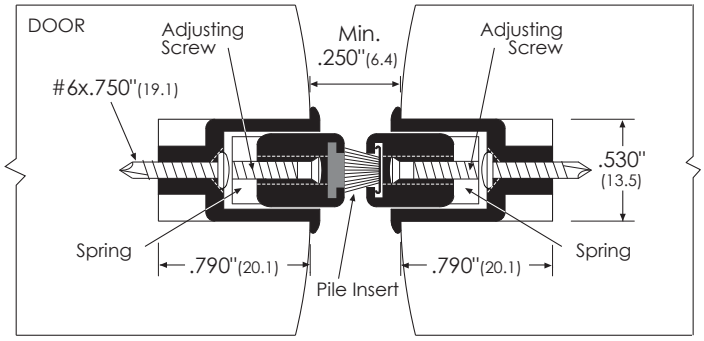


#55FS AA **#555FS AA**

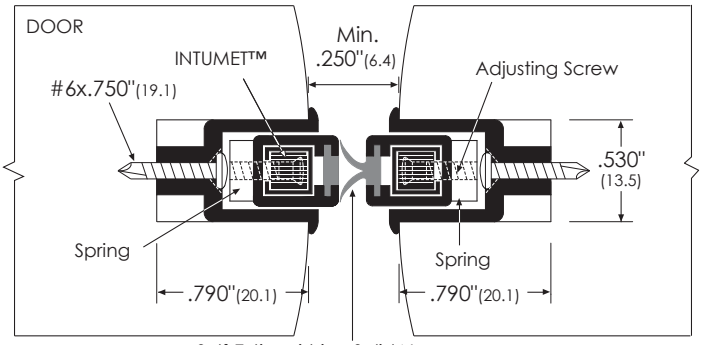
Adjustable Mortised Astragal



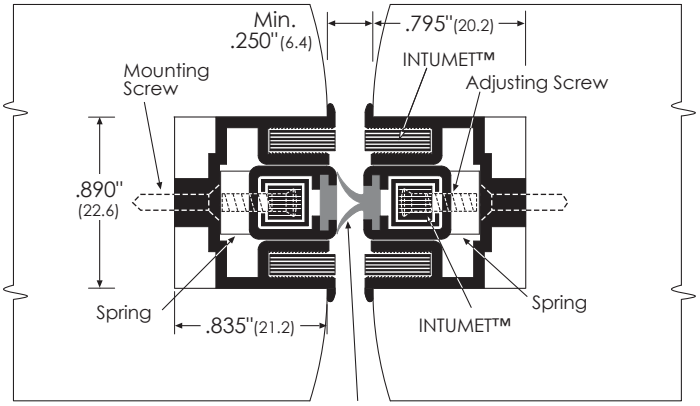
#56AA **#557AA**
#56D **#557D**
#56G **#557G**



#56AA **#156AA**
#56D **#156D**
#56G **#156G**

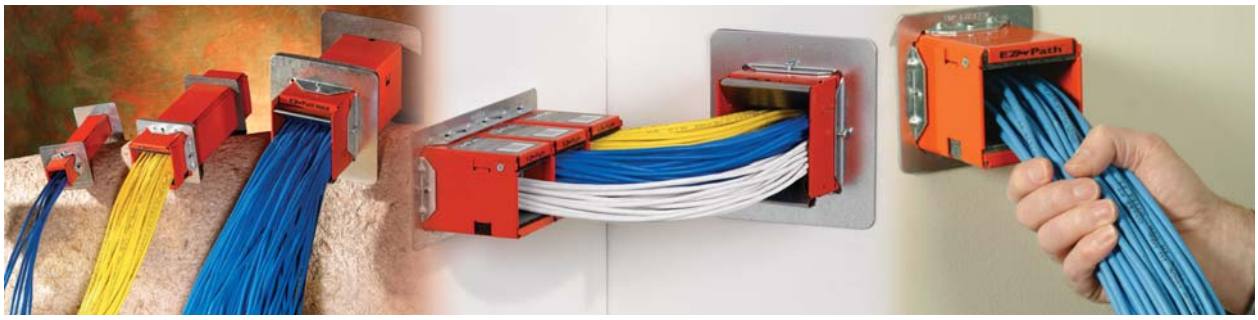


#56FS AA **#557FS AA**
#56FS D **#557FS D**
#56FS G **#557FS G**



#3056FS AA **#3557FS AA**
#3056FS D **#3557FS D**
#3056FS G **#3557FS G**

EZ-Path®
FIRE RATED PATHWAY



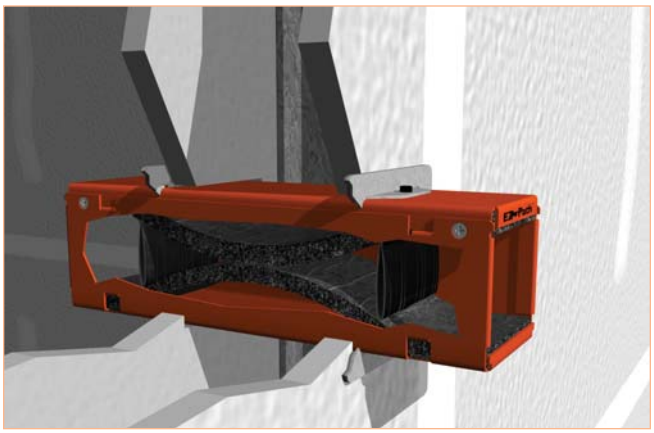
THE EZ-PATH® SYSTEM

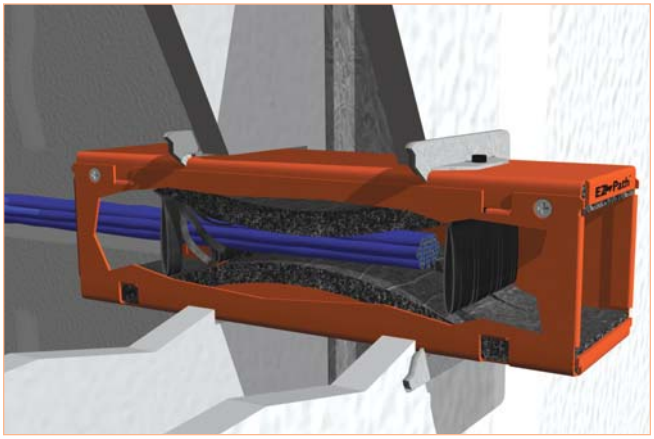
The Zero-Maintenance Solution for Firestopping Cables

www.stifirestop.com

Maximum Fire & Smoke Protection

- Maximum resistance to fire and smoke whether empty or 100% visually filled.
- Assures fire and smoke protection with every new or retrofit cable installation.
- Superior fire and smoke leakage vs. standard sleeve and putty systems.
- Unlike conventional sleeve and putty system, EZ-Path® remains fire and smoke compliant 100% of the time!





No Firestopping Required

- Built-in firestopping system automatically adjusts to the number of cables installed.
- Design assures it is firestopped at all stages of use.
- Mechanical application eliminates the use of sealant, putty and other products that need to be removed and replaced.

Fast Acting Intumescence

- Engineered for rapid expansion when exposed to fire or high temperatures.
- Intumescent material responds to flames or heat by quickly sealing the pathway and preventing the passage of flames and smoke.
- Innovative built-in firestop design assures it is firestopped and smoke-sealed — even at maximum cable loading.

Firestopping Cables

Performance

EZ-Path® — Always Compliant

- UL® Classified and FM Approved in accordance with ASTM E814 (UL1479).
- UL systems are available for up to 4 hour rated floor and wall constructions.
- Empty or full, EZ-Path® is continuously code compliant — 100% of the time.
- Tested and approved cable capacities range from 0 to 100% visual fill.
- U.S. Patent 6,732,481

Specifications

All data, video, and communications cable bundles shall utilize an enclosed fire rated pathway device wherever said cables penetrate rated walls. The fire-rated pathway shall contain a built-in fire sealing system sufficient to maintain the hourly fire rating of the barrier being penetrated. The self-contained sealing system shall automatically adjust to the installed cable loading and shall permit cables to be installed, removed, or retrofitted without the need to adjust, remove or reinstall firestop materials. The pathway shall be UL® Classified and/or FM Systems Approved and tested to the requirements of ASTM E814 (UL1479).

Specified Divisions

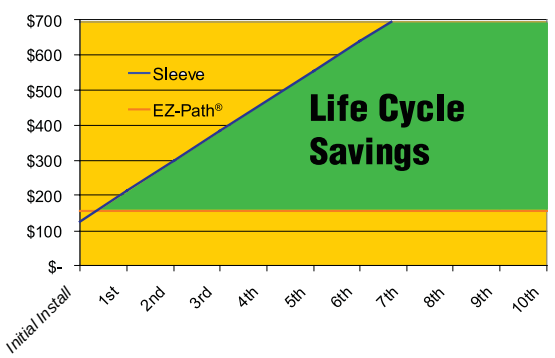
DIV. 7	07 84 00	Penetration Firestopping
DIV. 26	26 00 00	Electrical
DIV. 27	27 00 00	Communications

CLASSIFIED C UL US

FIRESTOP DEVICE FOR USE IN THROUGH-PENETRATION FIRESTOP SYSTEMS. SEE UL DIRECTORY OF PRODUCTS CERTIFIED FOR CANADA AND UL FIRE RESISTANCE DIRECTORY.

FM APPROVED

Pays for Itself in a Few Cable Changes



- All-in-one design installs in minutes.
- Conveniently packaged kits for easy installation — no additional parts to order.
- Splits apart for old work.
- Clean, professional, engineered appearance.
- Easy moves, adds and changes.
- Can be installed as the wall is being built.

3M

Fire Protection Products

Can Your Putty Stand The Heat?

3M™ Fire Barrier Moldable Putty+

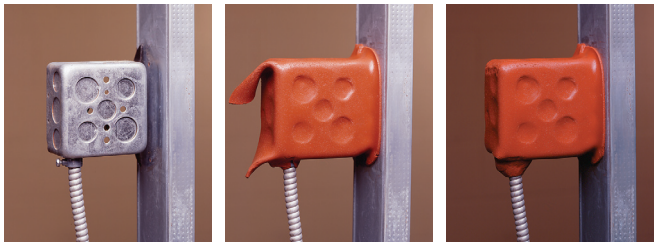
Here are five reasons to use 3M Fire Barrier Moldable Putty+:

1. **Pliable.** Easy to mold into any shape.
2. **Adheres.** Sticks well to most surfaces but not to the applicator's hands.
3. **Conformable.** Pads easily conform and adhere to a wide variety of metallic and non-metallic electrical outlet boxes.
4. **UL Listed.** Wide range of UL Listed systems.
5. **Ages Well.** Excellent aging properties.

3M™ Fire Barrier Moldable Putty+

Put your trust in the quality and reliability of the 3M name.

3M Fire Barrier Moldable Putty+ family of products.



Electrical box being firestopped.

3M Fire Barrier Moldable Putty+ is a one-part, halogen-free product designed to firestop electrical outlet boxes and a wide variety of through-penetrations including cable, conduit, insulated pipe and metal pipe, which penetrate fire-rated construction. During a fire, in a through-penetration application, 3M Fire Barrier Moldable Putty+ intumesces (expands) in the annular space. It completely surrounds the penetrant and stops fire and hot gases from spreading to the next room or next floor for the rated time period. 3M Fire Barrier Moldable Putty+ Pads on electrical outlet boxes will provide thermal and fire resistance plus reduce sound transmission in fire rated wall assemblies.

3M Fire Barrier Moldable Putty+ is designed to meet the intent of NEC, NFPA, SBCCI, BOCA, ICBO and ICC building codes.

Through-penetration being firestopped.

Cable bundle being firestopped.

PROPERTIES	
Color	Red
Density	8-11 Lbs/Gal (.95-1.31Kg/1)
Heat Expansion Begins At:	437˚F / 225˚C
Significant Heat Expansion Begins At:	617˚F / 325˚C
Volume Expansion	3x At 325˚C
Adhesion	Excellent
Humidity Testing	Yes
4 Hr. UL Listed Systems	Yes

SHIPPING INFORMATION

Product	Description	Shpg. Wt. Per Carton Lbs.	UPC Number	Packaging Per Case	Packaging Per Pallet
Moldable Putty+ Pads	MPP+ 4" x 8"	19.45	000-51116-11532-5	100	6400
	MPP+ 7" x 7"	7.25	000-51115-11533-2	20	5280
	MPP+ 9-1/2" x 9-1/2"	11.90	000-51115-11534-9	20	2640
Moldable Putty+ Stix	MP+ 1.4" x 11"	10.66	000-5116-11531-8	10	900

Building Safety Solutions Department
3M Center 223-2S-24
St. Paul, MN 55144-1000
Ph. 800-328-1687
www.3m.com/firestop

FILL, VOID OR CAVITY MATERIAL
FOR USE IN THROUGH-PENETRATION FIRESTOP SYSTEMS
SEE UL DIRECTORY OF PRODUCTS CERTIFIED FOR CANADA
AND UL FIRE RESISTANCE DIRECTORY
90G9

Subject to the conditions of approval as a Wall & Floor Prenetration Fire Stop when installed as described in the current edition of the FMRC Approval Guide

Printed in U.S.A.
Blgr. 5090063

SECTION 00 7200

GENERAL CONDITIONS

1.1 SUMMARY

A. Related Documents:
   1. Document 00 7300 – Supplementary Conditions
   2. Division 01 – General Requirements

1.2 DOCUMENT

A. American Institute of Architects (AIA) Document A201-2007, General Conditions of the Contract for Construction, forms a part of this Contract and by reference is incorporated herein as fully as if repeated at length.

END OF SECTION

SECTION 00 7300

SUPPLEMENTARY CONDITIONS

1.1 SUMMARY

A. Related Documents:
1. Document 00 7200 – General Conditions
2. Division 01 – General Requirements

1.2 GENERAL

A. The following supplements modify, delete from, or add to the General Conditions referenced above.

B. Where provisions of the General Conditions are modified, unaltered provisions remain in effect.

1.3 SUPPLEMENTS

A. Article 1 – General Provisions:
1. Add Subparagraph 1.1.9:

1.1.8 The term “product” includes materials, systems, and equipment.

2. Add Subparagraph 1.1.10:

1.1.9 The term “furnish” means to supply and deliver to Project site, ready for unloading, unpacking, assembly, erection, placement or similar requirements.

3. Add Subparagraph 1.1.11:

1.1.10 The term “install” means to unload, unpack, assemble, erect, place, finish, protect, adjust, and clean, or similar requirements.

4. Add Subparagraph 1.1.12:

1.1.11 The term “provide” means to furnish and install.

B. Article 4 – Administration of the Contract:
1. Add Subparagraph 4.3:

4.3 Architect’s Additional Services:

4.3.1 The Architect and his consultants will receive additional compensation for work performed under the following circumstances:
.1 Review of Contractor’s submittals out of sequence from the submittal schedule agreed to by the Architect.
.2 Responses to the Contractor’s requests for information where such information is available to the Contractor from a careful study and comparison of the Contract Documents, field conditions, Owner-provided information, Contractor-prepared coordination drawings, or prior Project correspondence or documentation.
.3 Change Order and Construction Change Directives requiring evaluation of proposals, including revisions to the Contract Documents.
.4 Providing consultation concerning replacement of Work resulting from fire or other cause during construction.

.5 Evaluation of an extensive number of claims by the Contractor in connection with the Work.
.6 Evaluation of substitutions proposed by the Contractor.
.7 Services provided after 60 days after the date of Substantial Completion.
.8 Submittal review in excess of the original submittal and one resubmittal.
.9 Review of mockups in excess of the original review and one re-review.
.10 Review and documentation of defective or nonconforming work due to the Contractor's failure to comply with Contract Document requirements.
.11 Services provided after the original Substantial Completion date if delay of Substantial Completion was caused by actions of the Contractor or any Subcontractor.
.12 Substantial or Final Completion inspections in excess of two inspections.

4.3.2 The Owner will compensate the Architect and his consultants for additional time and expenses and will deduct the amount of such services from the Contract Sum by Change Order. The Architect's Additional Services will be calculated at the following rates:

.1	Senior Principal:	$220.00 per hour
.2	Principal:	$180.00 per hour
.3	Project Architect:	$140.00 per hour
.4	Intern Architect:	$100.00 per hour
.5	Historic Preservation Specialist:	$100.00 per hour
.6	Administrative:	$ 75.00 per hour

C. Article 10 – Protection of Persons and Property:
1. Add Paragraph 10.3.7:

10.3.7 The Contractor shall not knowingly use any materials containing asbestos or other known hazardous materials in the Work.

END OF SECTION

SECTION 01 1000

SUMMARY OF WORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Project information.
2. Project description.
3. Texas Historic Commission (THC) requirements.
4. Access to site.
5. Work restrictions.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.2 PROJECT INFORMATION

A.	Project:	Fannin County Courthouse – Phase II Interior & Exterior Restoration Bonham, Texas 75418
B.	Owner:	Fannin County 101 E. Sam Rayburn Drive Bonham, Texas 75418 Texas Historical Commission Division of Architecture 108 W. 16th St. 2nd Floor Austin, Texas 78701
C.	Architect:	ArchiTexas 1907 Marilla 2nd Floor Dallas, Texas 75201
D.	MEP Engineer:	MEPCE 2928 Story Road West Las Colinas, Texas 75038
E.	Civil & Structural Engineer:	Jaster-Quintanilla & Associates 100 Glass Street Dallas, Texas 75207
F.	Landscape Architect:	Armstrong Berger P.O. Box 191425 Dallas, Texas 75219

G. AV & Acoustics: WJHW
3424 Midcourt Road, Suite 124
Carrollton, Texas 75206

1.3 PROJECT DESCRIPTION

A. Work of this Project is described as the interior and exterior restoration of the historic Fannin County Courthouse in Bonham, Texas.

B. Work includes selective demolition of non-historic materials, restoration of historic site, restoration and reconstruction of exterior masonry, tower and roof reconstruction, integration of new mechanical / plumbing / electrical / AV / IT / security systems, ADA upgrades, complete finish out and restoration of interior.

C. Project will be constructed under a General Contractor at Risk contract.

D. Originally constructed in 1888, the Fannin County Courthouse, located in Bonham, Texas is a Recorded Texas Historic Landmark. This project is authorized under the Historic Courthouse Preservation Program, Texas Government Code §§442.008, et seq. ("Program"), and the rules promulgated thereunder at 13 Texas Administrative Code §§12.1, et seq., and the Interlocal Cooperation Act, Government Code Chapter 791. All matters pertaining to the Project shall be conducted in conformance with the procedures described in the Texas Historic Courthouse Preservation Program Round IX Grant Manual, all applicable state and federal laws, rules and regulations and the legal directives of the Commission and its staff.

E. The Secretary of the Interior's Standards for the Treatment of Historic Properties apply to this project. The Texas Historic Commission considers this project a Restoration Treatment. The Scope of Work must comply with the Standards for Restoration.

F. For this project to demonstrate that it will preserve and restore the historic integrity of the Fannin County Courthouse the project delivery documents must show THC that no historic building materials, features, and spatial relationships that characterize the building during its period of significance will be unnecessarily removed, demolished or altered in this project. All character defining features of the building that will be removed during the project must be documented, stored and maintained for possible reinstallation in the future.

1.4 CONTRACTOR'S USE OF SITE AND PREMISES

A. Limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.

B. Use of Site: Limit use of Project site to areas within the Contract limits and areas specified by the County. Coordinate approved areas with the Owner prior to construction. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1. Walkways and Entrances: Keep walkways, loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.

a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

C. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.

D. Assume full responsibility for protection and safekeeping of products under this Contract stored on site.

E. Obtain and pay for use of any additional storage or work areas needed for operations.

F. Prohibit smoking within interior spaces.

1.5 WORK RESTRICTIONS

A. Work Restrictions, General: Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.

B. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:

1. Notify Owner not less than two (2) days in advance of proposed utility interruptions.
2. Obtain Owner's written permission before proceeding with utility interruptions.

C. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.

1. Notify Owner not less than two (2) days in advance of proposed disruptive operations.
2. Obtain Owner's written permission before proceeding with disruptive operations.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

SECTION 01 2100

ALLOWANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Administrative and procedural requirements governing allowances.
2. Types of allowances include the following:
   a. Contingency allowances.
   b. Testing allowances.

B. Related Requirements:

1. Section 00 1115 – Attachment A

1.2 CONTINGENCY ALLOWANCES

A. Use the contingency allowance only as directed by Architect for Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance.

B. Contractor's overhead, profit, and related costs for products and equipment ordered by Owner under the contingency allowance are included in the allowance and are not part of the Contract Sum. These costs include delivery, installation, insurance, equipment rental, and similar costs.

C. Change Orders authorizing use of funds from the contingency allowance will include Contractor's related costs and reasonable overhead and profit margins.

D. At Project closeout, credit unused amounts remaining in the contingency allowance to Owner by Change Order.

1.3 TESTING ALLOWANCES

A. Testing and inspecting allowances include the cost of engaging testing agencies, actual tests and inspections, and reporting results.

B. The allowance does not include incidental labor required to assist the testing agency or costs for retesting if previous tests and inspections result in failure. The cost for incidental labor to assist the testing agency shall be included in the Contract Sum.

C. Costs of services not required by the Contract Documents are not included in the allowance.

D. At Project closeout, credit unused amounts remaining in the testing and inspecting allowance to Owner by Change Order.

1.4 ADJUSTMENT OF ALLOWANCES

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

where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.

1. Include installation costs in purchase amount only where indicated as part of the allowance.
2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.
3. Submit substantiation of a change in scope of work, if any, claimed in Change Orders related to unit-cost allowances.
4. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.

B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.

1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of work has changed from what could have been foreseen from information in the Contract Documents.
2. No change to Contractor's indirect expense is permitted for selection of higher- or lower-priced materials or systems of the same scope and nature as originally indicated.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

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

3.3 SCHEDULE OF ALLOWANCES

A. Allowance No. 1 – Contingency:
1. Include an Owner’s contingency totaling 10% of Construction Contract.

B. Allowance No. 2 – Testing:
1. Include a $30,000.00 cash allowance testing and inspection laboratory services as specified in Section 01 4500 – Testing Laboratory Services.

END OF SECTION

SECTION 01 2200

UNIT PRICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Measurement.
   2. Payment.

B. Related Sections:
   1. Individual specification sections.

1.2 UNIT PRICES

A. Provide unit prices for items listed, for inclusion in Contract, guaranteed to apply for duration of Project as basis for additions to or deductions from Contract Sum.

B. Take measurements and compute quantities.

C. Quantities and measurements indicated are for Contract purposes only. Actual quantities and measurements supplied or placed in the Work will determine payment.

D. Payment includes full compensation for all required labor, Products, tools, equipment, plant, transportation, services, and incidentals, and for erection, application, or installation of an item of the Work.

E. Adjustments to Contract Sum will be made by Change Order based on net cumulative change for each item of the Work.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 UNIT PRICE SCHEDULE

A. Unit Price No. 1: Masonry Cleaning – Section 04 0344.
   1. Unit of measure: By the square foot including stripping, rinsing, and manual removal of mastic remnants in crevices with non-abrasive brush or pick.
   2. Basis of payment:
      a. Contract Sum to be based on quantities indicated on Drawings.
      b. If actual quantities of masonry cleaning vary from designated quantities, Contract Sum will be adjusted using unit prices.

B. Unit Price No. 2: Masonry Restoration (Patching) – Section 04 0342.

1. Unit of measure: By the square foot including removal of damaged masonry and installation of patching material.
2. Basis of payment:
    a. Contract Sum to be based on quantities indicated in the Drawings.
    b. If actual quantities of masonry patched vary from designated quantities, Contract Sum will be adjusted using unit prices.

C. Unit Price No. 3: Masonry Restoration (Veneering Limestone) – Section 04 0342.
1. Unit of measure: By the square foot including removal of damaged or defective masonry, replacement material, and installation.
2. Basis of payment:
    a. Contract Sum to be based on quantities indicated on Drawings.
    b. If actual quantities of veneering limestone vary from designated quantities, Contract Sum will be adjusted using unit prices.

D. Unit Price No. 4: Metal Pan Vault Ceiling – Section 05 5000.
1. Unit of measure: By the square foot including removal of damaged metal panels where required and installation of replacement panels.
2. Basis of payment:
    a. Contract Sum to be based on 50% replacement throughout the building.
    b. If actual quantities of metal pan vault ceiling replacement vary from designated quantities, Contract Sum will be adjusted using unit prices.

E. Unit Price No. 5: Masonry Infill – Section 04 2000.
1. Unit of measure: By the square foot including partial removal of damaged interior masonry where required and installation of infill at unforeseen locations.
2. Basis of payment:
    a. Contract Sum to be based on 500 SF replacement throughout interior of the building at unforeseen locations.
    b. If actual quantities of unit masonry infill vary from designated quantities, Contract Sum will be adjusted using unit prices.

F. Unit Price No. 6: Wood Joist Replacement – Section 06 1000.
1. Unit of measure: By the linear foot including removal of damaged or missing wood floor joists at unforeseen locations.
2. Basis of payment:
    a. Contract Sum to be based on 500 LF replacement throughout the building at unforeseen locations.
    b. If actual quantities of wood floor joists replacement vary from designated quantities, Contract Sum will be adjusted using unit prices.

END OF SECTION

SECTION 01 2300

ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for alternates.

B. Contract Documents contain pertinent requirements for materials and methods to accomplish work described herein.

C. Provide alternate costs for inclusion in Contract Sum if accepted by Owner.

1.2 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.3 PROCEDURES

A. Alternates will be exercised at the option of the Owner.

B. Coordinate related work and modify surrounding work as required to complete the work, including changes under each Alternate, when acceptance is designated in Owner / Contractor Agreement.

C. Execute accepted alternates under the same conditions as other work of the Contract.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Alternate No. 1: Perimeter Wall

1. Base Bid: Install site components as noted in the Drawings, except for perimeter wall.
2. Add Alternate: Install perimeter wall and associated metal fence and gate components.

END OF SECTION

SECTION 01 2500

SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Product Substitution Requirements

1.2 GENERAL

A. Definition: Proposal by Contractor to use manufacturer, product, material, or system different from one required in Contract Documents.

B. Do not substitute Products unless a Substitution Request Form has been submitted and approved by Architect.

C. Substitutions during Bidding: Refer to instructions to Bidders

D. Architect and THC representative will consider substitution requests within 60 days after award of Contract. After initial 60 day period, substitution requests will be considered only due to non-availability of a specified Product through no fault of Contractor.

E. In case of non-availability of a specified Product notify Architect in writing as soon as non-availability becomes apparent.

1.3 SUBSTITUTION REQUESTS

A. Submit substitution requests on copy of form bound into Project Manual.

B. Document specified product and proposed substitution with complete data, including:
1. Product identification, including name and address of manufacturer.
2. Product description, performance and test data, and reference standards.
3. Sample, if requested.
4. Description of any anticipated effect that acceptance of proposed substitution will have on Progress Schedule, construction methods, or other items of Work.
5. Description of any differences between specified product and proposed substitution.
6. Difference in cost between specified product and proposed substitution.

C. Burden of proof for substantiating compliance of proposed substitution with Contract Document requirements remains with Contractor.

D. A request constitutes a representation that the Contractor:
1. Has investigated the proposed Product and determined that it meets or exceeds the quality level of the specified Product.
2. Will provide the same warranty for the substitution as for the specified Product.
3. Will coordinate installation and make changes to other Work that may be required for the Work to be complete with no additional cost to the Owner.
4. Waives claims for additional costs or time extension that may subsequently become apparent.
5. Will reimburse Owner for design services associated with re-approval by authorities or revisions to Contract Documents to accommodate the substitution.

E. Substitutions will not be considered if:
   1. They are indicated or implied on Shop Drawings or other submittals without submittal of a substitution request form.
   2. Approval will require substantial revision of Contract Documents without additional compensation to the Architect.

F. Submit electronically in Adobe PDF format.

G. Architect will notify Construction Manager of approval or rejection of each Substitution Request.

PART 2 - PRODUCTS

Not used

PART 3 - EXECUTION

Not Used

END OF SECTION

DOCUMENT 01 2519

SUBSTITUTION REQUEST FORM

DATE: _____

TO: _____

ATTENTION: _____

PROJECT: _____

We submit for your consideration the following product as a substitution for the specified product:

Section No. Paragraph Specified Product

_____ _____ _____

Proposed Substitution: _____

_____

Reason for Substitution: _____

_____

Product Data:

Attach complete technical data for both the specified product and the proposed substitution. Include information on changes to Contract Documents that the proposed substitution will require for its proper installation.

Samples:

___ Attached ___ Will be furnished upon request

Does the substitution affect dimensions shown on Drawings?

___ No ___ Yes (explain) _____

_____

Effects of proposed substitution on other Work:

_____

_____

Differences between proposed substitution and specified Product:

_____

_____

Manufacturer's warranties of the proposed substitution are:

___ Same ___ Different (explain) _____

_____

Maintenance service and spare parts are available for proposed substitution from:

_____

_____

Previous installations where proposed substitution may be seen:

Project: _____ Project: _____

Owner: _____ Owner: _____

Architect: _____ Architect: _____

Date Installed: _____ Dated Installed: _____

Cost savings to be realized by Owner, if proposed substitution is approved:

_____

Change to Contract Time, if proposed substitution is approved:

___ No Change ___ Add _____ days ___ Deduct _____ days

Submittal constitutes a representation that Construction Manager has read and agrees to the provisions of Section 01 2500.

Submitted by Contractor:

_____
Signature

_____
Firm

For Use by Architect and THC Representative:

Based on the information supplied by the Construction Manager, the Architect and THC representative has reviewed the proposed substitution on the basis of design concept of the Work and conformance with information given in Contract Documents.

___ Approved ___ Approved as Noted ___ Rejected

Submit Additional Information: _____

Architect: _____ Date: _____

THC: _____ Date: _____

SECTION 01 2600

CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
1. Supplemental Instructions
2. Proposal Requests
3. Contractor's proposed changes
4. Construction Change Directives
5. Change Orders

B. Related Sections:
1. Section 01 6000 – Product Requirements

1.2 CHANGE PROCEDURES

A. Architect's Supplemental Instructions:
1. Format: AIA Document G710 – Architect's Supplemental Instructions.
2. Architect will advise of minor changes in the Work not involving an adjustment to Contract Sum or Contract Time as authorized by the Conditions of the Contract.

B. Proposal Requests:
1. Format: AIA Document G709 – Proposal Request
2. Architect may issue a Proposal Request that includes a detailed description of a proposed change with supplemental or revised Drawings and specifications.
3. Prepare and submit an estimate of any change to Contract Sum or Contract Time within 7 days after receipt. Include the following:
   a. Quantities and unit costs, with total cost or credit to Owner. If requested, furnish documentation of quantities.
   b. Delivery charges, equipment rentals, and trade discounts as applicable.
   c. If change in Contract Time is involved, provide updated Progress Schedule.
4. Do not stop work or initiate changes in response to a Proposal Request. If approved, Architect will prepare and issue a Change Order.
5. Submit electronically in Adobe PDF format.

C. Contractor's Proposed Changes:
1. Format: Contractor's standard.
2. Contractor may propose a change by submitting request for change to Architect.
3. Describe proposed change, reason for change, its full effect on Work, and any change to Contract Sum or Contract Time. Include the following:
   a. Quantities and unit costs, with total cost or credit to Owner. If requested, furnish documentation of quantities.
   b. Taxes, delivery charges, equipment rentals, and trade discounts as applicable.
   c. If change in Contract Time is involved, provide updated Progress Schedule.
4. Document any required substitutions in accordance with Section 01 6000.
5. Submit electronically in Adobe PDF format.

D. Construction Change Directive:
1. Architect may issue a directive, signed by Owner, instructing Contractor to proceed with a change for subsequent inclusion in a Change Order.
2. Documentation will describe changes in Work and designate method of determining any change to Contract Sum or Contract Time. Promptly execute change.

E. Change Orders:
   1. Format: AIA Document G701 – Change Order
   2. Execution: Prepare Change Orders for signature of parties as provided in Conditions of the Contract.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

SECTION 01 2900

PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. Schedule of Values.
   2. Applications for Payment.

B. Related Sections:
   1. Section 01 7700 – Closeout Procedures

1.2 SCHEDULE OF VALUES

A. General:
   1. Submit a Schedule of Values to Architect at least 20 days prior to submitting first Application for Payment.
   2. Upon request of Architect, furnish additional data to support values given that will substantiate their correctness.
   3. Approved Schedule of Values will be used as basis for reviewing Contractor's Applications for Payment.

B. Format and Content:
   1. Format: AIA Document G703 – Continuation Sheet of Application and Certification for Payment or Contractor's standard electronic media format.
   2. Use of Table of Contents of Project Manual as basis of format for listing costs of Work.
   3. List installed value of component parts of Work in sufficient detail to serve as basis for computing values for progress payments.
   4. Include separate line items for:
      a. Site mobilization
      b. Bonds and insurance
      c. Construction Manager's overhead and profit.
   5. For items on which payment will be requested for stored materials, break down value into:
      a. Cost of materials, delivered and unloaded
      b. Total installed value
   6. For each line item that has a value of more than $25,000.00, break down costs to list major products or operations under each item.
   7. Total of costs listed in Schedule shall equal Contract Sum.

C. Submit electronically in Adobe PDF format.

D. Review and Resubmittal:
   1. After initial review by Architect, revise and resubmit if required.
   2. Revise and resubmit along with next Application for Payment when a Change Order is issued. List each Change Order as a new line item.

1.3 APPLICATIONS FOR PAYMENT

A. Preparation:
   1. Format: AIA Document G702 – Application and Certification for Payment, supported by AIA Document G703 – Continuation Sheet or Contractor's standard electronic media format.

2. Prepare required information in typewritten format or on electronic media format.
3. Use data from reviewed Schedule of Values. Provide dollar value in each column for each line item representing portion of work performed.
4. List each authorized Change Order as a separate line item, listing Change Order number and dollar value.
5. Prepare Application for Final Payment as specified in section 01 7700.

B. Waivers of Lien:
1. Along with each Application of Payment, submit waivers of lien from Construction Manager and each Subcontractor or Sub-subcontractor included on the current month's Application for Payment.
2. Submit partial waivers on each line item for amount requested, prior to deduction of retainage.
3. For completed items, submit full or partial waiver.

C. Substantiating Data:
1. When Architect requires substantiating information, submit data justifying dollar amounts in question.
2. Provide one copy of data with cover letter showing Application number and date, and line item number and description.

D. Submittal:
1. Submit electronically in Adobe PDF format.
2. Payment period: Submit at intervals stipulated in Owner / Contractor Agreement.

E. THC Requirements:
1. Provide additional copy of certified Application for Payment, including any back-up documentation, to the Owner so it may be included with their reimbursement request to the THC
2. THC will review certified Applications for Payment after they have been paid and may request clarification from the consultant.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

SECTION 01 3100

PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. Project Coordination.
2. Requests for Information (RFIs).
3. Project meetings.

B. Related Requirements:

1. Section 01 7700 – Contract Closeout

1.2 PROJECT COORDINATION

A. Submit required project submittals electronically in Adobe PDF format.

B. Coordinate scheduling, submittals, and work of various Sections of specifications to assure efficient and orderly sequence of installation of interdependent construction elements.

C. Verify that utility requirement characteristics of operating equipment are compatible with building utilities. Coordinate work of various Sections having interdependent construction elements.

D. Coordinate space requirements and installation of mechanical and electrical items that are indicated diagrammatically on Drawings.
1. Follow routing shown as closely as practical; place runs parallel with building lines.
2. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

E. In finished areas, conceal pipes, ducts, and wiring within construction. Coordinate locations of fixtures and outlets with finish elements.

F. Coordinate completion and clean-up of work of separate Sections in preparation of Substantial Completion.

G. After Owner occupancy, coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents to minimize disruption of Owner's activities.

H. THC will be given an opportunity to review any samples, mock-ups, shop drawings or other submittals that have the potential to affect the quality or historic character of this project prior to their final approval.

I. Architect-approved substitutions, minor changes, construction change directives, or change orders that have the potential to affect the quality or historic character of this project shall also be reviewed by THC prior to implementation.

1.3 REQUESTS FOR INFORMATION (RFIs)

A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the Contractor's standard electronic media format.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Project name.
2. Project number.
3. Date.
4. Name of Subcontractor.
5. Name of Architect and Contractor.
6. RFI number, numbered sequentially.
7. RFI subject.
8. Specification Section number and title and related paragraphs, as appropriate.
9. Drawing number and detail references, as appropriate.
10. Field dimensions and conditions, as appropriate.
11. Contractor's suggested resolution. If Contractor's solution(s) impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
12. Contractor's signature.
13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

C. RFI Forms: Contractor's standard electronic media format.

D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow five (5) working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. or during weekend hours will be considered as received the following working day.

1. The following RFIs will be returned without action:

a. Requests for approval of submittals.
b. Requests for approval of substitutions.
c. Requests for coordination information already indicated in the Contract Documents.
d. Requests for adjustments in the Contract Time or the Contract Sum.
e. Requests for interpretation of Architect's actions on submittals.
f. Incomplete RFIs or inaccurately prepared RFIs.

2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 01 2600 - Contract Modification Procedures

a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within ten (10) days of receipt of the RFI response.

E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Include the following:

1. Project name.
2. Name and address of Contractor.
3. Name and address of Architect.
4. RFI number including RFIs that were dropped and not submitted.
5. RFI description.
6. Date the RFI was submitted.
7. Date Architect's response was received.

F. On receipt of Architect's action, update the RFI log and immediately and distribute the RFI response to affected parties. Review response and notify Architect within five (5) days if Contractor disagrees with response.

1.4 PROJECT MEETINGS

A. Schedule and administer preconstruction conference, progress meetings, and pre-installation conferences.

B. Make physical arrangements for meetings; notify involved parties, including THC representative, at least 5 days in advance.

C. Record significant proceedings and decisions at each meeting; reproduce and distribute copies to parties in attendance and others affected by proceedings and decisions made. THC to receive copy of meeting minutes in a timely manner whether or not they are in attendance at the meeting.

1.5 PRECONSTRUCTION CONFERENCE

A. Schedule within 15 days after date of Notice to Proceed at Contractor’s project field office.

B. Attendance:
1. Contractor
2. Owner
3. THC Representative
4. Architect
5. Major subcontractors and suppliers as Contractor deems appropriate.

C. Review and Discuss:
1. Relation and coordination of various parties, and responsible personnel for each party.
2. Use of premises, including office and storage areas, temporary controls, and security procedures.
3. Construction schedule and critical work sequencing.
4. Working hours
5. Owner’s occupancy requirements.
6. Parking availability.
7. First aid.
8. Processing of:
    a. Contract modifications
    b. Shop Drawings, Product Data, and Samples
    c. Applications for Payment
    d. Substitutions
    e. Submittals
9. Submittal Schedule
    a. Contractor to provide submittal schedule to THC representative for them to highlight submittal sections that will require their review and approval.
10. Schedule of Values
    a. Contractor to provide progress payment schedule
    b. THC will reimburse Owner no more than once a month
11. Construction photography requirements.
12. Adequacy of distribution of Contract Documents
13. Procedures for maintaining contract closeout submittals as specified in Section 01 7700.
14. Installation and removal of temporary facilities.
15. Notification procedures and extent of testing and inspection services.
16. Architect approved substitutions, minor changes, construction change directives, or change orders that have the potential to affect the quality or historic character of this project shall also be reviewed by THC prior to implementation.

1.6 PROGRESS MEETINGS

A. Schedule bi-monthly progress meetings.

B. Location: Contractor's project field office.

C. Attendance:
1. Contractor
2. Owner
3. THC Representative
4. Architect
5. Subcontractors and suppliers as appropriate to agenda
6. Others as appropriate to agenda.

D. Review and Discuss:
1. Work progress since previous meeting, including:
   a. Field observations, deficiencies, conflicts, and problems.
   b. Progress and completion date.
   c. Corrective measures needed to maintain quality standards, progress, and completion date.
2. Status of:
   a. Requests for information.
   b. Submittals.
   c. Contract modifications.
3. Coordination between various elements of Work.
4. Maintenance of Project Record Documents.

1.7 PRE-INSTALLATION CONFERENCES

A. Where required in individual specification Sections, convene a pre-installation conference at project site or other designated location.

B. Require attendance of parties directly affecting or affected by work of the specific Section.

C. Review conditions of installation, preparation and installation procedures, and coordination with related work.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

SECTION 01 3216

CONSTRUCTION PROGRESS SCHEDULES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. Construction progress schedule.

B. Related Requirements:

   1. Section 01 2900 – Payment Procedures

1.2 FORMAT

A. Prepare Progress Schedule as a horizontal bar chart with separate bar for each major portion of Work or operation, identifying first work day of each week.

B. Sequence of Listings: The chronological order of the start of each item of Work.

C. Scale and Spacing: To provide space for notations and revisions.

D. Sheet size: Multiples of 8-1/2” x 11”

1.3 CONTENT

A. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction.

B. Identify each item by specification Section number.

C. Provide subschedules to define critical portions of the entire Progress Schedule.

D. Show accumulated percentage of completion of each item, and total percentage of Work completed, as of the first day of each month.

E. Provide separate schedule of submittal dates for Shop Drawings, Product Data, and Samples, including:
   1. Dates reviewed submittals will be required from Architect.
   2. Decision dates for selection of finishes.

F. Coordinate content with Schedule of Values specified in Section 01 2900.

G. Revisions:
   1. Indicate progress of each activity to date of submittal, and projected completion date of each activity.
   2. Identify activities modified since previous submittal, major changes in scope, and other identifiable changes.

H. Provide narrative report to define problem areas, anticipated delays, and impact on Progress Schedule. Report corrective action taken, or proposed, and its effect.

1.4 SUBMITTAL

A. Submit initial Progress Schedule within 15 days after date of Notice to Proceed. After review, resubmit required data within 10 days.

B. Submit revised Progress Schedule with each Application for Payment.

C. Submit electronically in Adobe PDF format.

1.5 DISTRIBUTION

A. Distribute copies of approved Progress Schedule to project site file, Subcontractors, suppliers, and other concerned parties.

B. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in Progress Schedule.

C. Submit electronically in Adobe PDF format.

PART 2 - PRODUCTS

Not used

PART 3 - EXECUTION

Not used

END OF SECTION

SECTION 01 3233

CONSTRUCTION PHOTOGRAPHS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. Construction progress photographs
   2. Record photographs

B. Related Requirements:
   1. Section 01 2900 – Payment Procedures
   2. Section 01 7700 – Closeout Procedures

C. Identify and document the following:
   1. Conditions prior to commencement of work or demolition
   2. Major construction events
   3. Conditions at substantial completion

1.2 PROGRESS PHOTOGRAPHS

A. Photography:
   1. Photo document existing conditions before their alteration and repair and submit to Architect and THC for review and approval prior to starting construction.
   2. Take construction photographs each month just prior to each scheduled Application for Payment and upon Substantial Completion.
   3. Illustrate work conditions and conditions encountered at each successive period.
   4. Photograph minimum of 20 different views of exterior and 20 of interior at each specified time; views as directed by the Architect.
   5. At successive periods of photography, take photographs from same overall view as previously taken.
   6. Digital Camera: Utilize 4 megapixel image or greater.
   7. Provide correct exposure and focus, high resolution and sharpness, maximum depth of field, and minimum distortion.
   8. Photo documentation to be included in Project Completion Report.

B. Digital Images:
   1. Provide JPEG files on archival quality CD-ROM disc.
   2. Index files in chronological sequence.
   3. Identify each view by listing:
      a. Name of Project.
      b. Orientation of View.
      c. Date taken.
      d. Sequential photograph number.

C. Submittal: Submit monthly along with each Application for Payment

1.3 RECORD PHOTOGRAPHS

A. Index to record photographs:
   1. Submit key floor plan with photograph locations numbered for reference
   2. Include labels of clear sleeves noting subject, view, date and photographer.

B. Photographic format:
   1. Professional quality
   2. Perspective corrected lens preferred

C. Print format:
   1. 8 x 10 color digitally printed on archival paper or photographically printed on well-washed resin-coated paper.

D. Content:
   1. Each elevation, elevation details and not less than 12 interior views
   2. Show courtrooms, public corridors, typical office, stair and vaults. Views should be correlated to match angle and distance of previous view.

E. Intervals:
   1. Conditions prior to commencement of work or demolition
   2. During construction
   3. Conditions at completion

F. Negatives: photographic negatives in archival sleeves or a digital copy on compact disk in jpeg format.

G. Duplication requirements:
   1. Three print copies (in transparent sleeves with labels)
   2. Three copies of digital image data on a compact disk

PART 2 - PRODUCTS

Not used

PART 3 - EXECUTION

Not used

END OF SECTION

SECTION 01 3300

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Submittal procedures.
2. Proposed Products list.
3. Submittal schedule.
4. Shop Drawings.
5. Product Data.
6. Samples.
7. Quality control submittals.

B. Related Sections:
1. Section 01 4000 - Quality Requirements.

1.2 SUBMITTAL PROCEDURES

A. Number each submittal with Project Manual section number and a sequential number within each section. Number re-submittals with original number and an alphabetic suffix.

B. Identify Project, Contractor, Subcontractor or supplier, pertinent Drawing sheet and detail numbers, and specification Section number, as appropriate.

C. Submit all submittals listed under “Submittals for Review” simultaneously for each Product or Specification Section.

D. Where multiple Products function as an assembly, group submittals for all related Products into single submittal.

E. Architect will not review incomplete submittals.

F. Apply Contractor’s stamp, signed or initialed certifying that:
1. Submittal was reviewed.
2. Products, field dimensions, and adjacent construction have been verified.
3. Information has been coordinated with requirements of Work and Contract Documents.

G. Schedule submittals to expedite the Project, and deliver to Architect. Coordinate submittal of related items.

H. Coordinate review of submittals, samples and mockups with THC representative prior to commencing the Work.

I. Submittal:
1. For items requiring Architect’s review only, submit directly to Architect.
2. For items requiring review by Architect’s consultants and/or THC representative, submit simultaneously to Architect and to appropriate consultant.
3. Architect will provide a standard transmittal form containing Architect’s and consultants’ addresses, actions, and other procedural information.

J. Distribution after Review:
1. Approved submittals: Distribute copies of approved submittals to other concerned parties and to Project Record Documents file. Instruct parties to promptly report any inability to comply with provisions.
2. Submittals requiring resubmittal:
   a. Distribute copies of reviewed submittals to concerned parties. Instruct affected parties to revise and resubmit submittals.
   b. Identify changes made since previous submittal.

K. For each submittal, allow 14 days for Architect’s review, excluding delivery time to and from Construction Manager. Allow 21 days for THC review.

L. Identify variations from Contract Documents and Product or system limitations that may be detrimental to successful performance of completed Work.

M. Revise and resubmit submittals when required; identify all changes made since previous submittal.

N. Distribute copies of reviewed submittals to concerned parties and to Project Record Documents file. Instruct parties to promptly report any inability to comply with provisions.

1.3 PROPOSED PRODUCTS LIST

A. Within 15 days after date of Notice to Proceed, submit a complete list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.

B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

C. Submit electronically in Adobe PDF format.

1.4 SUBMITTAL SCHEDULE

A. Within 15 days after date of Notice to Proceed, submit a submittal schedule showing all submittals proposed for project, including submittals listed as:
1. Submittals for Review.
2. Quality Control Submittals.
3. Closeout Submittals.

B. Include for each submittal:
1. Specification section number.
2. Description of submittal.
3. Type of submittal.
4. Anticipated submittal date.
5. For submittals requiring Architect’s review, date reviewed submittal will be required from Architect.

C. Submit electronically in Adobe PDF format.

1.5 SHOP DRAWINGS

A. Present information in clear and thorough manner.

B. Identify details by reference to sheet and detail numbers or room number shown on Drawings.

C. Reproductions of details contained in Contract Documents are not acceptable.

D. Submit electronically in Adobe PDF format. Architect will return one copy to Contractor for printing and distribution.

1.6 PRODUCT DATA

A. Mark each copy to identify applicable products, models, options, and other data.

B. Supplement manufacturers' standard data to provide information unique to this Project.

C. Submit electronically in Adobe PDF format. Architect will return one copy to Contractor for printing and distribution.

1.7 SAMPLES

A. Submit samples to illustrate functional and aesthetic characteristics of Products, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.

B. Where so indicated, submit samples of finishes from the full range of manufacturers' standard colors, textures, and patterns for Architect's selection.

C. Include identification on each sample, with full Project information.

D. Unless otherwise specified in individual specifications, submit two of each sample.

E. Architect will notify Contractor of approval or rejection of samples, or of selection of color, texture, or pattern if full range is submitted.

1.8 QUALITY CONTROL SUBMITTALS

A. Quality control submittals specified in Section 01 4000 are for information and do not require Architect's responsive action except to require resubmission of incomplete or incorrect information.

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

Not used

END OF SECTION

SECTION 01 3591

RESTORATION PROJECT PROCEDURES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Definitions.
2. Historic significance.
3. Restoration procedures.
4. Historic artifacts.
5. Salvaged materials.
6. Alterations.
7. Hazardous material procedures.

B. Related Sections:
1. Division 01: Administrative, procedural, and temporary work requirements.
2. Texas Historic Courthouse Preservation Program Round IX Grant Manual

1.2 DEFINITIONS

A. Match Existing: Provide new materials to match the existing, in place material in all aspects as closely as possible. Existing materials are those which are visible in whole or in part in the building.

B. Match Original: Provide new materials to match the original material in all aspects as closely as possible. Original materials are those which were originally installed in the building at the time of its completion, prior to previous alterations, and which may predate existing materials.

C. Preservation: The act or process of applying measures necessary to sustain the existing form, integrity, and materials of an historic property.

D. Reconstruction: The act or process of reproducing, by means of new construction, the form, features, and detailing of a non-surviving building, structure, or object for the purpose of replicating its appearance at a specific period of time and in its historic location.

E. Restoration: The act or process of accurately depicting the form, features, and character as it appeared at a particular time by means of the removal of features from other periods in its history and reconstruction of missing features from the restoration period.

F. Salvage: The act or process of removing a building element or portion thereof, protecting it, documenting the location from which it was removed, packing for storage, and delivery to the Owner where applicable.

1.3 QUALITY ASSURANCE

A. Historic Significance:
1. Originally constructed in 1888, the Fannin County Courthouse, located in Bonham, Texas is a Recorded Texas Historic Landmark. This project is authorized under the Historic Courthouse Preservation Program, Texas Government Code §§442.008, et seq. (“Program”), and the rules promulgated thereunder at 13 Texas Administrative Code §§12.1, et seq., and the Interlocal Cooperation Act, Government Code Chapter 791. All matters pertaining to the Project shall be conducted in conformance with the procedures described in the Texas Historic Courthouse Preservation Program Round IX Grant Manual, all applicable state and federal laws, rules and regulations and the legal directives of the Commission and its staff.

2. The Secretary of the Interior’s Standards for the Treatment of Historic Properties apply to this project. The Texas Historic Commission considers this project a Restoration Treatment. The Scope of Work must comply with the Standards for Restoration.

3. For this project to demonstrate that it will preserve and restore the historic integrity of the Fannin County Courthouse the project delivery documents must show THC that no historic building materials, features, and spatial relationships that characterize the building during

its period of significance will be unnecessarily removed, demolished or altered in this project. All character defining features of the building that will be removed during the project must be documented, stored and maintained for possible reinstallation in the future.

B. Restoration Procedures:
1. Preserve original materials, finishes, and profiles.
2. Blend new and original work to provide smooth transitions and uniform appearance.
3. Cease work, notify Owner and Architect, and await instructions if materials or conditions encountered at the site are not as indicated by the Contract Documents or if structure is in danger of movement or collapse.

C. Historic Artifacts: If artifacts of a historic nature are encountered during the Work:
1. Cease work in the affected area immediately.
2. Protect artifacts from damage.
3. Notify Owner and Architect and await instructions.
4. Salvage or dispose of artifacts as directed by the Owner.

PART 2 PRODUCTS

2.1 MATERIALS

A. New Materials:
1. Provide new materials to match original adjacent materials or original materials for closing of openings, repairs, and reconstructions where suitable salvaged materials do not exist, are insufficient in quantity, or where reuse is not permitted.
2. Retain samples of original materials on site for comparison purposes.
3. Match original materials in material, type, size, quality, color, finish, and other attributes.

B. Reused Materials:
1. Clean and prepare salvaged materials for reuse.
2. Do not use materials with objectionable chips, cracks, splits, dents, scratches, or other defects.
3. Repair operable items to function properly.

PART 3 EXECUTION

3.1 PREPARATION

A. Test materials to be used in repairs for compatibility with existing original materials; do not use incompatible materials.

B. Cut, move, or remove items to provide access for alterations and restoration work. Replace and restore upon completion.

C. Protect original materials and surfaces from damage by construction operations.

3.2 ALTERATIONS

A. Coordinate alterations and renovations to expedite completion.

B. Minimize damage to original materials and surfaces; provide means for restoring products and finishes to their original or specified new condition.

C. Remove unsuitable materials not marked for salvage.

D. Remove debris and abandoned items from areas of work and from concealed spaces.

E. Refinish visible surfaces to specified condition, with neat transition to adjacent surfaces.

F. Install products and finish surfaces as specified in individual sections, or where no specification section exists, to match original.

G. Finish patches to provide uniform color and texture over entire surface, with repairs not discernible from normal viewing distance. If finish cannot be matched, refinish entire surface to nearest intersections.

H. Rework finished surfaces to smooth plane, without breaks, steps, or bulkheads:

1. Where new work abuts or aligns with existing, provide smooth and even transition.
2. Where a change in plane of 1/4 inch or more occurs, submit recommendation to Architect for transition.

I. Where alterations expose mechanical and electrical components which were previously concealed, rework to be concealed in completed work.

3.3 HAZARDOUS MATERIAL PROCEDURES

A. If hazardous or suspected hazardous materials are encountered:
1. Stop work in affected area immediately.
2. Notify Owner and Architect and await instructions.
3. Prevent damage to materials.
4. Prevent human contact.
5. Owner will arrange for abatement or removal of hazardous materials under a separate contract.

END OF SECTION

SECTION 01 3592

ART CONSERVATOR

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Qualifications, duties, and responsibilities of Art Conservator.
2. Submittals.

B. Related Sections:
1. Section 09 9100 - Painting.

1.2 REFERENCES

A. American Institute for Conservation of Historic and Artistic Works (AIC) - Code of Ethics and Guidelines for Practice.

1.3 QUALIFICATIONS

A. Art Conservator:
1. Regularly engaged in the conservation and restoration of artwork for the previous 10 years.
2. Fellow or Professional Associate of AIC.

1.4 ART CONSERVATOR DUTIES AND RESPONSIBILITIES

A. During Construction:
1. Perform additional paint discovery as directed by THC Representative.
2. Supervise restoration of historic paint on salvaged vault doors.

B. Ensure that proper materials and procedures are being used.

C. Supervise procedures for protection of existing improvements prior to, during, and after restoration, including temporary covers.

D. Document materials and procedures before, during, and after restoration.

E. Perform material testing and analysis.

1.5 SUBMITTALS

A. Art Conservator Qualifications:
1. Brief narrative describing firm's or individual's background and experience in conservation of similar components.
2. Project list with name, location, and contact person with telephone numbers.
3. Minimum of three letters of recommendation from individuals directly involved in the review and oversight of listed projects.
4. Complete resumes for individuals that will perform work.
5. Photocopies of licenses and certificates.

B. Condition Report and Conservation Treatment Plan (CRCTP):
1. Develop a detailed CRCTP for each component to be restored.
2. Contract Documents establish minimum requirements for materials and procedures to be used.
3. Photographically document each condition with 35 mm slides and black and white prints. Indicate existing conditions prior to start of work and completed work.
4. Submit complete CRCTP within 30 days after a Notice to Proceed is issued.
5. Obtain Owner and Architect approval prior to beginning work.
6. Maintain one copy of approved CRCTP on site; identify changes and field conditions encountered during the progress of the work.
7. Submit one copy each for Owner's and Architect's use plus additional copies as Conservator and Construction Manager require.

C. Final Condition Report and Conservation Treatment Plan (FCRCTP):

1. Use approved CRCTP as a basis for preparing the FCRCTP. Update and expand to indicate actual material and procedures used and conditions encountered during the work.
2. Include copies of:
   a. Approved Shop Drawings, Product Data, and Samples.
   b. Change Orders and Supplemental Instructions.
   c. Product substitution requests.
3. Identify:
   a. Product name by manufacturer and trade name.
   b. Changes in product application or installation.
   c. Concealed conditions.
4. Document work in progress by written description and 8 x 10 inch color photographs.
5. For each material, product, and component, identify as applicable:
   a. Ambient and substrate conditions including temperature and humidity.
   b. Product dilutions and application methods.
   c. Equipment used, delivery rates, pressures, temperatures, and results.
   d. Batch mixing and bulk delivery records.
   e. Field samples and mockups prepared and approvals received.
   f. Testing and qualifications of trade personnel involved.
   g. Inspections and certifications by governing authorities.
   h. Final inspection and correction procedures.
6. Submit one original and three copies.

1.6 QUALITY ASSURANCE

A. Art Conservator: Comply with AIC Code of Ethics and Guidelines for Practice.

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

Not used

END OF SECTION

SECTION 01 4000

QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. References.
2. Quality assurance and control of installation.
3. Mockups.
4. Manufacturer's field services and reports.
5. Design data and calculations.
6. Test reports and certifications.
7. Manufacturer's installation instructions.
8. Qualification Statements.

B. Related Sections:
1. Document 01 4001 - Qualification Statement Form.

1.2 REFERENCES

A. For products or workmanship specified by reference to association, trade, or industry standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. Should specified reference standards conflict with Contract Documents, request clarification from Architect before proceeding.

C. Conform to edition of reference standard in effect as of date of Owner / Contractor Agreement.

D. The contractual relationship of the parties to the Contract shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.3 QUALITY ASSURANCE AND CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, Products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply fully with manufacturers' instructions, including each step in sequence.

C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.

D. Comply with specified standards as a minimum quality for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Perform work by persons qualified to produce workmanship of specified quality.

F. Secure Products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement.

1.4 MOCKUPS

A. Definition:
1. Mockups are field samples constructed, applied, or assembled at the project site for review by the Owner and Architect that illustrate materials, equipment, or workmanship.
2. Approved mockups establish the standard of quality by which the Work will be judged.

B. Construct, apply, or assemble specified items, with related attachment and anchorage devices, flashings, seals, and finishes.

C. Perform work in accordance with applicable specifications sections.

D. Erect at project site at location acceptable to Architect. Protect from damage.

E. Removal:
   1. Mockups may remain as part of the Work only when so designated in individual specification sections.
   2. Do not remove mockups until removal is approved by Architect or upon Final Completion.
   3. Where mockup is not permitted to remain as part of the Work, clear area after removal of mockup has been approved by Architect.

1.5 MANUFACTURERS' FIELD SERVICES AND REPORTS

A. When specified in individual specification Sections, require material or Product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, or startup of equipment, as applicable, and to initiate instructions when necessary.

B. Individuals to report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

C. Submit electronically in Adobe PDF format within 10 days after each observation.

1.6 DESIGN DATA AND CALCULATIONS

A. When specified in individual specification Sections, require material or Product suppliers or manufacturers to provide design data and calculations.

B. Accuracy of design data and calculations is the responsibility of the Contractor.

C. When so specified, prepare design data and calculations under the direction of a professional engineer licensed in the state in which the Project is located. Affix engineer’s seal to submittals.

D. Submit electronically in Adobe PDF format.

1.7 TEST REPORTS AND CERTIFICATIONS

A. When specified in individual specification Sections, require material or Product suppliers or manufacturers to provide test reports and manufacturers’ certifications.

B. Indicate that material or Product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

C. Submittals may be recent or previous test results on material or Product, but must be acceptable to Architect.

D. Submit electronically in Adobe PDF format.

1.8 MANUFACTURER'S INSTALLATION INSTRUCTIONS

A. When Contract Documents require that Products be installed in accordance with manufacturer's instructions:
   1. Submit manufacturer's most recent printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, as applicable.
      a. Submit in quantities specified for Product Data.
      b. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.
      c. Identify conflicts between manufacturers' instructions and requirements of Contract Documents.
   2. Perform installation of Products to comply with requirements of manufacturer's instructions.
   3. If installation cannot be performed in accordance with manufacturer's instructions, notify Architect and await instructions.
   4. Submit electronically in Adobe PDF format.

1.9 QUALIFICATION STATEMENTS

A. Where individual specification sections require submittal of a Qualification Statement from Subcontractor, submit on copies of document included in Document 01 4001.

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

Not used

END OF SECTION

SECTION 01 4001

HISTORIC PRESERVATION
QUALIFICATION STATEMENT FORM

Originally constructed in 1888, the Fannin County Courthouse, located in Bonham, Texas is a Recorded Texas Historic Landmark. This project is authorized under the Historic Courthouse Preservation Program, Texas Government Code §§442.008, et seq. ("Program"), and the rules promulgated thereunder at 13 Texas Administrative Code §§12.1, et seq., and the Interlocal Cooperation Act, Government Code Chapter 791. All matters pertaining to the Project shall be conducted in conformance with the procedures described in the Texas Historic Courthouse Preservation Program Round IX Grant Manual, all applicable state and federal laws, rules and regulations and the legal directives of the Commission and its staff.

The Secretary of the Interior's Standards for the Treatment of Historic Properties apply to this project. The Texas Historic Commission considers this project a Restoration Treatment. The Scope of Work must comply with the Standards for Restoration.

For this project to demonstrate that it will preserve and restore the historic integrity of the Fannin County Courthouse the project delivery documents must show THC that no historic building materials, features, and spatial relationships that characterize the building during its period of significance will be unnecessarily removed, demolished or altered in this project. All character defining features of the building that will be removed during the project must be documented, stored and maintained for possible reinstallation in the future.

Due to the historic significance of the building, the contractor and selected subcontractors and their craftsmen will be subject to pre-qualification to assure that they have satisfactory previous experience and appropriate skills in the restoration of historic structures.

Pre-qualification is required for the following work sections:

Section 03 0330 – Concrete Restoration and Cleaning

Section 04 0341 – Restoration Mortar

Section 04 0342 – Masonry Restoration

Section 04 0344 – Masonry Cleaning

Section 05 7000 – Ornamental Metals

Section 06 4000 – Architectural Woodwork

Section 06 4600 – Wood Trim

Section 07 3116 – Metal Shingles

Section 07 6300 – Aluminum Cornice

Section 07 6400 – Aluminum Dormers

Section 08 0386 – Vault Door Restoration

Section 09 2300 – Gypsum Plaster

Section 09 6400 – Wood Flooring

Section 09 6516 – Resilient Sheet Flooring

Section 09 9100 - Painting

Section 10 7429 – Historic Cupola Clock Tower

Prospective subcontractors or general contractors intending to submit bids for the work of these sections must submit:

Three completed Historic Preservation Qualification Forms listing three successfully completed projects demonstrating appropriate experience in the work of relevant specification sections. Three forms should be submitted for each specification section requiring prequalification.

HISTORIC PRESERVATION QUALIFICATION FORM

The form must be completed by all contractors or subcontractors who wish to be prequalified for work sections noted on previous page. The form must be entirely filled in and all requested information must be provided. **Complete one of these forms for each of three different projects. Use a separate page for each project listed.**

Specification Section: _____

Company Name: _____

Listed project must have been completed within the last 5 years and be comparable in scale and type of work to be performed.

Name of Project: _____

Project Location: _____

Project Architect: (Name) _____

(Phone)_____

Project Owner: (Name) _____

(Phone)_____

Date of Construction: _____

Value of Contract: _____

Brief Work Description: _____

_____

_____

Project Personnel: (Name) _____

(Title) _____

(Name) _____

(Title) _____

END OF SECTION

SECTION 01 4523

TESTING AND INSPECTION SERVICES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Laboratory selection and payment.
2. Laboratory duties.
3. Contractor's responsibilities.

B. Related Sections: Individual specifications sections contain specific tests and inspections to be performed.

1.2 REFERENCES

A. ASTM International (ASTM):
1. C1077 - Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.
2. D3666 - Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials.
3. D3740 - Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
4. E329 - Standard Specification for Agencies Engaged in Construction Inspection and/or Testing.
5. E543 - Standard Specification for Agencies Performing Nondestructive Testing.

1.3 QUALITY ASSURANCE

A. Owner will employ and pay for services of an independent testing laboratory to perform specified testing and inspection.

B. Contractor shall cooperate with the Testing Laboratory to facilitate performance of its work.

C. Refer to the Conditions of the Contract for provisions related to special inspections and testing.

D. Qualifications of Laboratory:
1. Meet requirements of ASTM C1077, D3666, D3740, E329, and E543.
2. Authorized to operate in State in which project is located.

1.4 LABORATORY DUTIES

A. Cooperate with Architect and Contractor; provide qualified personnel after due notice.

B. Perform specified inspections, sampling, and testing of materials and methods of construction:
1. Comply with specified standards.
2. Ascertain compliance or noncompliance of materials with requirements of Contract Documents.

C. Promptly notify Architect and Contractor of observed irregularities or deficiencies of Work or products.

D. Promptly submit report of each test and inspection; submit electronically in Adobe PDF format to Architect and Contractor.

E. Each report shall include:
1. Date issued.
2. Project title and number.
3. Testing Laboratory name, address, and telephone number.
4. Name of Inspector and signature of individual in charge.
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 project.
10. Type of inspection or test.

11. Results of tests and compliance or noncompliance with Contract Documents.
12. Interpretation of test results when requested by Architect or Contractor.

F. Perform additional tests when required by Architect or General Contractor.

G. Laboratory 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 any duties of General Contractor.

1.5 CONTRACTOR'S RESPONSIBILITIES

A. Cooperate with Laboratory personnel, provide access to Work, and to manufacturer's operations.

B. When materials require testing prior to being incorporated into Work, secure and deliver to Laboratory adequate quantities of representative samples of materials proposed to be used.

C. Furnish copies of product test reports as required.

D. Furnish incidental labor and facilities:
1. To provide access to work to be tested.
2. To obtain and handle samples at site or at source of product to be tested.
3. To facilitate inspections and tests.
4. For safe storage and curing of test samples.

E. Notify Laboratory sufficiently in advance of operations to allow for Laboratory assignment of personnel and scheduling of tests.

F. When tests or inspections cannot be performed after such notice, reimburse Owner for Laboratory personnel and travel expenses incurred due to General Contractor's negligence.

G. Make arrangements with Laboratory and pay for additional samples and tests required for Contractor's convenience.

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

Not used

END OF SECTION

SECTION 01 5000

TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Temporary utilities.
2. Field offices and sheds.
3. Temporary controls.
4. Protection of installed Work.
5. Security.
6. Progress cleaning.
7. Water, erosion, sediment, dust, and mold and mildew control.
8. Removal.

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

3.1 TEMPORARY ELECTRICITY

A. Provide temporary electrical service of capacity and characteristics required for construction.

B. Provide power outlets for construction operations, with branch wiring and distribution boxes located as required. Provide flexible power cords as required.

C. Maintain distribution system and provide routine repairs.

3.2 TEMPORARY LIGHTING

A. Provide temporary lighting for construction and security purposes.

B. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps as required.

C. Maintain lamps and provide routine repairs.

D. Provide portable lights when required to provide minimum lighting levels necessary for specific work.

3.3 TEMPORARY HEAT

A. Provide temporary heating devices required to maintain specified ambient temperatures for construction.

B. Maintain minimum ambient temperature of 50 degrees F in areas where construction is in progress, unless otherwise indicated in individual specification sections.

3.4 TEMPORARY VENTILATION

A. Ventilate enclosed areas to facilitate curing of materials, disperse humidity, and prevent accumulations of dust, fumes, vapors, or gases.

B. Provide temporary fan units as required to maintain clean air for construction.

3.5 TEMPORARY TELEPHONE AND COMPUTER SERVICES

A. Provide temporary telephone service required during construction.

B. Provide computer in Contractor’s field office with printer, Internet access, scanner, and email service.

3.6 TEMPORARY WATER

A. Provide temporary water required for construction.

B. Extend branch piping and provide temporary hoses so that water is available at locations needed for work.

C. Protect from freezing.

D. Maintain distribution system and provide routine repairs.

3.7 TEMPORARY SANITARY FACILITIES

A. Provide chemical toilets for use during construction.

B. Permanent toilets may not be used during construction.

C. Maintain facilities in clean and sanitary condition.

3.8 FIELD OFFICES AND SHEDS

A. Provide temporary field offices and storage sheds required for construction.

B. Do not unreasonably encumber site or premises with excess materials or equipment.

C. Temporary Structures:
1. Portable or mobile buildings, structurally sound, weathertight, with floors raised above ground.
2. Thermal transmission resistance: Compatible with occupancy and storage requirements.
3. Provide connections for utility services when required.
4. Provide steps and landings at entrances.

D. Field Office:
1. Size required for Construction Manager's use and to provide space for project meetings.
2. Adequate electrical power, lighting, heating, and cooling to maintain human comfort.
3. Provide facilities for storage of Project Record Documents.
4. Provide thermometer mounted at convenient outside location, not in direct sunlight.

3.9 BARRIERS

A. Provide barriers to prevent unauthorized entry to construction areas and to protect existing facilities and adjacent properties from construction operations.

B. Provide barricades required by governing authorities for public right-of-ways.

C. Fencing:
1. Provide temporary fencing for construction operations.
2. Construction: Commercial grade chain link.
3. Height: 6 feet.
4. Locate to protect construction operations, materials, and equipment.
5. Provide vehicular gates.

D. Tree and Plant Protection:
1. Protect existing trees and plants at site that are designated to remain.
2. Employ qualified tree surgeon to remove roots and branches that interfere with construction.
3. Provide temporary barriers to height of 6 feet around individual or groups of trees and plants.
4. Do not permit vehicular traffic, parking, storage of materials, dumping of harmful chemicals or liquids, or standing or continuously running water within root zones.
5. Supervise earthwork operations to prevent damage to root zones.
6. Replace trees and plants that are damaged or destroyed due to construction operations.

3.10 EXTERIOR CLOSURES

A. Provide temporary weathertight closures for exterior openings to provide acceptable interior working conditions, to allow for temporary heating and maintenance of ambient temperatures required in individual specification sections, to protect the Work, and to prevent entry of unauthorized persons.

B. Provide access doors with locking hardware.

C. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction. Provide protective covered enclosure over path of egress to secured entry at north stair during construction.

3.11 PROTECTION OF INSTALLED WORK

A. Protect installed work from construction operations; provide special protection when required in individual specification sections.

B. Minimize traffic, storage, and construction activities on roof surfaces. If traffic, storage, or activity is necessary, obtain recommendations for protection from roofing manufacturer.

C. Prohibit traffic from landscaped areas.

3.12 PROGRESS CLEANING

A. Maintain areas free from waste materials, debris, and rubbish. Maintain site in clean and orderly condition.

B. Provide containers for collection of waste materials, debris, and rubbish; remove and dispose of off site as required by construction activities.

C. Periodically clean interior areas to provide suitable conditions for finish work.

3.13 TEMPORARY CONTROLS

A. Water Control:
1. Grade site to drain. Prevent puddling water.
2. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
3. Provide water barriers to protect site from soil erosion.

B. Erosion and Sediment Control:
1. Plan and execute methods to control surface drainage from cuts, fills, borrow areas, and waste disposal areas. Prevent erosion and sedimentation.
2. Minimize amount of bare soil exposed at any one time.
3. Provide temporary measures such as silt fences, dikes, berms, settlement basins, and drainage systems to prevent water flow and sedimentation.
4. Periodically inspect earthwork to detect erosion and sedimentation; promptly employ corrective measures.

C. Dust Control:
1. Provide dust control materials and methods to minimize dust from construction operations.
2. Prevent dust from dispersing into atmosphere.

D. Mold and Mildew Control:
1. Provide continuous measures to prevent formation of mold and mildew in construction.
2. Do not install materials sensitive to mold and mildew growth until protection can be provided.
3. Promptly remove and replace materials exhibiting mold and mildew growth.

3.14 REMOVAL

A. Remove temporary utilities, equipment, facilities, and services when construction needs can be met by use of permanent construction or upon completion of Project.

B. Remove foundations and underground installations; grade site as indicated.

C. Clean and repair damage caused by installation or use of temporary work.

D. Restore existing and permanent facilities used during construction to original or to specified condition.

END OF SECTION

SECTION 01 5800

PROJECT IDENTIFICATION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Project identification sign.
2. Maintenance and removal.

1.2 QUALITY ASSURANCE

A. Project Sign:
1. Design sign and structure to withstand 50 MPH wind velocity.
2. Sign Painter: Experienced as a professional sign painter for minimum 3 years.
3. Finishes, Painting: Adequate to withstand weathering, fading, and chipping for duration of construction.

B. Do not erect other signs at site without Owner's approval, except those required by governing authorities.

1.3 SUBMITTALS

A. Submittals for Review:
1. Shop Drawings: Show content, layout, lettering, colors, structure, sizes, and grades of members.
2. Samples: 3 x 3 inch samples of each paint color.

PART 2 PRODUCTS

2.1 MATERIALS

A. Structure and Framing: New lumber, structurally adequate.

B. Sign Surfaces: Exterior grade plywood with medium density overlay, nominally 3/4 inch thick, standard large sizes to minimize joints.

C. Rough Hardware: Galvanized steel or aluminum.

D. Paints: Alkyd type, exterior quality, semigloss sheen.

2.2 FABRICATION

A. Provide one sign of following design:
1. Area: 32 square feet.
2. Bottom edge of sign: 6 feet above ground.
3. Content:
a. Project title.
b. Owner's name.
c. Names and titles of Architect and Consultants.
d. Name of Contractor.
4. Graphic design, colors, and lettering style: As designated by Architect.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install project identification sign within 30 days after date of Notice to Proceed.

B. Erect at designated location.

C. Erect supports and framing on secure foundation, rigidly braced and framed to resist wind loadings.

D. Install sign surface plumb and level, with butt joints. Anchor securely.

E. Paint exposed surfaces of sign, supports, and framing.

3.2 MAINTENANCE

A. Maintain signs and supports clean. Repair deterioration and damage.

3.3 REMOVAL

A. Remove signs, framing, supports, and foundations at completion of Project and restore the area.

END OF SECTION

Specifications for County Courthouse Signage

TEXAS HISTORICAL COMMISSION

Texas Historic Courthouse Preservation Program

A Partnership for the Restoration of the

Sample County Courthouse

County Judge: John R. Doe
County Commissioners:
John S. Doe • John Doe
Jane Ann Doe • John F. Doe
CHC Chair: John M. Doe

Architect: Name of Firm Goes Here
Structural Engineer: Name of Firm Goes Here
MEP Engineer: Name Goes Here

General Contractor: Name Goes Here

TEXAS HISTORICAL COMMISSION
real places telling real stories

SCALE: 1" = 1'

FINISHED SIZE:
4' x 8'

BACKGROUND:
White

COLORS:
PMS 193
PMS Warm Gray 11
Black
(or equivalent vinyl color)

PHOTO OR ILLUSTRATION:
Grayscale

SANS SERIF FONTS:
Gotham Bold
Helvetica Bold

SERIF FONTS:
Adobe Garamond Pro Semibold
Adobe Garamond Pro Bold Italic

FOR MORE INFORMATION:
Please contact the Marketing Communications Division of the Texas Historical Commission at 512.463.6255.

SECTION 01 6000

PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Products.
2. Transportation and handling.
3. Storage and protection.
4. Reuse of existing materials.
5. Product options.

B. Related Sections:
1. Section 01 2500 - Substitution Procedures.

1.2 PRODUCTS

A. Provide interchangeable components by the same manufacturer for identical items.

B. Do not use products containing asbestos or other known hazardous materials.

C. Do not reuse materials and equipment removed from existing construction in completed Work, except as specifically permitted by the Contract Documents.

1.3 TRANSPORTATION AND HANDLING

A. Coordinate delivery of Products to prevent conflict with Work and adverse conditions at site.

B. Transport and handle Products in accordance with manufacturer's instructions.

C. Promptly inspect shipments to ensure that Products comply with requirements of Contract Documents, are undamaged, and quantities are correct.

D. Provide equipment and personnel to handle products by methods to prevent damage.

1.4 STORAGE AND PROTECTION

A. Store and protect Products in accordance with manufacturer's instructions with manufacturer's seals and labels intact and legible.

B. Store Products on site unless prior written approval to store off site has been obtained from Owner.

C. Store Products subject to damage by elements in weathertight enclosures. Maintain temperature and humidity within ranges required by manufacturer's instructions.

D. Exterior Storage:
1. Store fabricated Products above ground; prevent soiling and staining.
2. Cover products subject to deterioration with impervious sheet coverings; provide ventilation to prevent condensation.
3. Store loose granular materials in well drained area on solid surfaces; prevent mixing with foreign matter.

E. Arrange storage areas to permit access for inspection. Periodically inspect stored products to verify that products are undamaged and in acceptable condition.

1.5 REUSE OF EXISTING MATERIALS

A. Carefully remove, handle, protect, and store Products.

B. Clean and refinish Products to original or specified condition.

C. Restore operable components to working condition.

D. Arrange and pay for transportation, storage, and handling of Products requiring off site storage, restoration, or renovation.

1.6 PRODUCT OPTIONS

A. Products specified by reference standard only:
   1. Select any Product meeting the specified standard.
   2. Submit Product Data to substantiate compliance of proposed Product with specified requirements.

B. Products specified by naming two or more acceptable Products: Select any named Product.

C. Products specified by stating that the Contract Documents are based on a Product by a single manufacturer followed by the statement "Equivalent products by the following manufacturers are acceptable":
   1. Select the specified Product or a Product by a named manufacturer having equivalent or superior characteristics to the specified Product and meeting the requirements of the Contract Documents.
   2. If the specified Product is not selected, submit Product Data to substantiate compliance of proposed Product with specified requirements.
   3. The specified Product establishes the required standard of quality.

D. Products specified by naming one or more Products followed by "or approved substitute" or similar statement:
   1. Submit a substitution request under provisions of Section 01 2500 for Products not listed.
   2. The specified Product establishes the required standard of quality.

E. Products specified by naming one or more Products or manufacturers followed by the statement "Substitutions: Under provisions of Division 01":
   1. Submit a substitution request under provisions of Section 01 2500 for Products not listed.
   2. The specified Product establishes the required standard of quality.

F. Products specified by naming one Product followed by the statement "Substitutions: Not permitted": Substitutions will not be allowed.

G. Products specified by required performance or attributes, without naming a manufacturer or Product:
   1. Select any Product meeting specified requirements.
   2. Submit Product Data to substantiate compliance of proposed Product with specified requirements.

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

Not used

END OF SECTION

SECTION 01 7123

FIELD ENGINEERING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Survey and field engineering.
   2. Submittals.
   3. Records.

B. Provide and pay for field engineering services required for the Project:
   1. Survey work required in execution of the Work.
   2. Other professional engineering services specified or required to execute Contractor's construction methods.

1.2 QUALIFICATIONS

A. Surveyor: Qualified land surveyor, licensed in the State in which project is located.

1.3 SUBMITTALS

A. Submit documentation to verify accuracy of field engineering work upon Architect's request.

B. Submit certification that elevations and locations of improvements are in conformance with Contract Documents.

1.4 SURVEY REFERENCE POINTS

A. Existing horizontal and vertical control points for project are those designated on Drawings.

B. Locate, verify, and protect control points prior to beginning Work; preserve permanent reference points during construction.

1.5 PROJECT SURVEY REQUIREMENTS

A. Establish minimum of two permanent bench marks on site, referenced to survey control points. Record locations on Project Record Documents.

B. Establish lines and levels, locate and lay out, by instrumentation:
   1. Site improvements:
      a) Stakes for grading, fill, and topsoil placement.
      b) Utility slopes and invert elevations.
   2. Building foundation and column locations, floor elevations, and other controlling dimensions.
   3. Controlling lines and levels required for mechanical and electrical trades.

C. Verify property corners, easements, building setbacks, and horizontal control dimensions with information contained in Contract Documents.

D. Properly notify Architect of any errors or discrepancies noted; await instructions prior to proceeding with Work.

1.6 RECORDS

A. Maintain accurate log of control and survey work.

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

Not used

END OF SECTION

SECTION 01 7329

CUTTING AND PATCHING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Requirements and limitations for cutting and patching of work.

B. Related sections:
   1. Section 01 2500 - Substitution Procedures.

1.2 SUBMITTALS

A. Submit written request in advance of executing cutting or alteration that affects:
   1. Work of Owner or separate contractor.
   2. Structural integrity of project.
   3. Integrity or effectiveness of weather exposed or moisture resistant elements or systems.
   4. Efficiency, operational life, maintenance, or safety of operational elements.
   5. Visual qualities of sight exposed elements.

B. Include in Request:
   1. Identification of project.
   2. Description of work affected.
   3. Necessity for cutting or patching.
   4. Effect of cutting or patching on work of Owner or separate contractor, or on structural, weatherproof, or visual integrity of project.
   5. Description of proposed work:
      a. Scope of cutting and patching.
      b. Subcontractor and trades to execute work.
      c. Products proposed to be used.
      d. Extent of refinishing.
   6. Alternate to cutting and patching.
   7. Cost proposal, if applicable.
   8. Written permission of any separate contractor whose work will be affected.
   9. Written approval from Architect and THC representative

C. If conditions of work or schedule necessitate a change of material from that originally installed, submit substitution request in accordance with Section 01 2500.

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

3.1 PREPARATION

A. Examine existing conditions of work, including elements subject to movement or damage during cutting and patching.

B. After uncovering work, examine conditions affecting installation of new products or performance of work.

C. Provide protection for other portions of project.

D. Provide protection from elements.

3.2 CUTTING AND PATCHING

A. Execute cutting to include excavating, fitting, and patching of Work required to:

1. Make several parts fit properly.
2. Uncover work to provide for installation of ill timed work.
3. Remove and replace defective work.
4. Remove and replace work not conforming to requirements of Contract Documents.
5. Provide routine penetrations of nonstructural surfaces for installation of piping and electrical conduit.

B. Execute fitting and adjustment of products to provide finished installation to comply with specified tolerances, and finishes.

C. Execute cutting and demolition by methods that will prevent damage to other work, and will provide proper surfaces to receive installation of repairs and new work.

D. Execute excavating and backfilling by methods that will prevent damage to other Work, and will prevent settlement.

E. Employ original installer or fabricator to perform cutting and patching for:
1. Weather exposed or moisture resistant elements.
2. Sight exposed finished surfaces.

F. Restore work that has been cut or removed; install new products to provide completed Work in accordance with requirements of Contract Documents.

G. Refinish entire surfaces as necessary to provide an even finish:
1. Continuous surfaces: To nearest intersections.
2. Assembly: Refinish entirely.

END OF SECTION

SECTION 01 7700

CLOSEOUT PROCEDURES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Closeout procedures.
2. Final cleaning.
3. Adjusting.
4. Project record documents.
5. Operation and maintenance data.
6. Warranties.
7. Spare parts and maintenance materials.
8. Starting of systems.
9. Demonstration and instructions.

1.2 CLOSEOUT PROCEDURES

A. Substantial Completion:
1. Submit written certification that the Work is substantially complete in accordance with Contract Documents and is ready for inspection by Architect and THC representative. Include a comprehensive list of items to be completed prior to final payment.
2. Upon receipt of written certification and comprehensive list of items to be completed, the Architect and THC representative will make an inspection to determine whether the Work is substantially complete.
3. If Architect performs re-inspection due to failure of Work to comply with claims of status of completion made by Contractor, Owner will compensate Architect for such additional services and will deduct the amount of such compensation from final payment to Construction Manager.
4. When the Work or designated portion thereof is substantially complete, the Architect will prepare a Certificate of Substantial Completion that shall establish the date of Substantial Completion and establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance, and shall fix the time within which the Construction Manager shall finish all items on the list accompanying the Certificate. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.
5. The Certificate of Substantial Completion shall be submitted to the Owner and Construction Manager for their written acceptance of responsibilities assigned to them in such Certificate. Upon such acceptance and consent of surety, if any, the Owner shall make payment of retainage applying to such Work or designated portion thereof. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

B. Final Inspection:
1. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with the Contract Documents and ready for inspection by Architect and THC representative.
2. If Architect performs re-inspection due to failure of Work to comply with claims of status of completion made by Contractor, Owner will compensate Architect for such additional services and will deduct the amount of such compensation from final payment to Contractor.

C. Submit final Application for Payment showing original Contract Sum, adjustments, previous payments, retainage withheld from previous payments, and sum remaining due.

D. Closeout Submittals:
1. Evidence of compliance with requirements of governing authorities.
2. Certificate of Occupancy.
3. Project Record Documents.
4. Operation and Maintenance Data
5. Maintenance Manual for actual equipment, materials and finishes provided that includes recommended service frequency requirements and life expectancy estimates of equipment and systems.
6. Warranties.

7. Keys and keying schedule.
8. Spare parts and maintenance materials.
9. Evidence of payment of Subcontractors and suppliers.
10. Final lien waiver.
11. Certificate of insurance for products and completed operations.
12. Consent of Surety to final payment.

1.3 FINAL CLEANING

A. Execute final cleaning prior to final inspection.

B. Clean surfaces exposed to view:
1. Clean glass.
2. Remove temporary labels, stains and foreign substances.
3. Polish transparent and glossy surfaces.
4. Vacuum carpeted surfaces; damp mop hard surface flooring.

C. Clean equipment and fixtures to a sanitary condition.

D. Clean or replace filters of operating equipment.

E. Clean debris from roofs and drainage systems.

F. Clean site; sweep paved areas, rake clean landscaped surfaces.

G. Remove waste and surplus materials, rubbish, and construction facilities from the site.

1.4 ADJUSTING

A. Adjust operating Products and equipment to ensure smooth and unhindered operation.

1.5 PROJECT RECORD DOCUMENTS

A. Maintain following record documents on site; record actual revisions to the Work:
1. Drawings.
2. Specifications.
3. Addenda.
4. Change Orders and other Modifications to the Contract.
5. Reviewed Shop Drawings, Product Data, and Samples.
6. Material Safety Data Sheets.

B. Store Record Documents separate from documents used for construction.

C. Record information concurrent with construction progress.

D. Make entries neatly and accurately.

E. Label each set or volume with "PROJECT RECORD DOCUMENTS", project title, and description of contents.
1. Organize contents according to Project Manual table of Contents.
2. Provide table of contents for each volume.

F. Drawings: Mark each item to record actual construction including:
1. Measured depths of foundations in relation to finish floor datum.
2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
4. Field changes of dimension and detail.
5. Details not on original Drawings.

G. Specifications: Mark each Product section description of actual Products installed, including the following:
1. Manufacturer's name and product model and number.
2. Product substitutions or alternates utilized.
3. Changes made by Addenda and Modifications.

H. Shop Drawings: Mark each item to record actual construction including:
   1. Field changes of dimension and detail.
   2. Details not on original Shop Drawings.

I. Submission Requirements:
   1. One half size set of drawing to be included in Completion Report
   2. One full size set for THC archives
   3. Electronic files in Adobe PDF format along with final Application for Payment.

1.6 OPERATION AND MAINTENANCE DATA

A. Identify as "OPERATION AND MAINTENANCE INSTRUCTIONS" and title of project.

B. Contents:
   1. Directory: List names, addresses, and telephone numbers of Architect, Construction Manager, Subcontractors, and major equipment suppliers.
   2. Operation and maintenance instructions: Arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
      a. Significant design criteria.
      b. List of equipment.
      c. Parts list for each component.
      d. Operating instructions.
      e. Maintenance instructions for equipment and systems.
      f. Maintenance instructions for special finishes, including recommended cleaning methods and materials and special precautions identifying detrimental agents.
   3. Project documents and certificates including:
      a. Shop drawings and product data.
      b. Air and water balance reports.
      c. Certificates.
      d. Copies of warranties and bonds.

C. Submittal:
   1. Submit electronically in Adobe PDF format at least 15 days prior to final inspection.
   2. Architect will notify Construction Manager of any required revisions after final inspection.
   3. Revise content of documents as required prior to final submittal.
   4. Submit revised documents electronically in Adobe PDF format within 10 days after final inspection.

1.7 WARRANTIES

A. Execute and assemble documents from Subcontractors, suppliers, and manufacturers.

B. Include Table of Contents.

C. Submit electronically in Adobe PDF format along with final Application for Payment.

D. For items of Work delayed beyond date of Substantial Completion, provide updated submittal within 10 days after acceptance, listing date of acceptance as start of warranty period.

1.8 SPARE PARTS AND MAINTENANCE MATERIALS

A. Provide products, spare parts, maintenance and extra materials in quantities specified in individual specification Sections.

B. Deliver to Project site in location as directed; obtain receipt prior to final payment.

1.9 STARTING OF SYSTEMS

A. Notify Owner and Architect at least seven days prior to startup of each system or piece of equipment.

B. Prior to beginning startup verify that:
   1. Lubrication has been performed.
   2. Drive rotation, belt tension, control sequences, tests, meter readings, and electrical characteristics are within manufacturer's requirements.

3. Utility connections and support components are complete and tested.

C. Execute start-up under supervision of applicable manufacturer's representative or Construction Manager's personnel in accordance with manufacturers' instructions.

D. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to startup, and to supervise placing equipment or system in operation.

E. Submit written report that equipment or system has been properly installed and is functioning correctly.

1.10 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate operation and maintenance of Products to Owner's personnel two weeks prior to date of Substantial Completion.

B. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

C. Utilize Operation and Maintenance Manuals as basis for instruction. Review contents of manual with Owners' personnel in detail to explain all aspects of operation and maintenance.

D. Demonstrate startup, operation, control, adjustment, troubleshooting, servicing, maintenance, and shutdown of each item of equipment at agreed upon times, at equipment location.

E. Prepare and insert additional data in Operation and Maintenance Manuals when need for additional data becomes apparent during instruction.

1.11 COMPLETION REPORT

A. Purpose:
1. To document the changes that occurred to the property as a result of this project and why they were made. With an identification of which elements of the building are original, which have been reconstructed based on historic evidence, and which were inserted to serve current functional needs, further impacts to original materials may be avoided and the historic building fabric may be interpreted in terms of its historic significance.
2. To provide a record of the substantive investment of state funds made in the property. The condition of the building prior to work, work undertaken and the final result should be clearly documented.
3. To facilitate the grant recipient’s ability to operate and maintain the building in a good state of repair.

B. When Required:
1. All THCPP funded construction activities will require a completion report.

C. Final reimbursement to the Owner for grant eligible work performed by the Contractor on this project is contingent on receipt of the Project Closeout submittals from the Contractor.

D. Owner will withhold 5% of retainage from Contractor until Project Closeout submittals are fully submitted and approved by Architect and THC representative.

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

Not used

END OF SECTION

SECTION 02 4119

SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Salvage existing items to be reused or recycled.

1.2 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.

C. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.3 REGULATORY REQUIREMENTS

A. Conform to applicable code for demolition work, safety of structure, and dust control.

B. Obtain required permits from authorities.

C. Notify affected utility companies before starting work and comply with their requirements.

D. Conform to applicable codes when hazardous or contaminated materials are discovered.

1.4 PROJECT CONDITIONS

A. Minimize interference with streets, walks, public right-of-ways, and adjacent facilities.

B. If hazardous materials are discovered, notify Owner and Architect and await instructions.

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. If any of the following conditions are encountered, cease work immediately, notify Owner and Architect, await instructions:
1. Structure is in danger of movement or collapse.
2. Materials or conditions encountered differ from those designated in the Contract Documents.

E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

F. Obtain written approval from Architect and THC representative of all locations and demolition methods used for selective demolition prior to commencement of the Work.

1.5 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

Not used

PART 3 - EXECUTION

3.1 PREPARATION

A. Erect temporary barricades, warning devices, and controls.

B. Provide protective coverings, shoring, bracing, and supports for construction designated to remain.

C. Temporarily or permanently disconnect utilities as required.

3.2 DEMOLITION

A. Remove existing construction to extent indicated and as necessary to join new work to existing. Do not remove more than is necessary to allow for new construction.

B. Do not damage work designated to remain.

C. Minimize noise and spread of dirt and dust.

D. Assign work to trades skilled in procedures involved.

E. Plug ends of disconnected utilities with threaded or welded caps.

F. Protect and support active utilities designated to remain. Post warning signs showing location and type of utility and type of hazard.

G. Store items designated for reinstallation or reuse on site in protected areas.

H. Store items designated to remain property of the Owner where directed by Owner.

I. Remove and dispose of waste materials off site.

END OF SECTION

SECTION 03 0330

CONCRETE RESTORATION AND CLEANING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Paint removal from concrete.
2. Cleaning concrete.
3. Repair of deteriorated and spalled concrete.

B. Related Sections:

1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

A. ASTM International (ASTM) C856 – Petrographic Examination of Hardened Concrete.

1.3 DEFINITIONS

A. Low Pressure: Less than 60 PSI.

B. Medium Pressure: 60 to 300 PSI.

1.4 SUBMITTALS

A. Submittals for Review:
1. Product Data: Product descriptions, application procedures, and precautions in use or application of products.
2. Samples: Submit 3 x 3 inch samples showing proposed patching mix.

B. Quality Control Submittals:
1. Qualifications Statement: Restorer qualifications per Section 01 4001.
2. Test Reports: Existing concrete analysis.

1.5 QUALITY ASSURANCE

A. Restorer Qualifications:
1. Minimum 5 years experience in work of this Section.
2. Successful completion of at least 3 projects of similar scope and complexity within past 5 years.

B. Mockup:
1. Concrete cleaning: approximately 20 square feet.
2. Paint removal: approximately 20 square feet.
3. Concrete repair: minimum of 10 square feet.
4. Allow paint stripper to remain on surface for varying time periods in several locations to determine optimum time required.
5. Perform multiple applications of varying concentrations of cleaning solution to determine optimum concentration.
6. Test adjacent surfaces for detrimental reaction with paint stripper and cleaning solution.
7. Determine effectiveness of methods.
8. Ensure that materials and procedures will not discolor or damage existing surfaces.
9. Mockup to be approved by Architect and THC representative prior to commencing the Work.
10. Locate where directed.

C. Preconstruction Testing Laboratory Services:
1. Remove three samples of existing concrete from different locations.
2. Retain one sample for later comparison.
3. Test two concrete samples by petrographic analysis in accordance with ASTM C856; report the following:

a. Volumetric proportions of aggregate, cement, and other ingredients.
b. Type, color, and gradation of aggregate.
c. Presence of pigments or additives.

1.6 DELIVERY, STORAGE AND HANDLING

A. Protect materials from moisture absorption and damage; reject damaged containers.

B. Store sand to prevent inclusion of foreign matter.

1.7 PROJECT CONDITIONS

A. Do not apply repair materials during inclement or freezing weather, or if such conditions are anticipated within material curing period.

B. Apply materials within temperature range recommended by manufacturer.

PART 2 PRODUCTS

2.1 MATERIALS

A. Concrete Materials:
1. Portland Cement:
a. Type: ASTM C150, Type II.
b. Color: to match existing concrete.
2. Sand: Color, size, and type to match existing concrete.
3. Other components: As determined by existing concrete analysis to produce visual and performance characteristics to match existing concrete.

B. Concrete Cleaner: 942 Limestone and Marble Cleaner by Prosoco, Inc. (www.prosoco.com) or approved substitute.

C. Paint Stripper: Safstrip by Prosoco, Inc. (www.prosoco.com) or approved substitute.

D. Water: Potable, clean, and free from acids, alkalis, and detrimental matter.

2.2 MIXES

A. Patching Mortar: Proportions as determined by existing concrete analysis.

B. Cleaners: Mix materials in accordance with manufacturer's instructions to proportions determined by cleaning of mockup.

PART 3 EXECUTION

3.1 PREPARATION

A. Close off areas in which work is being performed in pedestrian and vehicular traffic.

B. Protect adjacent surfaces from damage.

3.2 CLEANING AND PAINT STRIPPING - GENERAL

A. Clean existing masonry surfaces.

B. Remove paint, dirt, grease, oil, pollutants, and residues.

C. Sandblasting and the use of non-proprietary acids is prohibited.

D. Follow manufacturer's instructions and procedures established during preparation of mockup.

E. Do not damage existing surfaces. Leave surfaces uniform in appearance.

3.3 PAINT STRIPPING

A. Remove loose and peeling paint by scraping and wire brushing.

B. Apply paint stripper by low pressure spray, roller, or brush. Work into surface voids.

C. Apply light water mist to surfaces.

D. Allow stripper to remain on surface until paint is visibly lifted or dissolved.

E. Remove stripper and dissolved paint using low pressure spray.

F. Scrub surfaces using power scrubber or buffer with abrasive, non-metallic scrubbing pads until paints and stripper are removed, adding more water if required.

G. Repeat process if required until paint is removed.

3.4 CLEANING

A. Apply cleaning solution by brush or roller to uniform coverage.

B. Allow solution to stand on surfaces for 3 to 5 minutes.

C. Rinse surfaces with medium pressure water. Hold nozzle perpendicular to surface; work at uniform rate and uniform distance from surface.

D. Continue washing until sudsing has ceased.

E. Repeat process if required until concrete is clean.

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:

1. Footings.
2. Foundation walls.
3. Slabs-on-grade.
4. Suspended slabs.
5. Concrete toppings.
6. Building frame members.
7. Building walls.

B. WORK INCLUDED

1. Design, fabrication, erection, and stripping of formwork for cast-in-place concrete including shoring, reshoring, falsework, bracing, proprietary forming systems, prefabricated forms, void forms, permanent metal forms, bulkheads, keys, blockouts, sleeves, pockets, and accessories. Erection shall include installation in formwork of items furnished by other trades.
2. Furnish all labor and materials required to fabricate, deliver and install reinforcement and embedded metal assemblies for cast-in-place concrete, including steel bars, welded steel wire fabric, ties and supports.
3. Furnish all labor and materials required to perform the following:
   a. Cast-in-place concrete
   b. Concrete mix designs
   c. Grouting structural steel baseplates

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, Slag Cement, and silica fume; subject to compliance with requirements.

1.4 SUBMITTALS

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

B. Design Mixtures: For each concrete mixture submit proposed mix designs in accordance with ACI 318, chapter 5. Each proposed mix design shall be accompanied by a record of past performance.
   1. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

2. Indicate amounts of mixing water to be withheld for later addition at Project site.

C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

1. Do not reproduce the structural drawings for use as shop drawings.
2. Embedded metal assemblies: Submit shop drawings for fabrication and placement. Use standard AWS welding symbols.

D. Steel Reinforcement Submittals for Information: Mill test certificates of supplied concrete reinforcing, indicating physical and chemical analysis.

E. Formwork Shop Drawings: Prepared and sealed by a qualified professional engineer, licensed in the State where the project is located, detailing fabrication, assembly, and support of formwork.

1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and installing and removing reshoring.

F. Welding certificates.

G. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:

1. Aggregates.

H. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials
2. Admixtures
3. Form materials and form-release agents
4. Steel reinforcement and accessories
5. Waterstops
6. Curing compounds
7. Floor and slab treatments
8. Bonding agents
9. Adhesives
10. Vapor retarders
11. Joint-filler strips
12. Repair materials

I. Submit manufacturer's certification of maximum chloride ion content in admixtures.

J. Fly ash: Submit certification attesting to carbon content and compliance with ASTM C618.

K. Construction Joint Layout: Submit a diagram of proposed construction joint locations for horizontal framing that exceed the limits of a single placement as stated in the structural notes, other than those indicated on the Drawings.

L. Floor surface flatness and levelness measurements to determine compliance with specified tolerances.

M. Field quality-control test and inspection reports.

N. Minutes of preinstallation conference.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Testing Agency Qualifications: An independent agency, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.

E. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code--Reinforcing Steel."

F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, "Specification for Structural Concrete,"
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

G. Concrete Testing Service: Owner may engage a qualified independent testing agency to perform material evaluation tests.

H. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

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 cast-in-place concrete to attend, including the following:

a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixtures.
c. Ready-mix concrete manufacturer.
d. Concrete subcontractor.

2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

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

C. Store all proprietary materials in accordance with manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Plywood, metal, or other approved panel materials.
2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

    a. High-density overlay, Class 1 or better.

3. Steel Forms

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.

1. Pans shall be free of dents, irregularities, sag, or other deterioration.
2. In areas permanently exposed to view, provide one-piece units, manufactured to length between beams or ribs, or segmented units with reinforced butt-joint splices.

E. Void Forms: Shall be the product of a reputable manufacturer regularly engaged in the commercial production of void forms.

1. Void form composition shall be of corrugated paper material with a moisture resistant exterior and an interior fabrication of a uniform cellular configuration, composed of components constructed of double-faced wax-impregnated (partially or fully), corrugated fiberboard that is laminated with moisture resistant adhesive.
2. Design and maintain void forms to support all vertical and lateral loads that might be applied during construction until such loads can be supported by the concrete structure.
3. Form material shall be designed to lose its strength under prolonged contact with the moisture which normally accumulates beneath slabs and beams on grade.
4. Void forms shall be used around the circular edges of all drilled piers at the intersection of the gradebeams and/or structural slabs by using premanufactured, non-field cut, sealed void forms with curved edges adjacent to drilled piers.
5. Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, VoidForm Products, Inc., Englewood, Colorado.

F. Protection Board: For use over void forms under structural slabs. Hard-pressed cellulose fiber board, 1/8 inch minimum thickness.

G. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

H. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

I. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

J. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

K. Soil Retainers: Shall be provided where specified and shown on the drawings to prevent migration of backfill under suspended foundation elements:
1. Retainers shall be composed of high density polypropylene materials that are not adversely affected by moisture. They must be flexible, impact resistant and have sufficient strength to resist lateral loads applied by soil.

a. Thickness: 3/8” for void spaces of 8” or less 1/2” for void spaces greater than 8”, but less than 12”, inclusive.
b. Soil retainers shall extend six inches above the void forms and a minimum of 3 inches below the void forms.
2. Retainers shall be ribbed and made from high density polyethylene. Refer to the Drawings for additional information. Soil retainers shall be Motzblock by VoidForm Products, Inc.

2.2 STEEL REINFORCEMENT

A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 60 percent.

B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

C. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.

D. Plain-Steel Welded Wire Reinforcement: ASTM A 1064, plain, fabricated from as-drawn steel wire into flat sheets.

2.3 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut bars true to length with ends square and free of burrs.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
2. For slabs on grade and slabs on void forms, provide sand plates, horizontal runners, or precast concrete blocks on bottom where base material will not support chair legs or where vapor barrier has been specified.

2.4 MECHANICAL SPLICES

A. Provide mechanical splices designed to develop, in tension and compression, 125 percent of the minimum ASTM specified yield strength of the smaller bar being spliced. The following splicing systems are acceptable:

1. Erico "Cadweld T-Series"
2. Erico "Lenton"
3. Dayton Barsplice "Bar-Grip"
4. Dayton Barsplice "Grip-Twist"

2.5 DOWEL BAR ANCHORS

A. Provide dowel bar anchors and threaded dowels designed to develop, in tension and compression, 125 percent of the minimum ASTM specified yield strength of the dowel bars. Unless otherwise indicated, anchors shall be furnished with ACI standard 90 degree hooks. Dowels shall be furnished by the anchor supplier. The following dowel splicing systems are acceptable:

1. Richmond Screw Anchor "Dowel Bar Splicer"
2. Erico "Lenton Form Saver"
3. Dayton Barsplice "Grip-Twist"

2.6 EMBEDDED METAL ASSEMBLIES

A. Steel Shapes and Plates: ASTM A36

B. Headed Studs: Heads welded by full-fusion process, as furnished by TRW Nelson Stud Welding Division.

C. Welded Deformed Bar Anchors: Welded by full fusion process, as furnished by TRW Nelson Stud Welding Division.

D. Reinforcing Bars to be Welded: ASTM A706.

E. Coatings

1. Epoxy coating for metal assemblies shall be "Hi-Build Epoxoline," as manufactured by the Tnemec Company, Kansas City, Missouri, applied in accordance with manufacturer's recommendations.

2.7 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I/II, gray. Supplement with the following:

a. Fly Ash: ASTM C 618, Class F or C.
b. Slag Cement: ASTM C 989, Grade 100 or 120.

B. Normal-Weight Aggregates: ASTM C 33, Class 3M coarse aggregate or better, graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: As indicated on drawings.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: ASTM C 1602/C 1602M and potable.

2.8 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.9 WATERSTOPS

A. Waterstops: At all construction joints below grade. "Synko-Flex" Preformed Plastic Waterstop by the Henry Company, Inc., meeting the requirements of Federal Specification SSS-210.

B. VAPOR RETARDERS

C. Plastic Vapor Retarder: ASTM E 1745, Class A.

1. Membrane shall have the following properties:

    a. Minimum 15 mils thickness.
    b. Permeance Rating: ASTM E96, 0.01 Perms [grains/(ft^2 * hr *- in Hg)] or lower as tested after mandatory conditioning (ASTM E 154 sections 8, 11, 12, 13)
    c. Installation shall be in accordance with ASTM E1643 and manufacturer’s instructions.

2. Products:

    a. Carlisle Coatings & Waterproofing, Inc.: Blackline 400.
    b. Epro; Ecoshield-E 15 mil.
    c. Inteplast Group; Barrier Bac VBC-350 Composite Vapor Retarder
    d. Reef Industries; Vaporguard.
    e. Stego Wrap 15 mil, by Stego.
    f. W.R. Meadows, Inc.: Premolded Membrane with Plasmatic Core (PMPC).

3. Accessories

    a. Perimeter/seam sealing tape for use with membranes that are not self-adhering to the underside of concrete slabs on void forms:
        1) Crete Claw detail tape by Stego Industries, LLC, for adhering vapor retarder membrane to the underside of concrete surface at slabs on carton void forms, 3-inch and 6-inch widths as noted in Part 3.
        2) StegoTack double-sided adhesive tape by Stego Industries, LLC, for adhering membrane to concrete at gradebeams.
    b. Manufacturer’s recommended standard adhesive or pressure sensitive tape for general use.

2.10 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

1. Products:

a. Axim Concrete Technologies; CATEXOL Cimfilm.
b. BASF Construction Chemicals – Building Systems; Confilm.
c. ChemMasters; Spray-Film.
d. Conspec by Dayton Superior; Aquafilm.
e. Dayton Superior Corporation; Sure Film (J-74).
f. Edoco by Dayton Superior; BurkeFilm.
g. Euclid Chemical Company (The), an RPM company; Eucobar.
h. Kaufman Products, Inc.; Vapor Aid.
i. Lambert Corporation; LAMBCO Skin.
j. L&M Construction Chemicals, Inc.; E-Con.
k. Meadows, W. R., Inc.; EVAPRE.
l. Metalcrete Industries; Waterhold.
m. Nox-Crete Products Group; Monofilm.
n. Sika Corporation, Inc.; SikaFilm.
o. SpecChem, LLC; Spec Film.
p. Symons by Dayton Superior; Finishing Aid.
q. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
r. Unitex; Pro-Film.
s. Vexcon Chemicals, Inc.; Certi-Vex Envio Set.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

1. Products:

a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
b. BASF Construction Chemicals – Building Systems; Kure 200.
c. ChemMasters; Safe-Cure Clear.
d. Conspec by Dayton Superior; W.B. Resin Cure.
e. Dayton Superior Corporation; Day Chem Rez Cure (J-11-W).
f. Edoco by Dayton Superior; Res X Cure WB.
g. Euclid Chemical Company (The), an RPM company; Kurez W VOX; TAMMSCURE WB 30C.
h. Kaufman Products, Inc.; Thinfilm 420.
i. Lambert Corporation; Aqua Kure-Clear.
j. L&M Construction Chemicals, Inc.; L&M Cure R.
k. Meadows, W. R., Inc.; 1100 Clear.
l. Nox-Crete Products Group; Resin Cure E.
m. Right Pointe; Clear Water Resin.
n. SpecChem, LLC; Spec Rez Clear.
o. Symons by Dayton Superior; Resi-Chem Clear.
p. TK Products, Division of Sierra Corporation; TK-2519 DC WB.
q. Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.

F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.

1. Products:

   a. Anti-Hydro International, Inc.; AH Clear Cure WB.
   b. BASF Construction Chemicals – Building Systems; Kure-N-Seal WB.
   c. ChemMasters; Safe-Cure & Seal 20.
   d. Conspec by Dayton Superior; Cure and Seal WB.
   e. Cresset Chemical Company; Crete-Trete 309-VOC Cure & Seal.
   f. Dayton Superior Corporation; Safe Cure and Seal (J-18).
   g. Edoco by Dayton Superior; Spartan Cote WB II.
   h. Euclid Chemical Company (The), an RPM company; Aqua Cure VOX; Clearseal WB 150.
   i. Kaufman Products, Inc.; Cure & Seal 309 Emulsion.
   j. Lambert Corporation; Glazecote Sealer-20.
   k. L&M Construction Chemicals, Inc.; Dress & Seal WB.
   l. Meadows, W. R., Inc.; Vocomp-20.
   m. Metalcrete Industries; Metcure.
   n. Nox-Crete Products Group; Cure & Seal 150E.
   o. Symons by Dayton Superior; Cure & Seal 18 Percent E.
   p. TK Products, Division of Sierra Corporation; TK-2519 WB.
   q. Vexcon Chemicals, Inc.; Starseal 309.

G. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, 18 to 25 percent solids, nondissipating**,** certified by curing compound manufacturer to not interfere with bonding of floor covering.

1. Products:

   a. BASF Construction Chemicals – Building Systems; Kure-N-Seal W.
   b. ChemMasters; Safe-Cure Clear.
   c. Conspec by Dayton Superior; High Seal.
   d. Dayton Superior Corporation; Safe Cure and Seal (J-19).
   e. Edoco by Dayton Superior; Spartan Cote WB II 20 Percent.
   f. Euclid Chemical Company (The), an RPM Company; Diamond Clear VOX; Clearseal WB STD.
   g. Kaufman Products, Inc.; SureCure Emulsion.
   h. Lambert Corporation; Glazecote Sealer-20.
   i. L&M Construction Chemicals, Inc.; Dress & Seal WB.
   j. Meadows, W. R., Inc.; Vocomp-20.
   k. Metalcrete Industries; Metcure 0800.
   l. Nox-Crete Products Group; Cure & Seal 200E.
   m. Symons by Dayton Superior; Cure & Seal 18 Percent E.
   n. Vexcon Chemicals, Inc.; Starseal 0800.

2.11 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

C. Sleeves and Blockouts: Formed with galvanized metal, galvanized pipe, polyvinyl chloride pipe, fiber tubes, or wood.

D. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required; of strength and character to maintain formwork in place while placing concrete.

2.12 REPAIR MATERIALS

A. Repair Mortar – Hand-Applied: Pre-packaged, cement-based, two-component, polymer-modified, trowel-grade mortar, enhanced with penetrating corrosion inhibitor.
   1. Compressive Strength: 1200 psi minimum at 1 day; 6000 psi minimum at 28 days when tested according to ASTM C 109.
   2. Bond Strength: 1800 psi minimum at 28 days when tested according to ASTM C 882 (Modified).
   3. Product / Manufacturer: SikaTop 122 Plus or SikaTop 123 Plus, Sika Corporation, or approved equal.

B. Repair Mortar – Form and Pour or Pump: Pre-packaged, cement-based, single-component, polymer-modified, silica-fume-enhanced, cementitious mortar.
   1. Compressive Strength: 3000 psi minimum at 1 day; 6500 psi at 28 days when tested according to ASTM C 109.
   2. Bond Strength: 2200 psi at 28 days when tested according to ASTM C 882 (modified).
   3. Product / Manufacturer: Sika MonoTop 611, Sika Corporation, or approved equal.

2.13 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

   1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

   2. Required average strength above specified strength:

      a. Based on a record of past performance: Determination of required average strength above specified strength shall be based on the standard deviation record of the results of at least 30 consecutive strength tests in accordance with ACI 318, Chapter 5.3 by the larger amount defined by formulas 5-1 and 5-2.
      b. Based on laboratory trial mixtures: Proportions shall be selected on the basis of laboratory trial batches prepared in accordance with ACI 318, Chapter 5.3.3.2 to produce an average strength greater than the specified strength f'c by the amount defined in table 5.3.2.2.

         1) Proportions of ingredients for concrete mixes shall be determined by an independent testing laboratory or qualified concrete supplier.
         2) For each proposed mixture, at least three compressive test cylinders shall be made and tested for strength at the specified age. Additional cylinders may be made for testing for information at earlier ages.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

   1. Fly Ash: 20 percent.
   2. Combined Fly Ash and Pozzolan: 25 percent.
   3. Slag Cement: 50 percent.
   4. Combined Fly Ash or Pozzolan and Slag Cement: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.

   5.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.

   1. Do not use admixtures which have not been incorporated and tested in accepted mixes.
   2. Use water-reducing admixture in concrete, as required, for placement and workability.

3. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
4. Use water-reducing admixture in pumped concrete, and concrete with a water-cementitious materials ratio below 0.50.

2.14 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Proportion normal-weight concrete mixture as indicated on drawings.

2.15 FABRICATING REINFORCEMENT

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

2.16 FABRICATION OF EMBEDDED METAL ASSEMBLIES

A. Fabricate metal assemblies in the shop. Holes shall be made by drilling or punching. Holes shall not be made by or enlarged by burning. Welding shall be in accordance with AWS D1.1.

B. Welding of deformed bar anchors and headed stud anchors shall be done by full fusion process equal to that of TRW Nelson Stud Welding Division. A minimum of two headed studs shall be tested at the start of each production period for proper quality control. The studs shall be capable of being bent 45 degrees without failure.

C. Welding of reinforcement shall be done in accordance with AWS D1.4, using the recommended preheat temperature and electrode for the type of reinforcement being welded. Bars larger than no. 9 shall not be welded. Welding shall be subject to the observance and testing of the Testing Laboratory.

D. Metal assemblies exposed to earth, weather or moisture shall be hot dip galvanized. All other metal assemblies shall be either hot dip galvanized or painted with an epoxy paint. Repair galvanizing after welding with a Cold Galvanizing compound installed in accordance with the manufacturer's instructions. Repair painted assemblies after welding with same type of paint.

2.17 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and furnish batch ticket information.

1. When air temperature is between 85 and 95 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 95 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

1. Vertical alignment:

    a. Lines, surfaces and arises less than 100 feet in height - 1 inch.
    b. Outside corner of exposed corner columns and control joints in concrete exposed to view less than 100 feet in height - 1/2 inch.

2. Lateral alignment:

    a. Members - 1 inch.
    b. Centerline of openings 12 inches or smaller and edge location of larger openings in slabs - 1/2 inch.
    c. Sawcuts, joints, and weakened plane embedments in slabs - 3/4 inch.

3. Level alignment:

    a. Elevation of slabs-on-grade - 3/4 inch.
    b. Elevation of top surfaces of formed slabs before removal of shores - 3/4 inch.
    c. Elevation of formed surfaces before removal of shores - 3/4 inch.
    d. Lintels, sills, parapets, horizontal grooves, and other lines exposed to view - 1/2 inch.

4. Cross-sectional dimensions: Overall dimensions of beams, joists, and columns and thickness of walls and slabs.

    a. 12 inch dimension or less - plus 3/8 inch to minus 1/4 inch.
    b. Greater than 12 inch to 3 foot dimension - plus 1/2 inch to minus 3/8 inch.
    c. Greater than 3 foot dimension - plus 1 inch to minus 3/4 inch.

5. Relative alignment:

    a. Stairs:

        1) Difference in height between adjacent risers - 1/8 inch.
        2) Difference in width between adjacent treads - 1/4 inch.
        3) Maximum difference in height between risers in a flight of stairs - 3/8 inch.
        4) Maximum difference in width between treads in a flight of stairs - 3/8 inch.

    b. Grooves:

        1) Specified width 2 inches or less - 1/8 inch.
        2) Specified width between 2 inches and 12 inches - 1/4 inch.

    c. Vertical alignment of outside corner of exposed corner columns and control joint grooves in concrete exposed to view - 1/4 inch in 10 feet.
    d. All other conditions - 3/8 inch in 10 feet.

C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:

1. Class B, 1/4 inch for rough-formed finished surfaces.
2. Class D, 1 inch for pan-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.

2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide elevation or camber in formwork as required for anticipated formwork deflections due to weight and pressures of concrete and construction loads.

H. Foundation Elements: The sides of all below grade portions of beams, pier caps, walls, and columns shall be formed straight and to the lines and grades specified. Foundation elements shall not be earth formed unless specifically indicated on the Drawings.

I. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

J. Chamfer exterior corners and edges of permanently exposed concrete.

K. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

L. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

M. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

N. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement, anchoring devices, and embedded items.

1. Do not apply form release agent where concrete surfaces are scheduled to receive subsequent finishes which may be affected by agent. Soak contact surfaces of untreated forms with clean water. Keep surfaces wet prior to placing concrete.

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."

a.	Spacing within a bolt group:	1/8"
b.	Location of bolt group (center):	1/2"
c.	Rotation of bolt group:	5 degrees
d.	Angle off vertical:	5 degrees
e.	Bolt projection:	± 3/8"

3.3 VOID FORMS

A. Install void forms in all locations shown on the Drawings. In general, void forms shall be placed below all structural elements supported by piers to separate these elements from the earth.

B. Seal discontinuous ends of void forms and tape all joints with waterproof tape so that concrete will not enter the void space during placement of concrete. Do not leave gaps between void form sections.

C. Premanufactured void forms with circular edges shall be used around all drilled piers. Field fabrication of pier void forms is not permitted.

D. Do not allow any portion of void forms to fall within the circumference of piers causing a reduction in the bearing area.

E. Protect void forms from water. Do not install void forms during wet weather or on wet ground. Void forms which become saturated prior to placement of concrete shall be removed and replaced. Void forms shall not be wrapped in plastic, or other similar material to protect from moisture when installed.

F. Exercise care in placement of concrete to avoid collapse of void form. If void forms collapse, soil beneath the concrete shall be dug out and a proper void space shall be created by installing soil retainers on each side of element.

G. Void forms under slabs shall be protected by a layer of one-eighth inch thick protection board followed by a vapor barrier or retarder per the specifications. Do not install void forms under soil supported slabs on grade.

3.4 SOIL RETAINERS

A. Install soil retainers in straight, clean trenches at sides of void forms prior to concrete placement. The gaps between the trench and retainers must be properly positioned or backfilled prior to the placement of concrete. Do not cast the sides of concrete beams directly against the soil.

B. Affix the soil retainers to the concrete beam with adhesive, pin/washer/load, or concrete hard nails spaced on 24 inch centers.

3.5 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
2. Formwork supporting conventionally reinforced concrete shall not be removed until concrete has attained 85 percent of its specified 28 day compressive strength as established by tests of field cured cylinders. In the absence of cylinder tests, supporting formwork shall remain in place until the concrete has cured at a temperature of at least 50 degrees Fahrenheit (10 degrees Celsius) for the minimum cumulative time periods given in ACI 347, Section 3.7.2.3. When the surrounding air temperature is below 50 degrees Fahrenheit (10 degrees Celsius), that time period shall be added to the minimum listed time period. Formwork for two-way conventionally reinforced slabs shall remain in place for at least the minimum cumulative time periods specified for one-way slabs of the same maximum span.
3. Two-way conventionally reinforced slabs shall be immediately reshored after formwork removal. Reshores shall remain until the concrete has attained the specified 28 day compressive strength.
4. Minimum cumulative curing times may be reduced by the use of high-early strength cement or forming systems which allow form removal without disturbing shores, but only after the Contractor has demonstrated to the satisfaction of the Architect that the early removal of forms will not cause excessive sag, distortion or damage to the concrete elements.
5. Forms for post-tensioned concrete shall not be removed until tensioning operations have been completed.
6. Wood forms shall be completely removed. Provide temporary openings if required.

7. Provide adequate methods of curing and thermal protection of exposed concrete if forms are removed prior to completion of specified curing time.
8. Areas required to support construction loads in excess of 20 psf shall be reshored to properly distribute construction loading. Construction loads up to the rated live load capacity may be placed on unshored construction provided the concrete has attained the specified 28 day compressive strength.
9. Obtaining concrete compressive strength tests for the purposes of form removal shall be the responsibility of the Contractor.
10. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.6 SHORES AND RESHORES

A. The Contractor shall be solely responsible for proper shoring and reshoring.

B. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.

1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

C. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

1. All structural framing required to support one or more subsequent levels of construction shall be reshored. Reshores shall be located in the same position on each floor. No construction loads shall be placed on the new construction until all supporting reshores have been installed.
2. Extend shores or reshored from ground to top level in structure three stories or less in height, unless noted otherwise.
3. In structures over three stories in height, extend reshores at least three levels under the level being placed. Extend shores beyond the minimum number of levels if required to ensure proper distribution of loads throughout the structure.
4. In crawl spaces or basements, shores or reshores shall extend to mud pads seated firmly on the soil or to on-grade construction.
5. Bottom tier of reshores shall remain in place until the supported concrete (at the uppermost level) has attained at least 85 percent of the specified 28 day compressive strength and construction loads in excess of 20 psf have been removed.
6. Conventionally reinforced uppermost floors do not need to be reshored provided forms supporting concrete are not removed until concrete has attained 85 percent of its specified 28 day compressive strength as established by tests of field cured cylinders.
7. All levels of reshores may be removed after formwork for the uppermost floor has been removed in accordance with these specifications.

D. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.7 VAPOR RETARDERS

A. Plastic Vapor Retarders: Place, protect, and repair vapor retarders according to ASTM E 1643 and manufacturer's written instructions.

B. Lap joints 6 inches and seal with tape as noted below.

1. Vapor retarder membrane seal at slabs on void forms for use with membranes that are not self-adhering to the underside of concrete slabs: Seal vapor retarder membrane to underside of slab using perimeter/seam seal tape applied continuously to perimeter of vapor retarder membrane at grade beams (3in. tape) and at the seams at interior conditions (6in. tape).
   a. Apply double-sided adhesive tape top surface of grade beam and adhere membrane to tape. Refer to the drawings for detail.
   b. Remove any dirt or debris from membrane prior to application of sealing tape.

2. General sealing and at slabs on grade: Use manufacturer's standard adhesive or pressure sensitive tape for sealing membrane at seams, pipe penetrations, tears, etc.

3.8 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Weld reinforcing bars according to AWS D1.4, where indicated. Only steel conforming to ASTM A706 may be welded.

D. Installation tolerances:

1. Top and bottom bars in slabs, girders, beams and joists:

   a. Members 8" deep or less: ±3/8"
   b. Members more than 8" deep: ±1/2"

2. Concrete Cover to Formed or Finished Surfaces: ±3/8" for members 8" deep or less; ±1/2" for members over 8" deep, except that tolerance for cover shall not exceed 1/3 of the specified cover.

E. Concrete Cover: Refer to the Structural Notes.

F. Splices: Provide standard reinforcement splices by lapping and tying ends. Comply with ACI 318 for minimum lap of spliced bars where not specified on the documents.

G. Mechanical Splices: Use for splicing of bars larger than no. 11 or where no. 11 bars are spliced to larger size bars and where indicated on the drawings. Comply with manufacturer's instructions for preparation of bars and installation procedures.

H. Field Welding of Embedded Metal Assemblies: All paint and galvanizing shall be removed in areas to receive field welds. All areas where paint or galvanizing has been removed shall be field repaired with the specified paint or cold galvanizing compound, respectively.

I. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

J. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.9 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 7 Section "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.10 WATERSTOPS

A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.

3.11 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301, and only if specifically noted as withheld on the batch ticket.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
2. Water content shall not exceed the maximum specified water/cement ratio for the mix.

C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
4. Do not permit concrete to drop freely any distance greater than 20'-0" for concrete containing a high range water reducing admixture (superplasticizer) or 5'-0" for other concrete. Provide chute or tremie to place concrete where longer drops are necessary. Do not place concrete into excavations with standing water. If place of deposit cannot be pumped dry, pour concrete through a tremie with its outlet near the bottom of the place of deposit.
5. Pump priming grout shall be discarded and not used in the structure.

D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

E. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

F. Hot-Weather Placement: Comply with ACI 305.1 and as follows:

1. Maintain concrete temperature below 95 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.12 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view.

C. 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.

3.13 MISCELLANEOUS CONCRETE ITEMS

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

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

1. Housekeeping pads: Concrete fill shall be normal weight concrete (3000 psi), reinforced with 4x4-W2.1xW2.1 welded wire mesh set at middepth of pad. Trowel concrete to a dense, smooth finish. Set anchor bolts for securing mechanical or electrical equipment during pouring of concrete fill.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel-finish concrete surfaces.

1. Mix one part Portland Cement and two parts crushed stone or gravel passing 3/8" sieve and retained on a 1/8" sieve, measured by volume with only sufficient water to produce a dry consistency for proper placing and finishing.
2. Placing: Place fill and reinforcement in all steel pan treads and landings. Reinforcement shall be 2"x2" by 14 gauge welded wire fabric extending over the area of each tread and landings. Support reinforcement 3/4" above bottom of steel pans. After sufficient hardening of the concrete fill, steel trowel the exposed surface to a smooth finish.
3. Abrasive aggregate: Sprinkle abrasive aggregate into the troweled concrete fill in two shakes at the rate of 1/4 pound per square foot and trowel lightly into the surface.

E. Protective slabs ("Mud slabs"): Concrete fill shall be normal weight concrete (2500 psi minimum) with a minimum thickness of 3 1/2". Reinforce protective slabs with 6x6-W2.9xW2.9 welded wire mesh reinforcing. Finish slab to a wood float finish.

3.14 INSTALLATION OF NON-SHRINK GROUT UNDER BASEPLATES

A. Grout under all bearing and baseplates. Comply with manufacturer's instructions. Do not dry pack.

B. Mixing: Use a mechanical mixer. Add only enough water to make grout placeable. Do not mix more grout than can be used in 20 minutes. Under no circumstances shall grout be retempered.

3.15 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 305.1 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

    a. Water.
    b. Continuous water-fog spray.
    c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

    a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
    b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
    c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

    a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.16 CONCRETE SURFACE REPAIRS

A. Surface Defects in Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Owner's approval.

B. Contractor shall submit a detailed, descriptive procedure listing proposed pre-packaged repair materials and methods for the repair of surface defects prior to the start of repair work.

C. Patching Mortar: Mix, place and finish pre-packaged repair mortar in accordance with manufacturer's instructions.

D. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, minor honeycombs and rock pockets with no exposed reinforcement, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out minor honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete, but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface, 1/4 inch deep minimum. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view using pre-packaged repair mortar so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.

E. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include minor spalls, pop outs, honeycombs and rock pockets with no exposed reinforcement, crazing and cracks in excess of 0.01 inch wide that do not penetrate to reinforcement, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with patching mortar. Remove defective areas with clean, square cuts, ¼" deep minimum. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Place, compact, and finish patching mortar to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
8. Unapproved and defective repairs shall be removed and replaced in accordance with requirements provided by the Engineer at no additional cost to the Owner.

3.17 STRUCTURAL REPAIRS

A. Structurally Defective Concrete: Structural defects include spalls, honeycombs or rock pockets with exposed reinforcement, hollow-sounding concrete, cracks that penetrate to the reinforcement or completely through concrete elements, inadequate cover over reinforcement, and other conditions that affect the structural performance or durability of the concrete as determined by the Engineer.

B. Repair structural defects in concrete in accordance with plans, specifications, details, etc. provided by the Engineer.

1. The cost of the additional services provided by the Engineer to prepare the repair documents, and to oversee the repair work shall be borne by the Contractor.

C. Unapproved and defective repairs shall be removed and replaced in accordance with requirements provided by the Engineer at no additional cost to the Owner.

3.18 CLEANUP

A. Imperfect or damaged work or any material damaged or determined to be defective before final completion and acceptance of the entire job shall be satisfactorily replaced at the Contractor's expense, and in conformity with all of the requirements of the Drawings and Specifications. Removal and replacement of concrete work shall be done in such manner as not to impair the appearance or strength of the structure in any way.

B. Cleaning: Upon completion of the work all forms, equipment, protective coverings and any rubbish resulting therefrom shall be removed from the site. After sweeping floors, wash floors with clean water. Finished concrete surfaces shall be left in a clean condition, satisfactory to the Owner.

3.19 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner may engage a special inspector and/or a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Inspections may include:

1. Steel reinforcement placement.
2. Steel reinforcement welding.
3. Headed bolts and studs.
4. Verification of use of required design mixture.
5. Concrete placement, including conveying and depositing.
6. Curing procedures and maintenance of curing temperature.
7. Verification of concrete strength before removal of shores and forms from beams and slabs.

C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.

a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

3. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
4. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
5. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
6. Compression Test Specimens: ASTM C 31/C 31M.

    a. Cast and laboratory cure four cylinders for each composite sample.

        1) Do not transport field-cast cylinders until they have cured for a minimum of 24 hours.

7. Compressive-Strength Tests: ASTM C 39/C 39M;

    a. Test one cylinder at 7 days
    b. Test two cylinders at 28 days
    c. Test one cylinder at 56 days
    d. If 4” by 8” cylinders are used, provide 1 additional cylinder at each stage

8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
9. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
11. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.

    a. When the strength level of the concrete for any portion of the structure, as indicated by cylinder tests, falls below the specified requirements, the Contractor shall provide improved curing conditions and/or adjustments to the mix design as required to obtain the required strength. If the average strength of the laboratory control cylinders falls so low as to be deemed unacceptable, the Contractor shall follow the core test procedure set forth in ACI 301, Section 1.6. Locations of core tests shall be approved by the Architect. Core sampling and testing shall be at Contractors expense.
    b. If the results of the core tests indicate that the strength of the structure is inadequate, any replacement, load testing, or strengthening as may be ordered by the Architect shall be provided by the Contractor without cost to the Owner.

12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
13. Correct deficiencies in the Work that test reports and inspections indicate does not comply with the Contract Documents.

END OF SECTION 03 30 00

SECTION 04 0341

RESTORATION MORTAR

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Analysis of original mortar.
   2. Mortar materials.
   3. Mortar mixes.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.
   2. Section 04 0342 - Masonry Restoration.

1.2 REFERENCES

A. ASTM International (ASTM):
   1. C144 - Standard Specification for Aggregate for Masonry Mortar.
   2. C150 - Standard Specification for Portland Cement.
   3. C207 - Standard Specification for Hydrated Lime for Masonry Purposes.
   4. C1324 - Standard Practice for Examination and Analysis of Hardened Masonry Mortar.

1.3 SUBMITTALS

A. Submittals for Review:
   1. Samples:
      a. Samples: 1/2 x 1/2 x 3 inch samples of proposed mortar.
      b. Remove two samples of each original mortar from different unweathered locations; submit for comparison to new mortar samples.

B. Quality Control Submittals:
   1. Test Reports: Original mortar analysis.
   2. Qualifications: Restorer qualifications, including previous projects.

1.4 QUALITY ASSURANCE

A. Restorer Qualifications:
   1. Minimum 5 years experience in work of this Section.
   2. Successful completion of at least 3 projects of similar scope and complexity within past 5 years.

B. Preconstruction Testing Laboratory Services:
   1. Remove minimum of 4 unweathered, undisturbed, full depth mortar samples from each original masonry system.
      a. Select samples from different locations representative of various existing conditions.
      b. Size: 6 inches wide, full depth.
      c. Include all types of mortar present in each location.
   2. Retain one sample from each original mortar system for later comparison with proposed mortar mixes.
   3. Test mortar in accordance with ASTM C1324; report the following:
      a. Volumetric proportions of aggregate, cement, lime, and other ingredients.
      b. Type, composition, color, and gradation of aggregate.
      c. Presence of pigments or additives.
   4. Based on test results, provide recommended mortar mix for each masonry system in accordance with ASTM C270, compatible with physical and mechanical properties of original masonry materials.

C. Mockup:
   1. Methodology for mortar removal
   2. Provide mockup of mortar that closely matches consistency, color, and strength of original mortar.
   3. Mortar testing, removal methods, field samples and mockup to be approved by Architect and THC representative prior to commencing the work.

1.5 DELIVERY, STORAGE AND HANDLING

A. Protect materials from moisture absorption and damage; reject damaged containers.

B. Store sand to prevent inclusion of foreign matter.

1.6 PROJECT CONDITIONS

A. Do not apply materials during inclement or freezing weather, or if such conditions are anticipated within material curing period.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers - Colorants:
   1. Arizona Oxides LLC. (www.arizonaoxides.com)
   2. Davis Colors. (www.daviscolors.com)
   3. Solomon Colors. (www.solomoncolors.com)

B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. Portland Cement:
   1. Type: ASTM C150, Type I, containing maximum 0.60 percent alkali (sodium oxide) and maximum 0.15 percent water soluble alkali by weight.
   2. Color: To match original mortar.

B. Lime: ASTM C207, Type S, hydrated masonry type.

C. Sand: ASTM C144; color, size, and type to match original mortar.

D. Water: Potable, clean, and free from deleterious amounts of acids, alkalis, and organic matter.

E. Colorant: Chemically pure mineral oxides, alkali proof and light fast.

F. Other Components: As determined by original mortar analysis to produce visual and performance characteristics to match original mortar.

G. Air Entraining, Antifreeze, Bonding, and Other Additives: Not permitted.

H. Premixed Mortar: Premixed restoration mortar Type N may be used in lieu of site mixed restoration mortar if requirements of Contract Document are met.

2.3 MIXES

A. Proportions: As determined by original mortar analysis.

B. Ultimate Compressive Strength: Not to exceed that of original mortar or masonry.

2.4 MIXING

A. Thoroughly mix ingredients in quantities needed for immediate use.

B. Mix dry ingredients mechanically until uniformly distributed; add water to achieve workable consistency.

C. Discard lumpy, caked, frozen, and hardened mixes, and mixes not used within 2 hours after initial mixing.

D. Use mortar within 2-1/2 hours after initial mixing at ambient temperatures below 80 degrees F and within 1-1/2 hours after initial mixing at ambient temperatures over 80 degrees F.

E. Do not add antifreeze compounds to lower freezing temperature of mortar.

F. Provide consistent color for exposed mortar.

PART 3 EXECUTION

3.1 INSTALLATION

A. Follow requirements specified in referenced sections.

END OF SECTION

SECTION 04 0342

MASONRY RESTORATION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Replacement of damaged and missing limestone.
2. Patching deteriorated and damaged limestone.
3. Veneering existing limestone.
4. Tooling existing limestone.
5. Repointing mortar joints.

B. Related Sections:
1. Division 01: Administrative, procedural, and temporary work requirements.
2. Section 01 2200 – Unit Prices.
3. Section 04 0341 - Restoration Mortar.
4. Section 04 0344 - Masonry Cleaning.
5. Section 07 9200 - Joint Sealers.

1.2 REFERENCES

A. ASTM International (ASTM):
1. A666 – Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
2. C97 - Standard Test Methods for Absorption and Bulk Specific Gravity of Dimension Stone.
3. C170 - Standard Test Method for Compressive Strength of Dimension Stone.
4. C295 - Standard Guide for Petrographic Examination of Aggregates for Concrete.

B. The Masonry Society (TMS):
1. 402 - Building Code for Masonry Structures.
2. 602 - Specification for Masonry Structures.

1.3 DEFINITIONS

A. Defective Mortar Joints:
1. Joints in which mortar is missing, loose, spalled, eroded, powdered, broken, hollow, unsound, soft, or weathered more than 3/16 inch from original plane.
2. Sound joints containing fine hairline cracks are excluded.

1.4 SUBMITTALS

A. Submittals for Review:
1. Samples: Limestone samples showing proposed color and texture ranges.

B. Quality Control Submittals:
1. Qualification Statement: Restorer qualifications per Section 01 4001.
2. Test Results: Certified test results of preconstruction stone testing.

1.5 QUALITY ASSURANCE

A. Architect and THC Representative will assess existing conditions after masonry has been cleaned and prior to masonry restoration.

B. Restorer Qualifications:
1. Minimum 5 years experience in work of this Section.
2. Successful completion of at least 3 projects of similar scope and complexity within past 5 years.

C. Perform Work in accordance with TMS 402 and 602.

D. Preconstruction Testing Laboratory Services:
1. Select four samples each of original limestone and proposed new limestone.
2. Test stone in accordance with ASTM C97, ASTM C170 and ASTM C295.

3. Report compressive strength, absorption, and initial rate of absorption.
4. Identify physical and mechanical characteristics.

E. Mockups:
1. Restore approximately 10 square feet of original masonry. Show:
a. Masonry replacement.
b. Masonry patching.
c. Masonry veneering.
d. Routing and repointing procedures.
e. Mortar color and texture.
f. Joint tooling sequence and profile.
2. Locate where directed.
3. Mockup to be approved by Architect and THC representative prior to commencing the Work.

1.6 PROJECT CONDITIONS

A. Wall Protection:
1. During erection, cover tops of partially completed walls with strong waterproof membrane at end of each day or work stoppage.
2. Extend cover minimum of 24 inches down both sides; hold securely in place.

B. Load Application:
1. Do not apply uniform loads for at least 12 hours after building masonry columns or walls.
2. Do not apply concentrated loads for at least 3 days after building masonry columns or walls.

C. Environmental Requirements:
1. Hot weather requirements: If ambient temperature is over 95 degrees F or relative humidity is less than 50 percent, protect from direct sun and wind exposure for minimum 48 hours after installation.
2. Cold weather requirements: Do not use frozen materials or build on frozen work.

1.7 SEQUENCING

A. Restore and clean masonry in following sequence:
1. Clean masonry under provisions of Section 04 0344.
2. Replace, patch, and veneer masonry.
3. Rout and repoint mortar joints.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers - Patching Compound:
1. Cathedral Stone Products, Inc. (www.cathedralstone.com)
2. Edison Coatings, Inc. (www.edisoncoatings.com)

B. Acceptable Manufacturers - Bonding Agents and Epoxies:
1. Bonstone Materials Corp. (www.bonstone.com)
2. IPA Systems, Inc. (www.ipasystems.com)
3. Specco Industries, Inc. (www.specco.com)

C. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. Limestone:
1. Reuse original limestone salvaged during demolition operations where possible.
2. Where salvaged limestone is of insufficient quantity or is unsuitable for reuse, provide new limestone from original quarry to match original in compressive strength, absorption, initial rate of absorption, color, size, and surface texture.
3. General Contractor is responsible for arrangements necessary to obtain limestone from original quarry, including access, quarrying, and restoration of quarry area.

B. Mortar: Specified in Section 04 0341.

2.3 ACCESSORIES

A. Anchors: Stainless steel, ASTM A666, Type 304 or 316.

B. Joint Sealers: Specified in Section 07 9200.

C. Patching Compound: Premixed cementitious mortar mix, color to match existing masonry; Jahn Restoration Mortar by Cathedral Stone Products, Inc. or approved substitute.

D. Epoxy: Multiple component, 100 percent solids, produced specifically for setting anchors in masonry.

E. Bonding Agent: Two component modified epoxy resin.

PART 3 EXECUTION

3.1 PREPARATION

A. Prior to beginning work examine existing mortar joints to determine procedures required to match new mortar to existing, including:
   1. Order in which horizontal and vertical joints were tooled.
   2. Style of tooling including depth and profile.

3.2 REPLACEMENT OF DAMAGED AND MISSING LIMESTONE

A. Remove damaged and deteriorated stone without damage to adjacent stone.

B. Install new or salvaged limestone where original limestone is missing or was removed.

C. Establish lines, levels, and courses to match original. Fit new masonry to bond and coursing of original stone.

D. Lay stone plumb and true to line.

E. Do not shift stone after mortar has achieved initial set. If adjustments must be made after initial set, remove mortar and replace with new.

F. Lay stone in full mortar bed, with full head joints.

G. Do not butter corners or excessively furrow joints.

H. Cut stone with straight, true cuts and clean, unchipped edges. Prevent oversized or undersized joints. Discard damaged units.

I. Where fresh stone joins existing or partially set stone, remove loose stone and mortar; clean and lightly wet exposed surface of set stone.

J. Rake out joints to 1/2 inch depth.

3.3 PATCHING LIMESTONE

A. Large Spalled Areas and Severely Deteriorated Surfaces:
   1. Patch deteriorated stone with patching compound to match original stone.
   2. Remove deteriorated stone until sound material is reached.
   3. Set anchors in existing stone:
      a. Drill holes for anchors at interface of new and existing stone.
      b. Space anchors maximum 9 inches on center.
      c. Provide minimum 3/4 inch coverage of patching compound over ends of anchors.
      d. Extend anchors into sound existing stone to a depth equivalent to anchor projection.
      e. Bond anchors to existing masonry with epoxy.
   4. Apply patching compound:
      a. Lightly wet stone. Apply bonding agent in accordance with manufacturer’s instructions.
      b. Mix and apply patching compound in accordance with manufacturer’s instructions. Build up in maximum 1/2 inch thick layers.
      c. Allow each layer to cure minimum time recommended by manufacturer before

proceeding. Lightly wet set material and existing stone before applying next layer.

d. Finish patches to match color and texture of original stone so that patches are nearly indistinguishable.

e. Keep patches moist until fully cured.

B. Small Spalled Areas, Minor Cracks and Holes, and Lightly Deteriorated Surfaces:

1. Patch stone with patching compound to match existing.
2. Remove deteriorated stone until sound material is reached.
3. Score or groove contact surfaces of stone to form mechanical bond with patching compound.
4. Lightly wet masonry. Apply bonding agent in accordance with manufacturer's instructions.
5. Mix and apply patching compound in accordance with manufacturer's instructions. Build up in maximum 1/2 inch thick layers.
6. Allow each layer to cure minimum 12 hours before proceeding. Lightly wet set material and existing stone before applying next layer.
7. Finish patches to match color and texture of original stone so that patches are nearly indistinguishable.
8. Keep patches moist until fully cured.

3.4 VENEERING LIMESTONE

A. Resurface deteriorated stone with new stone to match original.

B. Remove deteriorated stone to point at which sound stone is reached.

C. Drill holes for dowels at interface of new and existing stone.

D. Anchor new stone to existing with anchors set in epoxy.

E. Finish new stone flush with original.

3.5 REPOINTING MORTAR JOINTS

A. Rout out defective mortar joints.

B. Prepare dynamic joints and cracks to receive sealer as specified in Section 07 9200.

C. Repoint static joints with pointing mortar to match original.

D. Remove existing mortar to depth equal to 2-1/2 times joint width, but not less than 1/2 inch or depth at which sound mortar is reached.

E. Power grinders may be used as a preliminary step in removing joints only. Cut thin line down center of mortar joint; remove remaining mortar using hand tools.

F. Remove mortar cleanly, without damaging masonry. Cut back of joints square.

G. Remove loose particles with compressed air or water.

H. Lightly wet masonry just prior to repointing.

I. Fill areas where mortar has been removed to greatest depth first.

J. Build up mortar in several 1/4 inch compacted layers until outer face of masonry is reached.

K. Allow each layer to reach thumbprint hardness prior to applying next layer.

L. If existing masonry has worn, rounded edges, recess mortar slightly from face of masonry.

M. When final mortar layer has reached thumbprint hardness, tool to match sequence and profile of original. Avoid light streaks, hairline cracks, tool burning, open joints, and other defects caused by tooling when mortar is excessively wet or dry.

N. Remove excess mortar from edge of joint by brushing with stiff bristle brush; wire brushes not permitted.

O. If necessary to more closely match original mortar color and texture, artificially age mortar using one of following methods:
   1. Lightly brush with stiff natural brush after tooling.
   2. Apply fine mortar spray with low pressure water after tooling.
   3. Staining is not permitted.

END OF SECTION

SECTION 04 0344

MASONRY CLEANING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Chemical cleaning of limestone.

B. Related Sections:

1. Division 01: Administrative, procedural, and temporary work requirements.
2. Section 00 3126 – Environmental Reports.
3. Section 00 3138 – Historic Paint and Finish Analysis Report.
4. Section 00 3144 – Masonry Conservation Report.
5. Section 04 0342 – Masonry Restoration.

1.2 DEFINITIONS

A. Low Pressure: Less than 60 PSI.

B. Medium Pressure: 60 to 400 PSI.

C. High Pressure: 400 to 1000 PSI.

1.3 SUBMITTALS

A. Submittals for Review:
1. Product Data: Include product description, application procedures, precautions, and limitations in use of products.

B. Quality Control Submittals:
1. Qualifications: Restorer qualifications, including previous projects.

1.4 QUALITY ASSURANCE

A. Restorer Qualifications:
1. Minimum 5 years experience in work of this Section.
2. Successful completion of at least 3 projects of similar scope and complexity within past 5 years.

B. Mockup: Clean approximately 10 square feet of each type of existing masonry in the presence of Architect and THC representative.
1. Determine effectiveness of materials and methods.
2. Appropriate method to be used will be the gentlest means possible.
3. Test clean with water prior to attempting use of chemicals.
4. Ensure that materials and procedures will not discolor or damage historic surfaces.
5. Perform multiple applications of varying concentrations of cleaning solution to determine optimum concentration.
6. Test adjacent non-masonry surfaces for detrimental reaction with paint stripper and cleaning solution.
7. Locate where directed.

1.5 PROJECT CONDITIONS

A. Environmental Requirements:
1. Do not perform work when ambient or surface temperature is below 40 degrees F, during precipitation, or if these conditions are anticipated within 24 hours after completion of work.
2. Do not perform work when wind could carry materials to adjacent or underlying materials, or to adjacent property.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
   1. Dumond. (www.dumondchemicals.com)

B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. Paint Stripper: Peel Away 1 by Dumond or approved substitute.

B. Water: Potable, clean, and free from acids, alkalis, and detrimental matter.

2.3 EQUIPMENT

A. Spray Equipment:
   1. Capable of producing and maintaining water pressure of 400 psi maximum.
   2. Equipped with 40 degree stainless steel fan tip.

2.4 MIXES

A. Mix materials in accordance with manufacturer's instructions to proportions determined by cleaning of mockup.

PART 3 EXECUTION

3.1 PREPARATION

A. Close off areas in which work is being performed to pedestrian and vehicular traffic.

B. Protect adjacent and underlying surfaces from damage.

C. Install temporary dams and containment devices to collect runoff water.

D. Reference Section 00 3126 – Environmental Reports.

3.2 GENERAL

A. Clean existing masonry surfaces.

B. Remove dirt, hydrocarbons, grease, oil, environmental pollutants, and residues.

C. Sandblasting and the use of non-proprietary acids is prohibited.

D. Follow manufacturer's instructions and procedures established during preparation of mockup.

E. Do not damage existing surfaces. Leave surfaces uniform in appearance.

3.3 CLEANING OF LIMESTONE

A. Pre-wet surfaces with clean hot water at medium pressure until stone surface is saturated.

B. Apply paint stripper by brush or roller to uniform coverage. Work solution into surface voids and joints.

C. Allow solution to stand on surfaces for 48 hours.

D. If surfaces begin to dry, re-wet surfaces and apply additional solution.

E. Rinse surfaces with clean hot water at medium pressure.
   1. Hold nozzle perpendicular to surface; work at uniform rate and uniform distance from surface.
   2. Work from bottom of wall up.
   3. Continue washing until sudsing has ceased.

E. Repeat cleaning process (A through E) for entire exterior of the building.

F. Manually remove unsightly mastic remnants in crevices and joints that are visible from the ground level with non-abrasive brush or pick.

END OF SECTION

SECTION 04 0513

MASONRY MORTARING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Mortar for new masonry.

B. Related Sections:
1. Division 01: Administrative, procedural, and temporary work requirements.
2. Section 04 2000 – Unit Masonry.

1.2 REFERENCES

A. ASTM International (ASTM):
1. C144 - Standard Specification for Aggregate for Masonry Mortar.
2. C150 - Standard Specification for Portland Cement.
3. C207 - Standard Specification for Hydrated Lime for Masonry Purposes.
4. C270 - Standard Specification for Mortar for Unit Masonry.

B. The Masonry Society (TMS):
1. 402 - Building Code for Masonry Structures.
2. 602 - Specification for Masonry Structures.

1.3 SUBMITTALS

A. Submittals for Review:
1. Samples: 1/2 x 1/2 inch x 3 inch long colored mortar samples showing proposed color.

B. Quality Control Submittals:
1. Test reports: Indicating mortar compliance with ASTM C270.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with TMS 402 and 602.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver cement and lime in manufacturer's original, unopened packages or containers.

B. Protect materials from moisture absorption and damage; reject damaged containers.

C. Store aggregate to prevent inclusion of foreign matter.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers - Colorants:
1. Cathay Pigments. (www.cathaypigments.com)
2. Davis Colors. (www.daviscolors.com)
3. Solomon Colors. (www.solomoncolors.com)

B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. Portland Cement:
1. ASTM C150, Type I.
2. For exposed surfaces, provide cement from one source throughout project.

B. Aggregate:
   1. ASTM C144, standard masonry type.
   2. For exposed surfaces, provide aggregate from one source throughout project.

C. Lime: ASTM C207, Type S.

D. Colorant: Pure mineral oxide type.

E. Water: Clean and free from oils, acids, alkalies, organic matter, and other substances in amounts deleterious to mortar or metals in masonry.

2.3 MIXES

A. Mortar Mix: ASTM C270, Type N, gray, using the Property Method.

2.4 MIXING

A. Mix mortar in accordance with ASTM C270.

B. Mix using mechanical mixer. Hand mixing not permitted.

C. Mix approximately three-quarters of required water, all of cement and lime, and one-half of aggregate for minimum of 2 minutes.

D. Add remainder of water and aggregate; mix for minimum of 3 minutes.

E. Provide uniformity of color in exposed mortar.

F. Colorant may not exceed 9 pounds per 94 pound bag of cement.

G. Thoroughly mix ingredients in quantities needed for immediate use.

H. Discard lumpy, caked, frozen, and hardened mixes.

I. Mortar may be retempered by adding water as required. Use mortar within 2-1/2 hours after initial mixing at ambient temperatures below 80 degrees F and within 1-1/2 hours after initial mixing at ambient temperatures over 80 degrees F.

J. Do not add accelerators, retarders, water repellents, antifreeze compounds, or other additives without Architect's approval.

PART 3 EXECUTION

3.1 INSTALLATION

A. Follow requirements specified in referenced sections.

END OF SECTION

SECTION 04 0516

MASONRY GROUTING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Grout for masonry.

B. Related Sections:
1. Division 01: Administrative, procedural, and temporary work requirements.
2. Section 04 2000 - Unit Masonry.

1.2 REFERENCES

A. ASTM International (ASTM):
1. C150 - Standard Specification for Portland Cement.
2. C207 - Standard Specification for Hydrated Lim e for Masonry Purposes.
3. C404 - Standard Specification for Aggregates for Masonry Grout.
4. C476 - Standard Specification for Mortar and Grout for Reinforced Masonry.

B. The Masonry Society (TMS):
1. 402 - Building Code for Masonry Structures.
2. 602 - Specification for Masonry Structures.

1.3 SUBMITTALS

A. Quality Control Submittals:
1. Test reports: Indicating grout compliance with ASTM C476.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with TMS 402 and 602.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver cement and lime in manufacturer's original, unopened packages or containers.

B. Protect materials from moisture absorption and dam age; reject dam aged containers.

C. Store aggregate to prevent inclusion of foreign matter.

PART 2 PRODUCTS

2.1 MATERIALS

A. Portland Cement: ASTM C150, Type I.

B. Aggregate: ASTM C404.

C. Lime: ASTM C207, Type S.

D. Water: Clean and free from oils, acids, alkalies, organic matter, and other substances in amounts deleterious to mortar or metals in masonry.

2.2 MIXES

A. Grout Mix:
   1. ASTM C476, coarse grout.
   2. Compressive strength: Minimum 2500 psi at 28 days.
   3. Slump: 7 to 8 inches.

2.3 MIXING

A. Mix grout in accordance with ASTM C476.

B. Thoroughly mix ingredients in quantities needed for immediate use.

C. Mix dry ingredients mechanically until uniformly distributed; add water to achieve workable consistency.

D. Discard lumpy, caked, frozen, and hardened mixes.

E. Use grout within 2-1/2 hours after initial mixing at ambient temperatures below 80 degrees F and within 1-1/2 hours after initial mixing at ambient temperatures over 80 degrees F.

F. Do not add accelerators, retarders, water repellents, antifreeze compounds, or other additives without Architect's approval.

PART 3 EXECUTION

3.1 INSTALLATION

A. Follow requirements specified in referenced sections.

END OF SECTION

SECTION 04 2000

UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Concrete masonry units

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.
   2. Section 04 0513 – Masonry Mortaring
   3. Section 04 0516 – Masonry Grouting

1.2 REFERENCES

A. ASTM International (ASTM):
   1. A615/A615M – Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
   2. A951 – Standard Specification for Masonry Joint Reinforcement.
   3. C90 – Standard Specification for Hollow Loadbearing Concrete Masonry Units

B. The Masonry Society (TMS):
   1. 402 – Building Code for Masonry Structures
   2. 602 – Specification for Masonry Structures

1.3 SUBMITTALS

A. Submittals for Review:
   1. Product Data: Provide information on reinforcing and anchors including sizes, profiles, materials, and finishes.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Minimum 2 years documented experience in work of this Section.

B. Perform Work in accordance with TMS 402 and 602.

1.5 DELIVERY, STORAGE AND HANDLING

A. Store masonry off ground; prevent contact with materials that could cause staining or damage.

B. Protect reinforcement and anchors from corrosion.

1.6 PROJECT CONDITIONS

A. Wall Protection:
   1. During erection, cover tops of partially completed walls with strong waterproof membrane at end of each day or work stoppage.
   2. Extend cover minimum of 24 inches down both sides; hold securely in place.

B. Load Application:
1. Do not apply uniform loads for at least 12 hours after building masonry walls.
2. Do not apply concentrated loads for at least 3 days after building masonry walls.

C. Environmental Requirements:
1. Hot weather requirements: If ambient temperature is over 95 degrees F or relative humidity is less than 50 percent, protect from direct sun and wind exposure for minimum of 48 hours after installation.
2. Cold weather requirements: Do not use frozen materials or build on frozen work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers – Masonry Accessories:
1. Blok-Lok Ltd. (www.blok-lok.com)
2. Dur-O-Wal. (www.dur-o-wal.com)
3. Heckmann Building Products. (www.heckmannbuildingprods.com)
4. Hohmann and Barnard, Inc. (www.h-b.com)

B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. Concrete Masonry Units:
1. ASTM C129, hollow non-load bearing type, light weight, Type I – Moisture Controlled.
2. Size: Nominally 8 inches high x 16 inches long x thickness indicated.
3. Special shapes: Lintels and bond beams.

2.3 ACCESSORIES

A. Mortar: Specified in Section 04 0513.

B. Grout: Specified in Section 04 0516.

C. Joint Reinforcement:
1. Ladder type: ASTM A951, hot dipped galvanized steel wire, 9 gage side rods with 9 gage cross ties.
2. Width: Nominal wall thickness less 1-1/2 inches
3. Corner and tee fittings: Type to match reinforcement.

D. Reinforcing Bars: ASTM A615/A615M, deformed billet steel, Grade 40 or 60.

E. Cleaner: Type recommended by masonry manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Remove dirt, loose rust, and other foreign matter from reinforcement and anchors.

3.2 INSTALLATION

A. Establish lines, levels and courses indicated. Protect from displacement.

B. Maintain masonry courses to uniform dimensions. From horizontal and vertical joints of uniform thickness.

C. Lay masonry in running bond. Course one masonry unit and one mortar joint to equal 8 inches.

D. Lay masonry plumb and level. Do not adjust masonry units after mortar has set.

E. Lay masonry units with face shell bedding on head and bed joints.

F. Do not butter corners or excessively furrow joints.

G. Machine cut masonry with straight cuts and clean edges; prevent oversized or undersized joints. Discard damaged units. Do not expose cut cells.

H. Isolate masonry from structural members with compressible filler.

I. When joining fresh masonry to partially set masonry, remove loose masonry and mortar; clean and lightly wet exposed surface of set masonry.

J. Stop horizontal runs by racking back normal bond unit in each course. Toothing not permitted.

K. Horizontal Reinforcement:
   1. Place reinforcement at maximum 16 inches on center vertically and at topmost course.
   2. Extend minimum 24 inches each side of openings.
   3. Center reinforcing in wall.
   4. Lap ends 6 inches minimum; use fabricated tee and corner fittings at corners and intersections.

L. Secure new masonry to existing masonry with anchors spaced maximum 16 inches on center.

M. Finishing Mortar Joints:
   1. Exposed locations: Tool joints to concave profile.
   2. Concealed locations: Cut joints flush.

N. Installation Tolerances: Maximum variation from:
   1. Alignment face to face of adjacent units: Plus or minus 1/8 inch.
   2. Vertical alignment of head joints: Plus or minus 1/2 inch in 10 feet.
   3. True plane of wall: Plus or minus 1/4 inch in 10 feet and 1/2 inch in 20 feet or more.
   4. Plumb: Plus or minus 1/4 inch in 10 feet noncumulative; 1/2 inch in 20 feet or more.
   5. Level coursing: Plus or minus 1/8 inch in 3 feet; 1/4 inch in 10 feet; 1/2 inch in 30 feet.
   6. Joint thickness: Plus or minus 1/8 inch.

3.3 CLEANING

A. Protect adjacent and underlying surfaces.

B. Apply masonry cleaner in accordance with manufacturer's instructions.

C. Thoroughly rinse surfaces with clean water after completion of cleaning; remove all traces of cleaning solution.

END OF SECTION

SECTION 04 4000

STONE ASSEMBLIES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Cut limestone.
   2. Integral flashings.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.
   2. Section 01 2300 – Alternates.
   3. Section 04 0341 - Restoration Mortar.
   4. Section 04 0342 - Masonry Restoration.
   5. Section 07 9200 - Joint Sealers.

1.2 REFERENCES

A. ASTM International (ASTM):
   1. A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
   2. C97 - Standard Test Methods for Absorption and Bulk Specific Gravity of Dimension Stone.
   3. C119 - Standard Definitions of Term s Relating to Natural Building Stones.
   4. C170 - Standard Test Method for Com pressive Strength of Dimension Stone.

B. The Masonry Society (TMS):
   1. 402 - Building Code for Masonry Structures.
   2. 602 - Specification for Masonry Structures.

1.3 SUBMITTALS

A. Submittals for Review:
   1. Shop Drawings: Include location and sizes of pieces, arrangement and size of joints, anchorage details, and other details of installation.
   2. Product Data: Provide information on anchors including sizes, profiles, materials, and finishes.
   3. Samples: 12 x 12 inch stone samples showing color and finish ranges.

B. Quality Control Submittals:
   1. Qualification Statement: fabricator and installer qualifications per Section 01 4001.

1.4 QUALITY ASSURANCE

A. Fabricator and Installer Qualifications:
   1. Minim um 5 years documented experience in work of this Section.
   2. Successful completion of at least 3 projects of similar scope and complexity within past 5 years.

B. Mockup:
   1. Size: Minimum 4 x 4 feet.
   2. Show:
      a. Stone color and texture range.
      b. Mortar joint size, color, and profile.
      c. Bond pattern.
      d. Anchors.
      e. Flashings and weeps.
   3. Locate where directed.
   4. Mockup to be approved by Architect and THC representative prior to commencing the Work.

C. Perform Work in accordance with TMS 402 and 602.

1.5 DELIVERY, STORAGE AND HANDLING

A. Store stone off ground; prevent contact with materials that could cause staining or dam age.

B. Protect anchors from corrosion.

1.6 PROJECT CONDITIONS

A. W all Protection:
1. During erection, cover tops of partially completed walls with strong waterproof membrane at end of each day or work stoppage.
2. Extend cover minim um of 24 inches down both sides; hold securely in place.

B. Environmental Requirements:
1. Hot weather requirements: If ambient temperature is over 95 degrees F or relative humidity is less than 50 percent, protect from direct sun and wind exposure for minimum 48 hours after installation.
2. Cold weather requirements: Do not use frozen materials or build upon frozen work.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers - Masonry Accessories:
1. Blok-Lok Ltd. (www.blok-lok.com)
2. Dur-O-W al. (www.dur-o-wal.com)
3. Heckmann Building Products. (www.heckmannbuildingprods.com)
4. Hohmann and Barnard, Inc. (www.h-b.com)

B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. Cut Stone: Limestone to match original limestone; refer to Section 04 0342.

2.3 ACCESSORIES

A. Mortar: Specified in Section 04 0341.

B. Anchors: Stainless steel, ASTM A666, Type 304.

C. Flashings: Stainless steel, ASTM A666, Type 304, minim um inch thick.

D. Weeps: Recycled polyester mesh bonded with perm anent adhesive, 90 percent open, 2.5 x 3.5 inches x 0.5 inch thick; Mortar Net Weep Vents by Mortar Net USA Ltd. or approved substitute, color to be selected from manufacturer's full color range.

E. Mortar Dropping Control: High density polyethylene or nylon, 90 percent open mesh, 10 inches high x thickness to suit cavity width; The Mortar Net by Mortar Net USA Ltd. or approved substitute.

F. Joint Sealer: Specified in Section 07 9200.

2.4 FABRICATION

A. Cut adjacent pieces from same block wherever possible.

B. Fabricate stone for uniform coloration between adjacent units and over full area of installation.

C. Fabricate for beds and joints to match original stone.

D. Cut or saw bed and joint surfaces square for full thickness of unit.

E. Backs: Sawn.

F. Slope exposed top surfaces of stone and horizontal sill surfaces for shedding water.

G. Cut drip slot in stone projecting more than 1 inch. Size slot not less than 1/4 inch wide and deep for full width of projection.

H. Provide holes and cutouts to accommodate items attached to stone.

I. Groove out edges of stone to recess anchors below setting bed.

J. Fabrication Tolerances:
   1. Variation in width or height: Plus or minus 1/16 inch.
   2. Variation in thickness: Plus or minus 1/8 inch.
   3. Variation from true plane: Plus or minus 1/16 inch in 3 feet.

PART 3 EXECUTION

3.1 PREPARATION

A. Establish lines, levels, and coursing. Protect from disturbance.

B. Clean stone prior to installation. Do not use wire brushes or implements that can mark or damage exposed surfaces.

C. Wet stone in preparation for placement to minimize moisture suction from mortar.

3.2 INSTALLATION

A. Install in accordance with approved Shop Drawings.

B. Arrange stone pattern to provide color uniformity and constant joint sizes throughout.

C. Anchor stone to backup construction with edge anchors:
   1. Space anchors maximum 24 inches on center around perimeter
   2. Provide minimum of four anchors per panel.

D. Set stone plumb and level. Align adjacent pieces in same plane.

E. Obtain approval prior to cutting or fitting any item not so indicated on Drawings. Do not impair appearance or strength of stone work by cutting.

F. Set stone in full mortar setting bed; support stone over full bearing surface.

G. Completely fill beds and joints, then rake out for pointing.

H. Fill joints with pointing mortar; tool to profile to match original stone.

I. Flashings:
   1. Install flashing with outer edge flush with outside face of stone; extend up backup 8 inches minimum and build into masonry.
   2. Lap end joints 4 inches minimum and seal.
   3. Form end dams where flashing is stopped or interrupted.

J. Weeps:
   1. Locate in head joints in first course above flashings at maxim um 32 inches on center.
   2. Set weeps flush with exterior face of masonry.

K. Control Joints:
   1. Keep joints free from m ortar and grout.
   2. Install joint backing and joint sealer at control joints in accordance with Section 07 9200.

L. Install mortar dropping control continuously in cavities above flashings.

3.3 CLEANING

A. Clean stone with detergent and water applied with fiber brush.

3.4 PROTECTION

A. Protect stone subject to damage by use of nonstaining sheet coverings.

END OF SECTION

SECTION 04 7200

CAST STONE

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Plant cast simulated stone units.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.
   2. Section 04 0341 - Restoration Mortar.
   3. Section 07 9200 - Joint Sealers.

1.2 REFERENCES

A. American Concrete Institute (ACI) 318 - Building Code Requirements for Structural Concrete.

B. ASTM International (ASTM):
   1. A185/A185M - Standard Specification for Welded Steel Wire Reinforcement, Plain, for Concrete.
   2. A615 - Standard Specification for Deformed Billet Steel Bars for Concrete.
   3. A666 - Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
   4. C33 - Standard Specification for Concrete Aggregates.
   5. C150 - Standard Specification for Portland Cement.
   6. C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
   7. C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
   8. C426 - Standard Test Method for Linear Shrinkage of Concrete Masonry Units.
   9. C494 - Standard Specification for Chemical Admixtures for Concrete.
   10. C618 - Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolans for Use as a Mineral Admixture in Portland Cement Concrete.
   11. C979 - Standard Specification for Pigments for Integrally Colored Concrete.
   12. C1194 - Standard Test Method for Compressive Strength of Architectural Cast Stone.
   13. C1195 - Standard Test Method for Absorption of Architectural Cast Stone.
   14. C1364 - Standard Specification for Architectural Cast Stone.

C. Cast Stone Institute (CSI) - Technical Manual.

D. The Masonry Society (TMS):
   1. 402 - Building Code for Masonry Structures.
   2. 602 - Specification for Masonry Structures.

1.3 SUBMITTALS

A. Submittals for Review:
   1. Shop Drawings:
      a. Provide cross section showing profile, reinforcing, and attachment methods.
      b. Include plan and elevation of each unit, numbered in sequence for installation.
   2. Samples: Sample of typical unit, showing construction, profile, color, and finish.

B. Quality Control Submittals:
   1. Qualification Statement: Restorer qualifications per Section 01 4001.

1.4 QUALITY ASSURANCE

A. Fabricator and Installer Qualifications:
   1. Minimum 5 years experience in work of this Section.
   2. Successful completion of at least 3 projects of similar scope and complexity within past 5 years.

B. Mockup:
   1. Size: 4 feet long x full height.
   2. Show: Stone profile, color, and finish, anchors, and flashings.
   3. Locate where directed.
   4. Mockup to be approved by Architect and THC representative prior to commencing the Work.

C. Perform Work in accordance with TMS 402 and 602.

D. Design, fabricate, and install cast stone in accordance with CSI Technical Manual.

1.5 DELIVERY, STORAGE AND HANDLING

A. Support and isolate units during shipment on nonstaining spacers.

B. Store units to protect from staining and damage.

C. Store units on firm, level, and smooth surfaces; do not place on ground.

1.6 PROJECT CONDITIONS

A. W all Protection:
   1. During erection, cover tops of partially completed walls with strong waterproof membrane at end of each day or work stoppage.
   2. Extend cover minimum of 24 inches down both sides; hold securely in place.

B. Environmental Requirements:
   1. Hot weather requirements: If ambient temperature is over 95 degrees F or relative humidity is less than 50 percent, protect from direct sun and wind exposure for minimum 48 hours after installation.
   2. Cold weather requirements: Do not use frozen materials or build on frozen work.

PART 2 PRODUCTS

2.1 MATERIALS

A. Portland Cement: ASTM C150, Type 1.
   1. For facing mix: White color.
   2. For backing mix: Gray color.

B. Aggregates: ASTM C33, clean and uncoated.
   1. For backing mix: Washed concrete sand, pea gravel, or graded limestone.
   2. For facing mix: Limestone, marble screenings, silica sand, or other light colored sand; same as used in mix of approved sample.

C. Admixtures:
   1. Water reducing or water reducing/set retarding: ASTM C494, Type A or D.
   2. Air entraining: ASTM C260.
   3. Coloring: ASTM C979, pure mineral oxide, color to be selected from manufacturer's full color range.

D. Fly Ash: ASTM C618, maximum 2 percent loss on ignition.

E. Reinforcing Bars: ASTM A615, Grade 40 or 60; galvanized or epoxy coated when covered by less than 1-1/2 inches of material.

F. Welded W ire Fabric: ASTM A185/A185M.

G. Dowels: Stainless steel, ASTM A666, Type 302 or 304.

H. Spacers: Resilient plastic.

I. Formwork: Steel or overlay plywood, consistent with required finish.

2.2 ACCESSORIES

A. Mortar: Specified in Section 04 0341.

B. Joint Sealer: Specified in Section 07 9200.

C. Masonry Cleaner: Type recommended by stone manufacturer.

2.3 MIXES

A. Mix Design:
1. Compressive strength: Minimum 6500 PSI at 28 days, tested to ASTM C1194.
2. Absorption: Maximum 6 percent by cold water method or 10 percent by boiling water method, tested to ASTM C1195.
3. Air entrainment: 5 to 7 percent by volume, tested to ASTM C231.
4. Freeze/thaw: CPW L less than 5 percent after 300 cycles, tested to ASTM C1364.
5. Linear shrinkage: Maximum 0.0065 percent, tested to ASTM C426.
6. Colorant: Maximum 10 percent of cement used by weight.
7. Fly ash content: Minimum 20 percent by weight of cementitious material in mix.

2.4 FABRICATION

A. Fabricate units to match approved samples.

B. Construct rigid, tight molds that will cast required sections with smooth finish.

C. Provide smooth fillet on interior corners of molds to produce slight beveled edge on permanently exposed surfaces.

D. Clean surfaces of foreign materials prior to casting.

E. Coat contact surfaces with form release agent.

F. Provide reinforcing and accessories required for lifting and installation.
1. Before placing in forms, clean reinforcement and accessories of loose rust, mill scale, dirt, oil, and other materials that could reduce bonding.
2. Accurately position reinforcement to provide minimum coverage of not less than twice the bar diameter.
3. Provide reinforcing equal to minimum 0.25 percent of cross section area.
4. Do not use welded wire fabric for dry-cast units.

G. Tamp stone mixture containing minimum water into molds to produce dense stones with smooth surfaces, free from air pockets and voids.

H. Provide uniform surface texture on exposed surfaces, free from holes, voids, and irregularities.

I. Curing:
1. Cure units in warm curing chamber at minimum 100 degrees F and 95 percent humidity for minimum 12 hours, or at minimum 70 degrees F and 95 percent humidity for 16 hours.
2. Cure units in yard at 95 percent relative humidity for 350 degree-days prior to shipping.
3. Protect units cured in forms from evaporation by use of curing blankets or curing compound.

J. Fabrication Tolerances:
   1. Height and width: Plus or minus 1/8 inch.
   2. Length: L/360 or 1/8 inch, maximum plus or minus 1/4 inch.
   3. Bowing, twisting, or warping: Maximum L/360 or 1/8 inch.
   4. Location of dowels, flashing grooves, and similar features: Plus or minus 1/8 inch in any direction on formed sides, maximum 3/8 inch on unformed sides.

2.5 FINISHES

A. Color and Surface Finish: To match original limestone, free from voids and surface irregularities.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install cast stone in accordance with approved Shop Drawings.

B. Drench units with clean water just prior to setting.

C. Completely fill dowels holes and anchor slots with mortar.

D. Maintain uniform spacing between units with plastic spacers.

E. E. Bed each piece in full mortar bed.

F. Equalize bed and joint dimensions.

G. Completely fill beds and joints, then rake out to 3/8 inch depth to allow for pointing.

H. H. Point joints with pointing mortar; tool to profile to match original mortar.

I. Control Joints:
   1. Keep joints free from mortar and grout.
   2. Install joint backing and joint sealer at control joints in accordance with Section 07 9200.

J. Installation Tolerances; Maximum variation from:
   1. Alignment face to face of adjacent units: Plus or minus 1/8 inch.
   2. Plumb: Plus or minus 1/4 inch in 10 feet noncumulative.
   3. Level: Plus or minus 1/8 inch in 3 feet; 1/4 inch in 10 feet; 1/2 inch in 30 feet.
   4. Joint thickness: Plus 16 inch, minus 1/8 inch.

3.2 CLEANING

A. Clean stone with detergent and water applied with fiber brush.

B. If initial cleaning does not produce acceptable results, apply cleaner in accordance with manufacturer's instructions.
   1. Protect adjacent surfaces.
   2. Thoroughly rinse surfaces with clean water after completion of cleaning; remove all traces of cleaning solution.

END OF SECTION

SECTION 05 12 00

STRUCTURAL STEEL

PART 2 - GENERAL

2.1 RELATED DOCUMENTS

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

2.2 SUMMARY

A. This Section includes the following:

1. Structural steel framing members and connections.
2. Deck support angles.
3. Shop prime painting and touch up painting in the field.
4. Temporary construction bracing.
5. Fabrication and erection inspection and testing.

B. Related Sections include the following:

1. Division 1 Section "Quality Requirements" for independent testing agency procedures and administrative requirements.
2. Division 1 Section “Submittals” for administrative requirements for the submission of shop drawings and other submittals.
3. Division 5 Section “Architecturally Exposed Structural Steel.
4. Division 5 Section "Steel Deck" for field installation of shear connectors.
5. Division 5 Section "Metal Fabrications" for not defined as structural steel.
6. Division 5 Section “Metal Stairs”.

2.3 DEFINITIONS

A. Structural Steel: Elements of structural-steel frame, as classified by AISC's "Code of Standard Practice for Steel Buildings and Bridges," that support design loads.

2.4 PERFORMANCE REQUIREMENTS

A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator to withstand ASD-service loads indicated and comply with other information and restrictions indicated.

1. Select and complete connections using schematic details indicated and AISC's " Steel Construction Manual, edition as referenced in the Building Code.
2. Engineering Responsibility: Fabricator's responsibilities include using a qualified professional engineer to prepare structural analysis data for structural-steel connections.

B. Construction: Type PR, partially restrained.

2.5 SUBMITTALS

A. Submit in accordance with Division 1 Section “Submittals”.

B. Submittals for Review

1. Provide complete details and schedules for fabrication and shop assembly of members, erection plans, details, procedures, and diagrams showing sequence of erection of structural steel components.

    a. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
    b. Include embedment drawings.
    c. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.
    d. Indicate type, size, and length of bolts, distinguishing between shop and field bolts.

2. Shop drawings and erection drawings shall not be made by using reproductions of Contract Drawings.

3. Structural steel members for which shop drawings have not been reviewed shall not be fabricated. Engineer's review shall cover general locations, spacings, and details of design. Omission from shop drawings of any materials required by the Contract Documents shall not relieve the Contractor of the responsibility of furnishing and installing such materials, even though such shop drawings may have been reviewed and returned.

C. Submittals for Information:

1. Product Data: For each type of product indicated.
2. For structural-steel connections indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
3. Connection Calculations: Contractor shall design all connections not specifically detailed on the Drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State of Texas. Submit design calculations for the connections designed by the contractor, prior to or with the steel shop drawings. Shop drawings containing connections for which calculations have not been received shall be returned unchecked as an incomplete submittal. Calculations shall be retained for the Engineer's file and will not be approved or returned.

    a. Connections shall be designed in accordance with the requirements specified in the Structural Drawings and Specifications.
    b. Beam connections: Submit a complete calculation for each different beam connection used and detailed on the shop drawings. Conditions which are similar may be grouped together so as to utilize a single connection design.
    c. Submit complete connection calculations for wind brace connections, truss connections, moment connections and other connections where specified on the Contract Drawings. Each calculation shall identify the location or locations for which the connection applies, the member mark(s) from the Contract Documents, the piece mark(s) from the shop drawings, the member size, the design loading(s), member size, and the end of the member to which the connection applies.
    d. The unit of measurement for the connection calculations must follow the United States customary system (USCS).

4. Welding certificates.
5. Qualification Data: For Installer, fabricator, and testing agency.
6. Mill Test Reports: Signed by manufacturers certifying that the following products comply with requirements:

    a. Structural steel including chemical and physical properties.
    b. Bolts, nuts, and washers including mechanical properties and chemical analysis.
    c. Shear stud connectors.
    d. Shop primers.
    e. Nonshrink grout.

7. Source quality-control test reports.

2.6 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years documented experience.

B. Fabricator Qualifications: Company specializing in performing the work of this section with minimum 10 years of documented experience.

C. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."

D. The latest adopted edition of all standards referenced in this Section shall apply unless noted otherwise. In case of conflict between these Contract Documents and the referenced standard, the Contract Documents shall govern. In case of conflict between these Contract Documents and the Building Code, the more stringent shall govern.

E. The Contractor shall furnish fabrication and erection inspection and testing of all welds in accordance with AWS D1.1, Chapter 6. Submit records of inspections and tests to the Owner's testing laboratory for their review. The fabrication and erection inspectors shall be AWS certified welding inspectors.

F. All materials, fabrication procedures and field erection are subject to verification inspection and testing by the Owner's testing laboratory in both the shop and field. Such inspections and tests will not relieve the Contractor of the responsibility for providing materials and fabrication procedures in compliance with specified requirements.

G. Qualifications for Welding Work: Contractor shall be responsible for qualifying welding operators in accordance with the AWS "Standard Qualification Procedure." Provide certification to Owner's testing laboratory that welders to be employed in the work have satisfactorily passed AWS qualification tests. Recertification of welders shall be Contractor's responsibility.

H. Qualification of Welding Procedures: Contractor shall provide the testing laboratory with welding procedures which are to be used. Welding procedures shall be qualified prior to use in accordance with AWS D1.1, Part B.

I. Comply with applicable provisions of the following specifications and documents:

1. AISC's "Code of Standard Practice for Steel Buildings and Bridges”
2. AISC's "Specification for Structural Steel Buildings."
3. ASTM A6 "Specifications for General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use."
4. AISC's "Specification for the Design of Steel Hollow Structural Sections."
5. RCSC's "Specification for Structural Joints Using High Strength Bolts."
6. AWS D1.1 "Structural Welding Code"
7. SSPC (Society for Protective Coatings), standards as noted.

J. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

2.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from erosion and deterioration.

1. Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or rusty before use.

2. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

2.8 COORDINATION

A. Furnish anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 3 - PRODUCTS

3.1 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A 992.

B. Channels, Angles: ASTM A 36.

C. Plate and Bar: ASTM A 36.

D. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.

E. Steel Pipe: ASTM A 53, Type E, Grade B.

1. Weight Class: As indicated.
2. Finish: Black, except where indicated to be galvanized.

F. Welding Electrodes: Comply with AWS requirements.

3.2 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.

1. Finish: Plain.

B. High-Strength Bolts, Nuts, and Washers: ASTM A 490, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers, plain.

C. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.

D. Unheaded Anchor Rods: ASTM F 1554, Grade 36.

1. Configuration: Straight.
2. Nuts: ASTM A 563 hex carbon steel.
3. Plate Washers: ASTM A 36/A 36M carbon steel.
4. Washers: ASTM F 436 hardened carbon steel.
5. Finish: Plain.

E. Threaded Rods: ASTM A 193.

1. Nuts: ASTM A 563hex carbon steel.
2. Washers: ASTM A 36 carbon steel.
3. Finish: Plain.

F. Adhesive Anchors:
   1. In concrete:
      a. HIT RE 500V3-Safe Set System, Hilti Inc.
      b. SET-XP epoxy, Simpson Strong-Tie, Inc.
      c. HIT-HY 200 Safe Set System, Hilti, Inc.
      d. AT-XP acrylic, Simpson Strong-Tie Company, Inc.
   2. In grouted concrete masonry:
      a. HIT-HY 70, Hilti, Inc.
      b. SET epoxy, Simpson Strong-Tie Company, Inc.
      c. AT-XP acrylic, Simpson Strong-Tie Company, Inc.
   3. In ungrouted concrete masonry:
      a. HIT-HY 70, Hilti, Inc.
      b. SET epoxy, Simpson Strong-Tie Company, Inc.
   4. Adhesive anchor rods: As noted on the drawings.

3.3 PRIMER

A. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer.

B. Galvanizing Repair Paint: ASTM A 780.

C. Cold Galvanizing Compound shall be "ZRC" cold galvanizing compound as manufactured by ZRC Worldwide, Marshfield, Massachusetts.

3.4 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, Grade B, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time, capable of developing a minimum compressive strength of 5,000 psi at 28 days.

3.5 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Comply with fabrication requirements, including tolerance limits, of AISC's "Code of Standard Practice for Steel Buildings and Bridges", AISC's "Specification for Structural Steel Buildings", and as indicated on accepted shop drawings.

   1. Camber structural-steel members where indicated.
   2. Mill tolerances shall conform to ASTM A6. Identify high-strength structural steel according to ASTM A 6/ A 6M and maintain markings until structural steel has been erected.
   3. Mark and match-mark materials for field assembly.
   4. Plates shall be free of gross discontinuities such as ruptures and delaminations. Plates shall comply with ASTM A578, Level 1.
   5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

   1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.

C. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads. Members in compression joints which depend on contact bearing shall have the bearing surfaces milled to a common plane. Members to be milled shall be completely assembled before milling.

E. Base Plates: Oversize anchor bolt holes in base plates to facilitate erection as specified in Table 14-2 in AISC 360-05.

F. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 1, "Solvent Cleaning, SSPC-SP 2, "Hand Tool Cleaning, or SSPC-SP 3, "Power Tool Cleaning."

G. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

H. Holes: Provide holes required for securing other work to structural steel and for passage of other work through steel framing members.

1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
2. Base-Plate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

3.6 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

2. Provide washers over all slotted holes in an outer ply.

B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work. Welds not specified shall be continuous fillet welds designed to develop the full strength of the member. A combination of welds and bolts shall not be used to transmit stress at the same face of any connections. Clean completed welds prior to inspection. Slag shall be removed from all completed welds.

3.7 SHOP PRIMING

A. Shop prime steel surfaces except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
2. Surfaces to be field welded.
3. Surfaces to be high-strength bolted with slip-critical connections.
4. Galvanized surfaces.
5. Top surfaces of beams which support composite metal floor deck.
6. Headed shear studs, although overspray is acceptable.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:

1. SSPC-SP 2, "Hand Tool Cleaning."
2. SSPC-SP 3, "Power Tool Cleaning."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a dry film thickness of not less than 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

3.8 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/ A 123M.

1. Fill vent holes and grind smooth after galvanizing.

B. Galvanizing: The following steel shall be hot-dip galvanized (including any associated fasteners):

1. Lintels and shelf angles attached to structural-steel frame and located in exterior walls.
2. Railing exposed to weather.

3.9 SOURCE QUALITY CONTROL

A. Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.

1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

C. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1 and the following inspection procedures, at testing agency's option:

1. Liquid Penetrant Inspection: ASTM E 165.
2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
3. Ultrasonic Inspection: ASTM E 164.
4. Radiographic Inspection: ASTM E 94.

E. In addition to visual inspection, shop-welded shear connectors will be tested and inspected according to requirements in AWS D1.1 for stud welding and as follows:

1. Bend tests will be performed if visual inspections reveal either a less-than- continuous 360-degree flash or welding repairs to any shear connector.
2. Tests will be conducted on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1.

PART 4 - EXECUTION

4.1 EXAMINATION

A. Verify elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments, with steel erector present, for compliance with requirements.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

4.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Design of temporary bracing and supports shall be the responsibility of the Contractor. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.

4.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design," unless closer tolerances are required for proper fitting of adjoining or enclosing materials, in which case the more stringent shall apply.

B. Base and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.

1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of base plate.
3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate before packing with grout.
4. Promptly pack grout solidly between bearing surfaces and base or bearing plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
5. Grout under baseplates in accordance with Section 033000.

C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges," Unless adjoining materials dictate a tighter tolerance.

D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated. Any member having a splice not shown and detailed on the accepted shop drawings shall be rejected.

F. Do not field cut or alter structural members without approval of Architect/Engineer. Do not use thermal cutting during erection unless approved by Architect/Engineer. Finish thermally cut sections within smoothness limits in AWS D1.1.

G. Gas Cutting: Do not use gas cutting torches in the field to correct fabrication errors in structural framing.

H. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

I. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

4.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

2. A307 bolts and high-strength (A325 and A490) bolts noted to be "snug-tight" shall be tightened using a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench, bringing the plies into contact.

3. High-strength bolts which are not specifically designated to be "snug-tight" shall be tightened to provide at least the minimum tension shown in Table 4 of the "Specification for Structural Joints using ASTM A325 and A490 Bolts." Tightening shall be done by the turn-of-the-nut method, with direct tension indicators, or by properly calibrated wrenches.

4. Bolts tightened with a calibrated wrench or by torque control shall have a hardened washer under the element (nut or bolt head) turned in tightening.

5. Hardened washers shall be placed over slotted holes in an outer ply. Hardened beveled washers shall be used where the outer face of the bolted parts has a slope greater than 1:20 with respect to the bolt axis.

B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work. Welds not specified shall be continuous fillet welds designed to develop the full strength of the member. A combination of welds and bolts shall not be used to transmit stress at the same face of any connections. Clean completed welds prior to inspection. Slag shall be removed from all completed welds.

1. Comply with AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings" for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.

4.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.

B. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Field welds will be visually inspected according to AWS D1.1.

1. In addition to visual inspection, field welds will be tested according to AWS D1.1 and the following inspection procedures, at testing agency's option:

a. Liquid Penetrant Inspection: ASTM E 165.
b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
c. Ultrasonic Inspection: ASTM E 164.
d. Radiographic Inspection: ASTM E 94.

D. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1 for stud welding and as follows:

1. Perform bend tests if visual inspections reveal either a less-than- continuous 360-degree flash or welding repairs to any shear connector.
2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1.

E. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

4.6 REPAIRS AND PROTECTION

A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Touch-up Cold Galvanizing: Touch up areas of hot dip galvanized members where galvanizing has been abraded during shipping and erection and areas where galvanizing has been removed or damaged due to welding. Apply cold galvanizing compound in accordance with the manufacturer's instructions to a minimum dry film thickness of 2.0 mils.

END OF SECTION 05 12 00

SECTION 05 31 00

STEEL DECK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Roof deck.
2. Composite floor deck.
3. Noncomposite form deck.

B. Work Included

1. Furnish all labor and materials required to fabricate, deliver and install steel roof deck and accessories including formed steel cant strips, eave strips, valley strips, sump pans, edge closures, pour stops, reinforcing plates and related accessories.
2. Furnish all labor and materials required to fabricate, deliver and install steel floor deck and accessories including formed steel end closures, edge forms, flashings, and reinforcing plates, headed shear studs, and related accessories.

C. Related Sections include the following:
1. Division 3 Section "Cast-in-Place Concrete" for structural concrete fill over steel deck.
2. Division 5 Section "Structural Steel" for shop- and field-welded shear connectors.
3. Division 5 Section "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

1.3 SUBMITTALS

A. Submittals for Review:

1. Shop Drawings: Show layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.
2. Product Data: For each type of deck, accessory, and product indicated. Provide deck dimensions, sectional properties, uplift resistance and diaphragm capacity for specified fastener layout and support spacing, and finishes.

B. Submittals for Information:

1. Product Certificates: For each type of steel deck, signed by product manufacturer. Certify that products comply with SDI, UL and ICC standards as specified.
2. Manufacturer’s installation instructions.
3. Welding certificates: For each welder employed on the Work.
4. Field quality-control test and inspection reports.
5. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:

a. Power-actuated mechanical fasteners.

6. ICC Evaluation Service Reports: Deck units shall be approved by the International Code Council and shall have a corresponding report from ICC.
7. Deck units shall be classified by Underwriter's Laboratory, Inc. and shall be labeled and marked as required by UL, indicating manufacturer testing and inspection.

1.4 QUALITY ASSURANCE

A. Installer: Company specializing in performing the work of this Section with minimum 5 years documented experience.

B. Testing Agency Qualifications: An independent agency qualified according to ASTM E 329 for testing indicated.

C. Welding: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

D. Fire-Test-Response Characteristics: Where indicated, provide steel deck units identical to those tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Fire-Resistance Ratings: Indicated by design designations of applicable testing and inspecting agency.
2. Steel deck units shall be identified with appropriate markings of applicable testing and inspecting agency.

E. Comply with applicable provisions of the following specifications and documents.

1. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."
2. FM Global Listing: Provide steel roof deck evaluated by FM Global and listed in its "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.
3. SDI (Steel Deck Institute) - Design Manual for Composite Decks, Form Decks, Roof Decks.
4. UL - Fire Resistance Directory.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Steel Deck:
   a. Canam Steel Corp.;The Canam Manac Group.
   b. Consolidated Systems, Inc.
   c. Epic Metals Corporation.
   d. New Millennium Building Systems, LLC.

e. Nucor Corp.; Vulcraft Division.
f. Verco Manufacturing Co.

2.2 ROOF DECK

A. Steel Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 30, and with the following:

1. Galvanized Steel Sheet: ASTM A 653/A, Structural Steel (SS), Grade 33, G60 zinc coating.
2. Deck Profile: As indicated.
3. Profile Depth: As indicated.
4. Design Uncoated-Steel Thickness: As indicated.
5. Span Condition: As indicated.
6. Side Laps: Overlapped.

2.3 COMPOSITE FLOOR DECK

A. Composite Steel Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 30, with the minimum section properties indicated, and with the following:
1. Galvanized Steel Sheet: ASTM A 653/A, Structural Steel (SS), Grade 33, G30 zinc coating.
2. Profile Depth: As indicated.
3. Design Uncoated-Steel Thickness: As indicated.
4. Span Condition: As indicated.

2.4 NONCOMPOSITE FORM DECK

A. Noncomposite Steel Form Deck: Fabricate ribbed-steel sheet noncomposite form-deck panels to comply with "SDI Specifications and Commentary for Noncomposite Steel Form Deck," in SDI Publication No. 30, with the minimum section properties indicated, and with the following:

1. Uncoated Steel Sheet: ASTM A 1008/A, Structural Steel (SS), Grade **33** minimum.

2. Galvanized Steel Sheet: ASTM A 653/A, Structural Steel (SS), Grade 33, G60 zinc coating.

3. Profile Depth: As indicated.
4. Design Uncoated-Steel Thickness: As indicated.
5. Span Condition: As indicated.
6. Side Laps: Overlapped.

2.5 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

1. Mechanical Fasteners: Galvanized hardened steel, self-tapping "Teks" screws, manufactured by Illinois Tool Works, Inc., Buildex Division, or equal. Size shall be #10 minimum, unless noted otherwise.
2. Powder Actuated Fasteners: Zinc coated fastener with .145 inch shank diameter and 1 1/4 inch shank length. X-DNI pin as manufacturer by Hilti, or equal.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10

minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile recommended by SDI Publication No. 30 for overhang and slab depth.

G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck, unless otherwise indicated.

H. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.

I. Flat Sump Plate: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck, sealed watertight. For drains, cut holes in the field.

J. Galvanizing Repair Paint: ASTM A780.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 30, manufacturer's written instructions, and requirements in this Section.

B. Locate deck bundles to prevent overloading of supporting members.

C. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

D. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

E. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

F. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

G. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

H. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 ROOF-DECK INSTALLATION

A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches long, and as follows:

1. Weld Diameter: As indicated.
2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Space welds as indicated.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of 1/2 of the span or [**18 inches**] [**36 inches**], and as follows:

1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
2. Mechanically clinch or button punch.
3. Fasten with a minimum of 1-1/2-inch- long welds.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:

1. End Joints: Lapped 2 inches minimum.

D. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.

1. Weld cover plates at changes in direction of roof-deck panels, unless otherwise indicated.

E. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

F. Architectural finishes and mechanical, electrical, and plumbing equipment shall not be hung directly from the metal deck.

3.4 FLOOR-DECK INSTALLATION

A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:

1. Weld Diameter: As indicated.
2. Weld Spacing: As indicated.
3. Welds may be omitted if stud shear connectors are provided at same or closer spacing.

B. Fasten deck to concrete support members at ends and intermediate supports with powder actuated fasteners at 12 inches maximum spacing if deck spans parallel to the supporting member and at every other flute if the deck spans perpendicular to the supporting member.

C. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of half of the span or 36 inches, and as follows:

1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
2. Mechanically clinch or button punch.
3. Fasten with a minimum of 1-1/2-inch- long welds.

D. End Bearing: Install deck ends over supporting steel frame with a minimum end bearing of 1-1/2 inches. Install deck on masonry and concrete support surfaces with 3 inch minimum bearing Provide end joints as follows:

1. End Joints: Lapped.

E. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations, unless otherwise indicated.

1. Install wet concrete stops at floor edges and around openings and penetrations upturned to top surface of slab, to contain wet concrete. If size of stop is not shown on the Drawings, provide stops of sufficient strength to deflect no more than 1/8 inch vertically or horizontally.

F. Install 6 inch minimum wide sheet steel cover plates, of same thickness as deck, where deck changes direction. Fusion weld or mechanically fasten plate to deck at 12 inches maximum spacing.

G. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

H. Position floor drain pans with flange bearing on top surface of deck. Fusion weld at each deck flute.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field welds will be subject to inspection.

C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.

D. Remove and replace work that does not comply with specified requirements.

E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.6 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 31 00

SECTION 05 44 00

COLD-FORMED METAL TRUSSES

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. Cold-formed steel trusses for roofs.

B. Related Requirements:
   1. Division 5 Section "Cold-Formed Metal Framing" for cold-formed steel studs, joists, headers and rafters.

1.3 SUBMITTALS

A. Submittals for Review
   1. Product Data: For each type of product.
   2. Shop Drawings:
      a. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel trusses; fabrication; and fastening and anchorage details, including mechanical fasteners.
      b. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
   3. Delegated-Design Submittal: For cold-formed steel trusses and connections.

B. Submittals for Information:
   1. Qualification Data: For testing agency.
   2. Welding certificates.
   3. Product Test Reports: For each listed product, for tests performed by a qualified testing agency.
      a. Steel sheet.
      b. Expansion anchors.
      c. Power-actuated anchors.
      d. Mechanical fasteners.
      e. Miscellaneous structural clips and accessories.
   4. Field quality-control reports.
   5. Shop Drawings signed and sealed by a Professional Engineer registered in the State of Texas.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

C. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.1, "Structural Welding Code - Steel."

2. AWS D1.3, "Structural Welding Code - Sheet Steel."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed steel trusses from corrosion, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Aegis Metal Framing.
2. Genesis Worldwide Inc.
3. Marino/WARE.
4. Nuconsteel, A Nucor Company.
5. Steel Construction Systems.
6. TrusSteel; an ITW company.
7. USA Frametek.
8. Steelway International

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Division 01 "Quality Requirements," to design cold-formed steel trusses.

B. Structural Performance: Provide cold-formed steel trusses capable of withstanding design loads within limits and under conditions indicated.
1. Design Loads: As indicated on Structural Drawings.
2. Deflection Limits: Design trusses to withstand design loads without deflections greater than the following:
a. Roof Trusses: Total load vertical deflection of 1/240 of the span.
3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.

C. Cold-Formed Steel Framing Design Standards:
1. Roof Systems: Design according to AISI S210.
2. Lateral Design: Design according to AISI S213.
3. Roof Trusses: Design according to AISI S214.

D. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.3 COLD-FORMED STEEL TRUSS MATERIALS

A. Steel Sheet: ASTM A 1003, structural grade, Type H, metallic coated, of grade and coating weight as follows:
1. Grade: Minimum yield strength of 33 ksi for 18 gauge and lighter, and 50 ksi for 16 gauge and heavier
2. Coating: G60.

2.4 ROOF TRUSSES

A. Roof Truss Members: Manufacturer's standard steel sections.
   1. Connecting Flange Width: 1-5/8 inches, minimum at top and bottom chords connecting to sheathing or other directly fastened construction.
   2. Minimum Base-Metal Thickness: 0.0329 inch, or as required by design.
   3. Section Properties: As required by design.

2.5 ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003, structural grade, Type H, metallic coated, of same grade and coating weight used for truss members.

B. Provide accessories of manufacturer's standard thickness and configuration unless otherwise indicated.

2.6 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36, zinc coated by hot-dip process according to ASTM A 123.

B. Power-Actuated Fasteners: Fastener system of type suitable for application, fabricated from corrosion-resistant materials, with capability to sustain, without failure, allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.

C. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.
   1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.

D. Welding Electrodes: Comply with AWS standards.

2.7 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20 or MIL-P-21035B.

B. Shims: Load bearing, of high-density multimonomer plastic, nonleaching; or of cold-formed steel of same grade and coating as framing members supported by shims.

2.8 FABRICATION

A. Fabricate cold-formed steel trusses and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
   1. Fabricate trusses using jigs or templates.
   2. Cut truss members by sawing or shearing; do not torch cut.
   3. Fasten cold-formed steel truss members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator.
      a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
   4. Fasten other materials to cold-formed steel trusses by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace trusses to withstand handling, delivery, and erection stresses. Lift fabricated trusses to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting cold-formed steel trusses for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed steel trusses without reducing thickness of fire-resistive materials below that is required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

3.3 INSTALLATION

A. Install, bridge, and brace cold-formed steel trusses according to AISI S200, AISI S214, AISI's "Code of Standard Practice for Cold-Formed Steel Structural Framing," and manufacturer's written instructions unless more stringent requirements are indicated.

B. Install cold-formed steel trusses and accessories plumb, square, and true to line, and with connections securely fastened.
1. Fasten cold-formed steel trusses by welding or mechanical fasteners.
    a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    b. Locate mechanical fasteners and install according to Shop Drawings; comply with requirements for spacing, edge distances, and screw penetration.

C. Install temporary bracing and supports. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

D. Truss Spacing: As indicated on Structural Drawings.

E. Do not alter, cut, or remove framing members or connections of trusses.

F. Erect trusses with plane of truss webs plumb and parallel to each other, align, and accurately position at spacings indicated.

G. Erect trusses without damaging framing members or connections.

1. Align webs of bottom chords and load-bearing studs or continuously reinforce track to transfer loads to structure. Anchor trusses securely at all bearing points.

H. Install continuous bridging and permanently brace trusses as indicated on Shop Drawings and designed according to CFSEI's TechNote 551e, "Design Guide: Permanent Bracing of Cold-Formed Steel Trusses.

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

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspection agency to perform tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Remove and replace all work where test results indicate that it does not comply with specified requirements.

E. Additional testing and inspection, at Contractor’s expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.5 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure that cold-formed metal trusses are without damage or deterioration at time of Substantial Completion.

END OF SECTION 054400

SECTION 05 5000

METAL FABRICATIONS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Shop fabricated metal components.
2. Gratings.
3. Ladders.
4. Guardrails and handrails.
5. Replication of original corrugated metal ceilings.
6. Recreation of vault doors.

B. Related Sections:
1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

A. American Welding Society (AWS) D1.1 - Structural Welding Code - Steel.

B. ASTM International (ASTM):
1. A36/A36M - Standard Specification for Carbon Structural Steel.
2. A47/A47M - Standard Specification for Ferritic Malleable Iron Castings.
3. A48/A48M - Standard Specification for Gray Iron Castings.
4. A108 - Standard Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality.
5. A123/A123M - Standard Specification for Zinc (Hot-Galvanized) Coatings on Iron and Steel Products.
6. A283 - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes and Bars.
7. A307 - Standard Specification for Carbon Steel Externally Threaded Standard Fasteners.
8. A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
9. A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
10. A780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
11. A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
12. A1011/A1011M – Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength, Low-Alloy and High-Strength Low-Alloy with Improved Formability.
13. E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings.

C. National Association of Architectural Metal Manufacturers (NAAMM) MBG 531 – Metal Bar Grating Manual.

D. Society for Protective Coatings (SSPC) - Painting Manual.

1.3 SYSTEM DESCRIPTION

A. Minimum design loads:
1. Pedestrian Loading:
   a. Uniform load of 100 PSF.
   b. Concentrated load of 300 pounds.
   c. Maximum deflection under loading: L/240.
2. Guard rails and handrails:
   a. 50 pounds per linear foot applied in any direction at top, transferred via attachments and supports to building structure.
   b. Concentrated 200 pound load applied in any direction at any point along top, transferred via attachments and supports to building structure.
   c. Maximum deflection under loading: L/120.
3. Concentrated and uniform loads do not need to be applied simultaneously.

B. Fabricate guard rails and handrails in accordance with ASTM E985

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1.4 SUBMITTALS

A. Submittals for Review:
1. Shop Drawings: Show dimensions, metal thicknesses, finishes, joints, attachments, and relationship of work to adjacent construction.

B. Samples: 4 x 4 finish samples from manufacturer.

PART 2 PRODUCTS

2.1 MATERIALS - STEEL

A. Shapes: ASTM A36/A36M.

B. Plate: ASTM A283.

C. Sheet: ASTM A1008/A1008M.

D. Galvanized Sheet: ASTM A653/A653M, Structural Quality, G90 coating class, 24 gage core steel unless noted otherwise.

E. Pipe: ASTM A501.

F. Tube: ASTM A500.

G. Bars: ASTM A108.

2.2 MATERIALS – BAR GRATINGS

A. Formed Steel Sheet for Welding: ASTM A1011/A1011M, rectangular shape.

2.3 ACCESSORIES

A. Exposed Screws: Same material as metal being fastened; Phillips flat head, countersunk, unless noted otherwise.

B. Bolts: ASTM A307, hexagonal head type.

C. Primer Paint: SSPC Paint 15, Type 1, red oxide.

D. Anchoring Cement: Non-shrink cementitious type.

2.4 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

D. Exposed Mechanical Fastenings: Flush countersunk screws or bolts, unobtrusively located, consistent with design of component except where specifically noted otherwise.

E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

F. Conceal fastenings where possible.

G. Welding to conform to AWS D1.1.
1. Use welds for permanent connections where possible. Grind exposed welds smooth.
2. Tack welds prohibited on exposed surfaces.

2.5 FINISHES

A. Exterior Ferrous Metal: Galvanized; ASTM A123/A123M, to 2.0 ounces per square foot.

B. Interior Ferrous Metal:
1. Shop painted except steel to be encased in concrete and surfaces to be welded.
2. Surface preparation: SSPC SP2 - Hand Tool Cleaning or SP3 - Power Tool Cleaning.
3. Application: One coat; follow coating manufacturer's instructions.
4. Minimum dry film thickness: 2.0 mils.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install items in accordance with approved Shop Drawings.

B. Install components plumb, level, and rigid.

C. Welding: AWS D1.1. Continuously weld connections. Grind and fill exposed welds; finish smooth and flush.

D. Make bends uniform and free from buckles and other defects.

E. Cut intersections square to within 2 degrees and to length within 1/8 inch. Remove burrs from cut ends. Miter and cope intersections within 2 degrees, fit to within 1/8 inch.

F. Install sleeved components with anchoring cement.

G. Prevent contact of exterior aluminum and dissimilar metals by use of zinc rich paint, bituminous coating, or non-absorptive gaskets.

3.2 ADJUSTING

A. Clean and touch up damaged primer paint with same product as applied in shop.

B. Clean and touch up galvanized coatings at welded and abraded surfaces in accordance with ASTM A780, Annex A2.

3.3 SCHEDULE

A. This Schedule includes principal items only; refer to Drawings for additional items not listed.

B. Ladders:
1. Side rails: Continuous steel flat bars, minimum ½ x 2-1/2 inches, eased edges, spaced 18 inches apart.
2. Rungs: Round steel bars, 3/4 inch diameter, spaced 12 inches on center. Fit rungs in centerline of side rails and plug weld on outer rail face.
3. Support ladders at top, bottom, and at intermediate points spaced maximum 5’-0” on center with steel brackets, welded or bolted to supports.

C. Guardrails and Handrails:
1. Fabricate from steel stock of sizes and types indicated.
2. Make bends uniform and free from buckles and other defects.
3. Cut intersections square to within 2 degrees and to length within 1/8 inch. Remove burrs from cut ends.
4. Miter and cope intersections within 2 degrees, fit to within 1/8 inch.
5. Continuously weld connections.
6. Where length exceeds that suitable for shipping and handling, fabricate in sections with concealed internal sleeves forming slip joints. Extend sleeves minimum 2 inches on both sides of joint; field weld and grind smooth.

D. Corrugated Metal Ceilings: Fabricate to corrugation patterns to match historic.

E. Vault Doors:
1. Fabricate to sizes and profiles indicated from steel shapes and plates.
2. Cut intersections square.
3. Continuously weld connections.

END OF SECTION

SECTION 05 5100

METAL STAIRS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Shop fabricated steel stairs with concrete pan treads and landings.
2. Guardrails and handrails.

B. Related Sections:
1. Division 01: Administrative, procedural, and temporary work requirements.
2. Section 05 5000 – Metal Fabrications
3. Section 09 9100 - Painting

1.2 REFERENCES

A. American Welding Society (AWS) D1.1 - Structural Welding Code - Steel.

B. ASTM International (ASTM):
1. A36/A36M - Standard Specification for Carbon Structural Steel.
2. A283 - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes and Bars.
3. A307 - Standard Specification for Carbon Steel Externally Threaded Standard Fasteners.
4. A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
5. A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
6. A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
7. C94 – Standard Specification for Ready-Mixed Concrete
8. E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings.

C. National Association of Architectural Metal Manufacturers (NAAMM) AMP 510 – Metal Stairs Manual.

D. Society for Protective Coatings (SSPC) - Painting Manual.

1.3 SYSTEM DESCRIPTION

A. Design Requirements:
1. Design stair assembly to support a uniform live load of 100 PSF and a concentrated load of 300 pounds, with maximum deflection of L/240.
2. Design guardrails and handrails to resist following without damage or permanent set:
   a) 50 pounds per linear foot applied in any direction at top, transferred via attachments and supports to building structure.
   b) Concentrated 200 pound load applied in any direction at any point along top, transferred via attachments and supports to building structure.
   c) Maximum deflection under loading: L/120.
3. Concentrated and uniform loads do not need to be applied simultaneously.
4. Perform design under direct supervision of Professional Structural Engineer licensed in State in which Project is located, with minimum 2 years experience in work of this Section.

B. Fabricate stair assembly to NAAMM AMP 510, Commercial Class.

C. Fabricate guardrails and handrails in accordance with ASTM E985.

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1.4 SUBMITTALS

A. Submittals for Review:
1. Shop Drawings:

a) Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
b) Indicate welded connections using standard AWS welding symbols. Indicate net weld lengths.

B. Quality Control Submittals:
1. Qualification Statement: Fabricator qualifications per Section 01 4001.
2. Design calculations certified by Professional Engineer responsible for system design for stair members and member connections to each other and to structure.

1.5 QUALITY ASSURANCE

A. Minimum 2 years documented experience in work of this Section.

B. Perform Work in accordance with ASTM E985.

PART 2 PRODUCTS

2.1 MATERIALS - STEEL

A. Sections: ASTM A36/A36M.

B. Plate: ASTM A283.

C. Sheet: ASTM A1008/A1008M.

D. Pipe: ASTM A501.

E. Tube: ASTM A500.

F. Bars: ASTM A108.

G. Wire Mesh: 2 x 2 inch mesh, square pattern, lockcrimp weave, minimum 0.1620 inch wire diameter.

2.2 MATERIALS - CONCRETE

A. Concrete: ASTM C94; 3000 psi 28 day strength, 2 to 3 inch slump.

B. Concrete Reinforcement: Mesh type, unfinished.

2.3 ACCESSORIES

A. Bolts, Nuts, and Washers: ASTM A307

B. Primer Paint: SSPC Paint 15, Type 1, red oxide.

2.4 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.

B. Fabricate components with joints tightly fitted and secured.

C. Continuously weld connections. Welding to conform to AWS D1.1.

D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

F. Accurately form components required for anchorage of stairs, landings, and railings to each other and to building structure.

G. Treads and Landings:

1. Fabricate from minimum 14 gage steel sheet, shaped to receive concrete.
2. Fabricate stairs with closed steel sheet risers.
3. Reinforce underside with steel angles when required to resist design loads.
4. Secure pans to stringers with clip angles, welded in place.

H. Guardrails and Handrails:
1. Fabricate from steel pipe or tube stock.
2. Make bends uniform and free from buckles and other defects.
3. Where length exceeds that suitable for shipping and handling, fabricate in sections with concealed internal sleeves forming slip joints. Extend sleeves minimum 2 inches on both sides of joint; field weld and grind smooth.

2.5 FINISHES

A. Steel:
1. Surface preparation: SSPC SP2 - Hand Tool Cleaning or SP3 - Power Tool Cleaning.
2. Application: One coat; follow coating manufacturer's instructions.
3. Minimum dry film thickness: 2.0 mils.
4. Do not prime surfaces in direct contact with concrete or where field welding is required.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install components plumb and level, accurately fitted, free from distortion and defects.

B. Provide anchors, angles, hangers, and struts required for connecting stairs to structure.

C. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

D. Field weld components indicated on Shop Drawings. Perform field welding in accordance with AWS D1.1.

E. Field bolt and weld to match shop bolting and welding. Conceal bolts and screws whenever possible.

F. Mechanically fasten joints butted tight, flush, and hairline. Grind welds smooth and flush.

G. Fill treads and landings with concrete. Consolidate concrete, strike off flush with perimeter frame, and apply light broom finish with striations parallel to long dimension of tread.

H. Installation Tolerances:
1. Maximum variation from plumb: 1/4 inch per story, noncumulative.
2. Maximum offset from true alignment: 1/4 inch.

3.2 ADJUSTING

A. Clean and touch up primer paint at welded and abraded surfaces with same product as applied in shop.

END OF SECTION

SECTION 05 7000

ORNAMENTAL METALS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Replication of missing ornamental cast iron components:
      a. Balcony railings.
      b. Perimeter wall fencing and gates.
      c. Stairs and railings.
      d. Basement ventilation grilles.
   2. Casing trim at historic vault door locations.
   3. Restoration and replacement of existing corrugated metal ceilings, trim, and moulding.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.
   2. Section 01 2300 – Alternates.

1.2 REFERENCES

A. ASTM International (ASTM):
   1. A336 – Steel, Carbon, Cold-Rolled Sheet, Commercial Quality.
   2. A47/A47M - Standard Specification for Ferritic Malleable Iron Castings.
   3. A48/A48M - Standard Specification for Gray Iron Castings.
   4. B26 – Aluminum-Alloy Sand Castings.
   5. B85 – Aluminum-Alloy Die Casting.

B. Society for Protective Coatings (SSPC) - Painting Manual.

1.3 SYSTEM DESCRIPTION

A. Design Requirements:
   1. Design stair assemblies to support a uniform live load of 100 PSF and a concentrated load of 300 pounds, with maximum deflection of L/240.
   2. Design guard rails and handrails to resist following without damage or permanent set:
      a. 50 pounds per linear foot applied in any direction at top, transferred via attachments and supports to building structure.
      b. Concentrated 200 pound load applied in any direction at any point along top, transferred via attachments and supports to building structure.
      c. Maximum deflection under loading: L/120.
   3. Concentrated and uniform loads do not need to be applied simultaneously.
   4. Perform design under direct supervision of Professional Structural Engineer licensed in State in which project is located, with minimum 2 years experience in work of this Section.

1.4 SUBMITTALS

A. Submittals for Review:
   1. Shop Drawings: Show dimensions, metal thicknesses, finishes, joints, attachments, and relationship of work to adjacent construction.
   2. Samples:
      a. Vent Grille: Full size.
      b. Casing Trim: Minimum 12 inches long.
      c. Corrugated metal ceiling: Minimum 12 x 12 inches.

B. Quality Control Submittals:
   1. Qualification Statement: Fabricator and installer qualifications per Section 01 4001.

1.5 QUALITY ASSURANCE

A. Fabricator and Installer Qualifications:
   1. Minimum 5 years experience in work of this Section.
   2. Successful completion of at least 3 projects of similar scope and complexity within past 5 years.

B. Mockups:
   1. Provide mockups of following components:
      a. Balcony railing: Minimum 4 feet long x full height
      b. Perimeter fencing: Minimum 8 feet long x full height.
      c. Stairs and railings: One full landing of each type.
      d. Basement ventilation grille: One grille.
      e. Vault casing trim: Minimum 48 inches long with corners and attachments.
      f. Corrugated metal ceiling: Minimum 4 x 4 feet, with trim and mouldings.
   2. Include associated attachments, flashings, joints, junctions, and terminating items.
   3. Locate where directed.
   4. Mockup to be approved by Architect and THC representative prior to commencing the Work.

PART 2 PRODUCTS

2.1 MATERIALS

A. Cast Iron: ASTM A48/A48M, Class 30, or ASTM A47/A47M.

B. Cast Aluminum: ASTM B26 or ASTM B85, alloy and temper best suited to application.

C. Steel Sheet: ASTM A366.

2.2 ACCESSORIES

A. Fasteners: Material compatible with base metal; countersunk Phillips's flat head where exposed.

B. Primer Paint for Steel: SSPC Paint 15, Type 1.

C. Primer Paint for Aluminum: Fast curing, lead free, universal modified alkyd primer.

D. Anchoring Cement: Premixed, cementitious based.

2.3 FABRICATION

A. Shop assemble in largest practical pieces.

B. Form metal work to shape and size with sharp lines, angles and arises.

C. Fit joints and intersections accurately.

D. Exposed Components:
   1. Fabricate in longest practical lengths. Locate joints symmetrically.
   2. Fit adjacent pieces to hairline joints.
   3. Space exposed fasteners evenly and symmetrically.
   4. Miter corners and intersections.

E. Castings:
   1. Cast new components to match original profiles and sizes.
   2. Use molds produced from existing material wherever possible.
   3. Cast components free from pits, gas holes, and warped surfaces.
   4. Hand tool to sharp, clean edges.
   5. Chemically clean completed castings.

F. Conceal fastenings wherever possible.

G. Corrugated Metal:
   1. Fabricate replacement units from minimum 0.020 inch thick steel sheet with corrugation pattern and profile to match existing.

H. Welding:
1. Use welds for permanent connections where possible. Grind exposed welds smooth.
2. Tack welds prohibited on exposed surfaces.

2.4 FINISHES

A. Finish for Steel:
1. Shop painted except steel to be encased in concrete and surfaces to be welded.
2. Surface preparation: SSPC SP2 – Hand Power Tool Cleaning or SP3 – Power Tool Cleaning.
3. Application: One coat; follow coating manufacturer's instructions.
4. Minimum dry film thickness: 2.0 mils.

B. Finish for Aluminum:
1. Shop painted except aluminum to be encased in concrete and surfaces to be welded.
2. Surface preparation: SSPC SP1 – Solvent Cleaning.
3. Application: One coat; follow coating manufacturer's instructions.
4. Minimum dry film thickness: 2.0 mils.

PART 3 EXECUTION

3.1 INSTALLATION OF REPLACEMENT METALS

A. Install items in accordance with approved Shop Drawings.

B. Install components plumb, level, and rigid.

C. Welding: AWS D1.1. Grind and fill exposed welds; finish smooth and flush.

D. Install sleeved components with anchoring cement.

E. Isolate dissimilar metals with zinc rich paint, bituminous coating, or non-absorptive gaskets.

3.2 RESTORATION OF EXISTING METALS

A. Install welded connections and fasteners; remove damaged, stripped, missing, and deteriorated connections and fasteners.

B. Cut or grind damaged or deteriorated surfaces to provide smooth, flat surface for welding or brazing.

C. Make repairs as inconspicuous as possible.

D. Repair badly damaged, deteriorated, and missing wrought iron and steel by welding or brazing new pieces to the existing using conventional welding techniques. Grind exposed welds smooth.

E. Repair moderately damaged and deteriorated wrought iron and steel with epoxy; sand exposed epoxy smooth.

F. Replace fasteners with new to match original. Tighten existing fasteners.

G. Clean and touch up shop coatings at welded and abraded surfaces.

3.3 CORRUGATED METAL CEILINGS

A. Salvage corrugated metal ceiling panels for reuse from existing ceilings that are to be hidden with lowered new ceiling construction.
1. Calculate and coordinate quantity of salvaged ceiling panels for reuse from amount of ceiling panels needed for replacement.
2. Remove rust, clean, patch, and paint salvaged ceiling panels.

B. Replacement of Corrugated Ceiling Panels:
1. Damaged panels:
a. Perforation and bent damage. Verify with Architect and THC Representative.

b. Replace rust damaged panels as required.

2. Other areas: Use salvaged panels if existing quantity allows: provide new panels as required.

END OF SECTION

SECTION 06 1000

ROUGH CARPENTRY

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Wood blocking and furring.
2. Telephone and electrical panel backboards.
3. Roof curbs.
4. Roof sheathing.
5. Floor decking.

B. Related Sections:
1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

A. American Wood Protection Association (AWPA) U1 - Use Category System - User Specification for Treated Wood.

B. ASTM International (ASTM):
1. A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
2. E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

C. Engineered Wood Association (APA) PRP-108 - Performance Standards and Qualification Policy for Structural-Use Panels.

D. National Institute of Standards and Technology (NIST) - Product Standard PS 20 - American Softwood Lumber Standard.

E. Southern Pine Inspection Bureau (SPIB) - Standard Grading Rules for Southern Pine Lumber.

1.3 QUALITY ASSURANCE

A. Lumber Grading Agency: Certified to NIST PS 20.

B. Identify lumber and sheet products by official grade mark.

C. Fire Retardant Treated Products: Bear label of recognized independent testing laboratory indicating flame spread rating of 25 or less, tested to ASTM E84.

1.4 DELIVERY, STORAGE AND HANDLING

A. Store materials minimum 6 inches above ground on framework or blocking and cover with protective waterproof covering providing for adequate air circulation.

B. Do not store seasoned or treated materials in damp location.

C. Protect edges and corners of sheet materials from damage.

PART 2 PRODUCTS

2.1 MATERIALS

A. Lumber:
1. Grading rules: SPIB.
2. Species: Southern Yellow Pine.
3. Grade: No. 2.
4. Surfacing: Surfaced four sides (S4S).
5. Maximum moisture content: 19 percent.

B. Panel Products:
   1. Type: APA Plywood.
   2. Panel grade: APA Rated Sheathing.
   3. Exposure:
      a. Roof decking and related wood: Exterior.
      b. Interior applications: Interior.

2.2 ACCESSORIES

A. Fasteners:
   1. Type and size: As required by conditions of use.
   2. Exterior locations and treated products: Hot-dip galvanized steel, ASTM A153/A153M, G90 coating class.
   3. Other interior locations: Plain steel.

2.3 FABRICATION

A. Preservative Treatment:
   1. Treat lumber and sheet products in accordance with AWPA U1:
      a. Interior locations protected from moisture sources: Category UC1 – Interior / Dry.
      b. Interior locations subject to sources of moisture: Category UC2 – Interior / Damp.
      c. Exterior locations: Category UC3A - Above Ground / Protected.
   2. Treatment process: Type CCA - Chromated Copper Arsenate.

B. Fire Retardant Treatment; treat interior lumber and sheet products in accordance with AWPA U1, Category UCFA - Fire Retardant/Interior.

PART 3 EXECUTION

3.1 INSTALLATION

A. Provide blocking, nailers, grounds, furring, and other similar items required to receive and support work.

B. Set members level, plumb, and rigid.

C. Curb roof openings except where prefabricated curbs are provided. Form corners by alternating lapping side members.

D. Install telephone and electrical panel backboards where indicated. Oversize panel by 12 inches on all sides.

E. Roof Sheathing:
   1. Place panels perpendicular to framing members with ends staggered and sheet ends over firm bearing.
   2. Install sheathing clips between adjacent sheets between roof framing members.
   3. Leave 1/8 inch expansion space at panel ends and edges.
   4. Secure to supports with screws spaced maximum 6 inches on center along edges and maximum 12 inches on center in field of panels.

F. Floor Decking:
   1. Place panels perpendicular to framing members with ends staggered and sheet ends over firm bearing.
   2. Leave 1/8 inch expansion space at panel ends and edges.
   3. Secure to supports with screws spaced maximum 12 inches on center along edges and in field of panels.

END OF SECTION

SECTION 06 4000

ARCHITECTURAL WOODWORK

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Wood courtroom furnishings:
a. Judge's benches.
b. Attorney tables.
c. Courtroom wood railings.
d. Sliding wood shutters.
2. Shop finishing.

B. Related Sections:
1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

A. Architectural Woodwork Institute / Architectural Woodwork Manufacturers of Canada / Woodwork Institute (AWI / AWMAC / WI) – Architectural Woodwork Standards

1.3 SUBMITTALS

A. Submittals for Review:
1. Shop Drawings: indicate sizes, dimensions, and room layouts.
2. Product Data: illustrate construction, materials, finishes and accessories.
3. Samples: 6 x 6 inch wood samples showing color and finish.

B. Quality Control Submittals:
1. Qualifications: Fabricator qualifications per Section 01 4001.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications:
1. Minimum 5 years experience in work of this Section.
2. Successful completion of at least 3 projects of similar scope and complexity within past 5 years.

B. Mockups:
1. Provide mockups of:
a. Judge's benches: minimum 4 feet wide x full height.
b. Attorney tables: one table.
c. Courtroom wood railing. Minimum 4 linear feet
d. Sliding wood shutters: One typical shutter with hardware.
2. Locate where directed.
3. Mockups to be approved by Architect and THC representative prior to commencing with the Work.

C. Pre-Installation Conference:
1. Convene 2 weeks prior to beginning work of this Section.
2. Attendance: Architect, THC Representative, Contractor, installer, and related trades.
3. Review, discuss and resolve:
a. Critical dimensions.
b. Product delivery and storage.
c. Staging and sequencing.
d. Protection of completed work.

1.5 PROJECT CONDITIONS

A. Do not install woodwork until:
1. Space is enclosed and weatherproof.
2. Wet work, painting, and overhead work in space is complete.
3. Ambient temperature and humidity conditions can be maintained near those for final occupancy.

PART 2 PRODUCTS

2.1 MATERIALS

A. Lumber:
1. Graded in accordance with AWI/AWMAC/WI Architectural Woodwork Standards, Section 4 requirements for quality grade specified.
2. Species: White Oak, quarter sawn, of quality suitable for transparent finish.
3. Average moisture content: 6 percent.

2.2 ACCESSORIES

A. Pew and Balcony Seat Supports: Cast iron with baked-on gloss black enamel paint finish.

B. Sliding Shutter Hardware: Types as indicated on Drawings.

C. Anchors: Type best suited to application.

2.3 FABRICATION

A. Quality: AWI/AWMAC/WI Architectural Woodwork Standards, Section 12, Premium Grade.

B. Fabricate components to sizes and profiles indicated on Drawings.

C. Fabricate pews with open ends and longitudinal slat seats and backs mounted on cast iron frames.

D. Shop assemble for delivery to project site in units easily handled.

E. Prior to fabrication, field verify dimensions to ensure correct fit.

2.4 FINISHES

A. Factory Finishing:
1. Factory finish woodwork in accordance with AWI/AWMAC/WI Architectural Woodwork Standards, Section 5.
2. Finish system: 2 – Laquer, precatalyzed.
3. Color: to be selected from manufacturer's full color range.
4. Sheen: Semigloss.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with AWI/AWMAC/WI Architectural Woodwork Standards.

B. Set plumb, level, and rigid.

3.2 ADJUSTING

A. Touch up minor scratches and abrasions to match factory finish.

END OF SECTION

SECTION 06 4100

ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Special fabricated cabinet units.
2. Shop finishing.
3. Cabinet hardware.

B. Related Sections:
1. Division 01: Administrative, procedural, and temporary work requirements.
2. Section 06 6116 - Solid Surfacing Fabrications.
3. Section 07 9200 - Joint Sealers.

1.2 REFERENCES

A. Architectural Woodwork Institute/Architectural Woodwork Manufacturers of Canada/Woodwork Institute (AWI/AWMAC/WI) - Architectural Woodwork Standards.

1.3 SUBMITTALS

A. Submittals for Review:
1. Shop Drawings:
a. Include dimensioned plan, sections, elevations, and details, including interface with adjacent work.
b. Designate wood species and finishes.
2. Samples:
a. 6 inch long lumber samples for transparent finish.
b. 12 x 12 inch sheet product samples for transparent finish.
c. Each hardware component.

B. Quality Control Submittals:
1. Qualification Statement: Fabricator qualifications per Section 01 4001.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications:
1. Minimum 5 years documented experience in work of this Section.
2. Certified under AWI Quality Certification Program.

B. Mockups:
1. Size: Base and wall cabinet, minimum 48 inches wide.
2. Show: Cabinets and hardware.
3. Locate where directed.
4. Mockups to be approved by Architect and THC representative prior to commencing with the Work.

C. Pre-Installation Conference:
1. Convene 2 weeks prior to beginning work of this Section.
2. Attendance: Architect, THC Representative, Contractor, installer, and related trades.
3. Review, discuss and resolve:
a. Critical dimensions.
b. Product delivery and storage.
c. Staging and sequencing.
d. Protection of completed work.

1.5 DELIVERY, STORAGE AND HANDLING

A. Do not deliver materials until proper protection can be provided, and until needed for installation.

1.6 PROJECT CONDITIONS

A. Environmental Requirements: HVAC system complete and operational for minimum 7 days prior to installation of cabinets.

PART 2 PRODUCTS

2.1 MATERIALS

A. Sheet Products:
1. Graded in accordance with AWI/AWMAC/WI Architectural Woodwork Standards, Section 4 requirements for quality grade specified.
2. Exposed and semi-exposed veneers: White Oak, plain sliced, of quality suitable for transparent finish.
3. Sheet core: Medium density fiberboard.

B. Lumber:
1. Graded in accordance with AWI/AWMAC/WI Architectural Woodwork Standards, Section 3 requirements for quality grade specified, average moisture content of 6 percent.
2. Exposed and semi-exposed locations: White Oak, plain sliced, of quality suitable for transparent finish.

2.2 ACCESSORIES

A. Solid Surfacing Countertops: Specified in Section 06 6116.

B. Fasteners: Type and size as required by conditions of use.

C. Adhesives: Waterproof, water based type, compatible with backing and veneer materials.

D. Finish Hardware: As scheduled at end of Section or approved substitute.

E. Joint Sealers: Specified in Section 07 9200.

2.3 FABRICATION

A. Quality: AWI/AWMAC/WI Architectural Woodwork Standards, Section 10, Premium Grade.

B. Semi-Exposed Surfaces: Wood to match exposed surfaces.

C. Fit exposed and semi-exposed panel edges with matching wood edging.

D. Fabricate drawer bodies to full depth of drawer fronts less 1/2 inch.

E. Shop assemble for delivery to project site in units easily handled.

F. Prior to fabrication, field verify dimensions to ensure correct fit.

G. Where field fitting is required, provide ample allowance for cutting. Provide trim for scribing and site conditions.

H. Provide cutouts and reinforcement for plumbing, electrical, appliances, and accessories. Prime paint surfaces of cut edges.

2.4 FINISHES

A. Factory Finishing:
1. Factory finish casework in accordance with AWI/AWMAC/WI Architectural Woodwork Standards, Section 5.
2. Finish system: 2 – Laquer, Precatalyzed.
3. Color: to be selected from manufacturer’s full color range.
4. Sheen: Semigloss.

PART 3 EXECUTION

3.1 PREPARATION

A. Prior to installation, condition cabinets to average humidity that will prevail after installation.

3.2 INSTALLATION

A. Install in accordance with AWI/AWMAC/WI Architectural Woodwork Standards.

B. Set plumb, rigid and level.

C. Scribe to adjacent construction with maximum 1/8 inch gaps.

D. Fill joints between cabinets and adjacent construction with joint sealer as specified in Section 07 9200; finish flush.

3.3 FINISH HARDWARE SCHEDULE

DESCRIPTION	MANUFACTURER	MODEL
Door and drawer pulls	White Chapel Ltd. (www.whitechapel-ltd.com)	54CH5P
Drawer slides	Knape and Vogt (www.knapeandvogt.com)	1284
Door hinges	Amerock (www.amerock.com)	4611-A14
Concealed adjustable shelf standards and brackets	Knape and Vogt (www.knapeandvogt.com)	255 and 256
Door and drawer locks	CompX (www.compx.com)	C8054 Cam Lock

END OF SECTION

SECTION 06 4600

WOOD TRIM

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Interior wood trim.
2. Shop finishing.

B. Related Sections:
1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

A. Architectural Woodwork Institute/Architectural Woodwork Manufacturers of Canada/Woodwork Institute (AWI/AWMAC/WI) - Architectural Woodwork Standards.

1.3 SUBMITTALS

A. Submittals for Review:
1. Samples: 12 inch long samples of each profile.

B. Quality Control Submittals:
1. Qualification Statement: Fabricator qualifications per Section 01 4001.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications:
1. Minimum 5 years documented experience in work of this Section.
2. Certified under AWI Quality Certification Program.

B. Mockups:
1. Size: 8 feet long.
2. Show: Each trim profile.
3. Locate where directed.
4. Mockups to be approved by Architect and THC representative prior to commencing with the Work.

C. Pre-Installation Conference:
1. Convene 2 weeks prior to beginning work of this Section.
2. Attendance: Architect, THC Representative, Contractor, installer, and related trades.
3. Review, discuss and resolve:
   a. Critical dimensions.
   b. Product delivery and storage.
   c. Staging and sequencing.
   d. Protection of completed work.

1.5 DELIVERY, STORAGE AND HANDLING

A. Do not deliver materials until proper protection can be provided, and until needed for installation.

1.6 PROJECT CONDITIONS

A. Environmental Requirements: HVAC system complete and operational for minimum 7 days prior to installation of cabinets.

PART 2 PRODUCTS

2.1 MATERIALS

A. Interior Trim: Clear Vertical Grain Douglas Fir, plain sawn, of quality suitable for transparent finish.

2.2 ACCESSORIES

A. Fasteners: Type and size as required by conditions of use.

B. Adhesives: Waterproof, water-based type, compatible with trim and substrate materials.

2.3 FABRICATION

A. Quality: AWI/AWMAC/WI Architectural Woodwork Standards, Section 6, Premium Grade.

B. Where field fitting is required, provide ample allowance for cutting.

C. Groove back of trim applied to flat substrate, except do not groove exposed ends.

2.4 FINISHES

A. Factory Finishing:
1. Factory finish trim in accordance with AWI/AWMAC/WI Architectural Woodwork Standards, Section 5.
2. Finish system: 2 – Laquer, Precatalyzed.
3. Color: to be selected from manufacturer's full color range.
4. Sheen: Semigloss.

PART 3 EXECUTION

3.1 PREPARATION

A. Prior to installation, condition cabinets to average humidity that will prevail after installation.

B. Back prime wood installed against masonry or cementitious materials prior to installation.

3.2 INSTALLATION

A. Install in accordance with AWI/AWMAC/WI Architectural Woodwork Standards.

B. Install in longest practical lengths.

C. Set plumb, rigid and level.

D. Miter ends, corners, and intersections.

E. Scribe to adjacent construction with maximum 1/8 inch gaps.

F. Fasten or adhere to supporting construction.

END OF SECTION

SECTION 06 6116

SOLID SURFACING FABRICATIONS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Solid surfacing countertops.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.
   2. Section 07 9200 - Joint Sealers.

1.2 REFERENCES

A. ASTM International (ASTM) E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

1.3 SUBMITTALS

A. Submittals for Review:
   1. Shop Drawings: Indicate dimensions, component sizes, fabrication details, attachment provisions and coordination requirements with adjacent work.
   2. Product Data: Indicate product description, fabrication information and compliance with specified performance requirements.
   3. Samples: 2 x 2 inch samples showing available colors.

B. Closeout Submittals:
   1. Maintenance Data: Include recommended cleaning materials and procedures and damage repair.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Minimum 3 years documented experience in work of this Section.

B. Fire Hazard Classification: Class A flame spread/smoke developed rating, tested to ASTM E84.

C. Mockup:
   1. Size: One full size countertop.
   2. Show: Countertop, splash, apron, and trim.
   3. Locate where directed.
   4. Mockup to be approved by Architect and THC representative prior to commencing the Work.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
   1. Caesarstone. (www.caesarstoneus.com)
   2. Cambria. (www.cambriausa.com)
   3. Cosentino USA. (www.silestone.com)

B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. Solid Surfacing:
   1. Material: Homogenous sheet material composed of resins, quartz aggregates, and coloring agents.
   2. Thickness: 3/4 inch.
   3. Edge: Eased or bullnose
   4. Color: To be selected from manufacturer's full color range. Bid documents to be based on Silestone Platinum Series – Chrome, or approved substitute.

5. Surface finish: Polished

2.3 ACCESSORIES

A. Adhesive: Type recommended by solid surfacing manufacturer.

B. Joint Sealer: Specified in Section 07 9200.

2.4 FABRICATION

A. Fabricate components in shop to sizes and shapes indicated, in accordance with manufacturer's instructions and approved Shop Drawings.

B. Fabricate splashes and skirts from solid surfacing in color to match countertops.

C. Form joints to be inconspicuous in appearance and without voids. Join pieces with adhesive.

D. Provide holes and cutouts for mounting of sinks, trim, and accessories.

E. Finish exposed edges to smooth, uniform bullnose profile.

F. Allowable Tolerances:
1. Maximum variation in size: 1/8 inch.
2. Maximum variation in location of openings: 1/8 inch from indicated location.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions and approved Shop Drawings.

B. Set plumb, level, and rigid.

C. Adhere countertops, splashes, and skirts with beads of adhesive.

D. Seal perimeter with joint sealer as specified in Section 07 9200. Finish smooth and flush.

E. Allowable Tolerances:
1. Maximum variation from level and plumb: 1/8 inch in 10 feet, noncumulative.
2. Maximum variation in plane between adjacent pieces at joint: Plus or minus 1/32 inch.

3.2 ADJUSTING

A. Sand out minor scratches and abrasions.

3.3 PROTECTION

A. Protect surfaces from damage with non-staining coverings.

END OF SECTION

SECTION 07 1700

BENTONITE WATERPROOFING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Bentonite clay waterproofing in geotextile sheet form.
   2. Drainage board.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 SUBMITTALS

A. Submittals for Review:
   1. Shop Drawings: Include termination and penetration details, corner conditions, and interface with adjacent construction.
   2. Product Data: Include product description and performance characteristics.

1.3 QUALITY ASSURANCE

A. Applicator Qualifications:
   1. Minimum 2 years documented experience in work of this Section.
   2. Licensed or certified by waterproofing system manufacturer.

B. Pre-Installation Conference:
   1. Convene at site 2 weeks prior to beginning work of this Section.
   2. Attendance: Architect, THC Representative, Contractor, waterproofing applicator, waterproofing manufacturer's representative, and related trades that may affect waterproofing installation prior to, during, or following installation.
   3. Review and discuss Contract Documents, waterproofing system manufacturer's literature, job conditions, scheduling, and other matters affecting application as appropriate.
   4. Tour representative areas of waterproofing substrates, and discuss substrate construction, related items, work conditions, termination details, and materials compatibility.

1.4 PROJECT CONDITIONS

A. Materials m ay be applied to damp surfaces, but not in standing water or during precipitation.

1.5 DELIVERY, STORAGE AND HANDLING

A. Provide continuous protection for bentonite products against m oisture absorption and wetting.

1.6 WARRANTIES

A. Furnish manufacturer’s 5 year warranty providing coverage against water leakage through waterproofing system.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
   1. Cetco. (www.cetco.com)

B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. Bentonite Waterproofing System:
   1. Description: High swelling granular sodium bentonite contained within geotextile fabric facings.
   2. Size: 4 x 15 feet.
   3. Accessories:
      a. Trowel grade bentonite.
      b. Bentonite tubes: 2 inch diameter.
      c. Granular bentonite.

2.3 ACCESSORIES

A. Patching Compound: Cementitious based.

B. Fasteners: Type best suited to application.

C. Cover Sheet: Minimum 4 mil thick polyethylene sheet.

D. Drainage Board: Three dimensional geomatrix core with filter fabric facing one side; waterproofing manufacturer's standard product.

PART 3 EXECUTION

3.1 PREPARATION

A. Prepare substrate to receive waterproofing:
   1. Remove protrusions flush with adjacent surface.
   2. Remove loose and spalled concrete and masonry.
   3. Patch holes and depressions with patching com pound; finish flush with adjacent surfaces.

3.2 INSTALLATION OF W ATERPROOFING

A. Install waterproofing system in accordance with manufacturer's instructions.

B. Patch voids in excess of 3/4 inch diameter, cracks, joints, and sharp offsets with patching com pound; finish flush.

C. Remove projections exceeding 3/4 inch.

D. Place bentonite tubes along top of wall to footing joints.

E. Place sheets horizontally, lapping ends and edges 4 inches minimum .

F. Mechanically fasten panels to substrate at maximum 12 inches on center.

G. Cut sheets to fit at penetrations and around perimeter. Seal penetrations with trowel grade bentonite.

3.3 INSTALLATION OF DRAINAGE BOARD

A. Apply drainage board the same day membrane is applied.

B. Install in accordance with manufacturer's instructions.

C. Cut pieces from roll to required length. Cut to fit around penetrations and at perimeter.

D. Mechanically fasten to substrate. Place with filter fabric to earth.

E. Overlap and secure filter fabric on adjacent sheets.

F. Pull filter fabric loose from core at bottom of wall; wrap fabric around subsurface drainage pipe.

G. Complete backfilling as soon as possible after application of protection board; within 7 days maximum.

END OF SECTION

SECTION 07 2126

BLOWN INSULATION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Loose insulation pneumatically placed between framing members at attics.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

A. ASTM International (ASTM) C764 - Standard Specification for Mineral Fiber Loose Fill Insulation.

1.3 SUBMITTALS

A. Submittals for Review:
   1. Product Data: Product Data: Manufacturer's literature for products furnished, including performance criteria and application instructions.

1.4 DELIVERY, STORAGE AND HANDLING

A. Store materials off ground or floor in protected, dry area; discard materials that have been exposed to weather prior to use.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
   1. CertainTeed Corp. (www.certainteed.com)
   2. Johns Manville. (www.jm.com)
   3. Knauf Insulation. (www.knaufusa.com)
   4. Owens Corning. (www.owenscorning.com

B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. Blown Insulation:
   1. ASTM C764, glass fiber type, bulk for pneumatic placement.
   2. Minimum R value: 2.4 per inch of thickness.

PART 3 EXECUTION

3.1 PREPARATION

A. Close off openings and vents with temporary coverings prior to installing insulation.

3.2 INSTALLATION

A. Install insulation in accordance with manufacturer's instructions.

B. Pneumatically place insulation in attics between framing members to depth required to achieve an R-value of 20.0.

C. Fill spaces without gaps or voids. Place tight to mechanical and electrical services.

3.3 ADJUSTING

A. Inspect areas for complete coverage; fill voids.

END OF SECTION

SECTION 07 2600

VAPOR RETARDERS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Sheet materials for controlling vapor diffusion at floor slabs on grade.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

A. ASTM International (ASTM):
   1. D882 - Standard Test Method for Tensile Properties of Thin Plastic Sheeting.
   2. D1709 - Standard Test Methods for Impact Resistance of Plastic Film by Free-Falling Dart Method.
   3. D1876 - Standard Test Method for Peel resistance of Adhesives (T-Peel Test).
   4. E96 - Standard Test Method for Water Vapor Transmission of Materials.
   5. E154 - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.
   6. E1643 - Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
   7. E1745 - Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

1.3 SUBMITTALS

A. Submittals for Review:
   1. Product Data: Include product description and performance characteristics.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Contract Documents are based on products by Flatiron Films LLC.

B. Equivalent products by following manufacturers are acceptable:
   1. Griffolyn, Division of Reef Industries.
   2. Raven Industries.
   3. W.R. Meadows, Inc.

C. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. Vapor Retarder:
   1. Product: Iron-Barr 10.
   2. Description: Multi-ply lamination consisting of highly puncture resistant virgin polyolefin and metallized polyester films.
   3. Thickness: 10 mils.
   4. Exceed requirements of ASTM E745, Class A.
   5. Water vapor permeance: Maximum 0.0013 wvtr, tested to ASTM E96, Method A.
   6. Tensile strength: Minimum 89 lbf/in dry and minimum 82 lbf/in after soak, tested to ASTM D882.
   7. Puncture resistance: Minimum 3960 grams, tested to ASTM D1709, Method B.
   8. Chemical resistance: Unaffected, tested to ASTM E154.

9. Life expectancy: Indefinite, tested to ASTM E154.
10. Seam tape adhesive: Minimum 7 lb/lf, tested to ASTM D1876.

2.3 ACCESSORIES

A. Joint Tape: Minimum 2 inches wide, pressure sensitive, waterproof, compatible with vapor retarder.

PART 3 EXECUTION

3.1 INSTALLATION

A. Remove sharp rocks and objects that could puncture vapor retarder.

B. Install vapor retarder without tears, voids, and holes.

C. Lap ends and edges minimum 6 inches over adjacent sheets.

D. Tape seal lapped joints, tears, holes, perimeter, and penetrations through vapor retarder.

3.2 REPAIR

A. Inspect vapor retarder for dam age just prior to covering.

B. Clean damaged areas and cover with additional vapor retarder material cut minimum 6 inches larger than damaged area on all sides. Seal to main vapor retarder with continuous tape.

END OF SECTION

SECTION 07 3116

METAL SHINGLES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Metal shingles.
   2. Metal flashings and accessories.
   3. Underlayment.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

A. ASTM International (ASTM):
   1. A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
   2. D412 - Standard Test Method for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension.
   3. D1970 - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.

B. National Roofing Contractors Association (NRCA) - Steep Roofing Manual.

1.3 SUBMITTALS

A. Submittals for Review:
   1. Product Data: Technical data and installation instructions published by manufacturer of shingles.
   2. Samples: Full size shingle samples illustrating configuration, color, and surface finish.

B. Quality Control Submittals:
   1. Qualifications: Installer qualifications per Section 01 4001.

1.4 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Minimum 5 years experience in work of this Section.
   2. Successful completion of at least 3 projects of similar scope and complexity within past 5 years.

B. Perform Work in accordance with NRCAManual.

C. Mockup:
   1. Size: Minimum 20 square feet.
   2. Include: Underlayment, shingles, and flashings.
   3. Locate where directed.
   4. Mockup to be approved by Architect and THC representative prior to commencing the Work.

1.5 PROJECT CONDITIONS

A. Do not install underlayment at ambient or surface temperatures less than 40 degrees F or on wet or frozen substrate.

B. Do not install shingles on wet or frozen substrate.

1.6 MAINTENANCE

A. Extra Materials: 2 percent of extra shingles.

PART 2 PRODUCTS

2.1 MATERIALS

A. Galvanized Steel Sheet:
   1. ASTM A653/A653M, Structural Quality; 24 gage core steel with minimum 1.25 ounces/square foot galvanized coating.
   2. Prefinished with fluoropolymer coating containing minim um 70 percent PVDF resins, Colonial Red or approved substitute.

2.2 ACCESSORIES

A. Underlayment (valleys, eaves, gutters):
   1. Description: ASTM D1970; minimum 30 mil thick polymer modified asphalt laminated to slip-resistant polyethylene film, self-adhering with release paper facing, specifically formulated for extended high in-service temperatures.
   2. Elongation: Minimum 250 percent, tested to ASTM D412.
   3. Tensile strength: Minim um 250 PSI, tested to ASTM D412.
   4. Source: Grace Ultra by Grace Construction Products or approved substitute.

B. Underlayment:
   1. Description: vapor permeable underlayment
   2. Source: Tyvek Protec 200 or approved substitute.

C. Fasteners: Type recommended by NRCA, hot dip galvanized steel, length to penetrate minimum 3/4 inch into sheathing.

D. Asphalt Plastic Cement: ASTM D2822, Type II, non-running, heavy body material composed of asphalt and other mineral ingredients.

2.3 FABRICATION

A. Metal Shingles:
   1. Profile: Stam ped to size and profile to match original shingles.
   2. Edges: Interlocking.
   3. Form shingles true to shape, accurate in size, and free from distortion and defects.

B. Metal Flashings and Trim:
   1. Fabricate from same material as shingles.
   2. Fabricate cleats and starter strips of same material as sheet metal.
   3. Hem exposed edges on underside 1/2 inch; miter and seam corners.
   4. Form sections true to shape, accurate in size, square, and free from distortion and defects.

PART 3 EXECUTION

3.1 INSTALLATION OF UNDERLAYMENT

A. Starting at low edge, apply underlayment horizontally on roof. Weatherlap each sheet 4 inches over preceding sheet. Lap ends 6 inches minimum.

B. Press to full bond with substrate without voids, wrinkles, bridging, or fishmouths. Seal ends and edges.

C. Lap underlayment minimum 12 inches over hips and ridges from both sides. Apply 36 inch wide strip centered lengthwise over ridge.

D. Extend minimum 4 inches up abutting vertical surfaces.

3.2 INSTALLATION OF FLASHINGS

A. Weather lap ends 2 inches minim um and seal with plastic cement.

B. Apply one layer of 24 inch wide galvanized metal centered over valleys. Weather lap joints 2 inches minimum.

C. Nail in place at 8 inches on center maximum.

D. Apply plastic cement to cover nail heads and at edge of flashings for entire length of metal.

3.3 INSTALLATION OF SHINGLES

A. Remove foreign matter from interlocking edges and between shingles.

B. Cut shingles at perimeter and around penetrations with maxim um 1/8 inch gaps.

C. Nail shingles with two nails each. Do not drive nails so far as to create strain on shingles. Locate nails under subsequent shingles or cover heads with metal flashing.

D. Miter shingles at centerline of valley metal to ensure straight border.

E. Install flashings and trim to provide visual continuity and prevent water infiltration.

END OF SECTION

SECTION 07 5400

THERMOPLASTIC MEMBRANE ROOFING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Sheathing board.
   2. Tapered roof insulation.
   3. Fully adhered single ply membrane roofing.
   4. Base flashings.
   5. Walkway pads.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.
   2. Section 06 1000 - Rough Carpentry.
   3. Section 07 6200 - Sheet Metal Flashing and Trim.

1.2 REFERENCES

A. American Society of Civil Engineers (ASCE) 7 - Minimum Design Loads for Buildings and Other Structures.

B. ASTM International (ASTM):
   1. C728 - Standard Specification for Perlite Thermal Insulation Board.
   2. C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
   3. D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
   4. D6878 - Standard Specification for Thermoplastic Polyolefin Based Sheet Roofing.
   5. E108 - Standard Test Methods for Fire Tests of Roof Coverings.

C. Factory Mutual Insurance Co. (FM) 4470 - Approval Standard for Class 1 Roof Covers.

D. National Roofing Contractors Association (NRCA) - Roofing and Waterproofing Manual.

1.3 SYSTEM DESCRIPTION

A. Design Requirements: Design roofing system to resist minimum wind loads in accordance with ASCE 7.

1.4 SUBMITTALS

A. Submittals for Review:
   1. Shop Drawings: Indicate:
      a. Setting plan for sheathing board and roof insulation.
      b. Roof slopes.
      c. Layout of seams.
      d. Base flashing, termination, and special details.
      e. Fastener types and locations.
      f. Walkway pads.
   2. Product Data: Manufacturer's product specifications, installation instructions, and general recommendations for each product.
   3. Warranty: Sample warranty form.

B. Quality Control Submittals:
   1. Certificates of Compliance: Certification from an independent testing laboratory that roofing system meets fire hazard and windstorm classification requirements.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Minimum 3 years documented experience in work of this Section.
   2. Licensed or certified by roofing materials manufacturer.

B. Roofing System:
   1. FM 1-90 Windstorm Resistance and MH Hail Resistance, tested to FM 4470.
   2. Class A Fire Hazard Classification, tested to ASTM E108.

C. Pre-Installation Conference:
   1. Convene at site 2 weeks prior to beginning work of this Section.
   2. Attendance: Architect, Contractor, roofing applicator, roofing manufacturer's representative, and related trades.
   3. Review and discuss: Contract Documents, roofing system manufacturer's literature, project conditions, scheduling, and other matters affecting application.
   4. Tour representative areas of roofing substrates; discuss substrate construction, related work, work conditions, and materials compatibility.

1.6 DELIVERY, STORAGE AND HANDLING

A. Store materials, other than membrane, in protected, dry area, between 60 and 80 degrees F until used; provide proper ventilation.

B. Protect sheet goods from damage and wetting.

1.7 PROJECT CONDITIONS

A. Do not apply roofing to damp or frozen substrate.

B. Do not apply roofing during inclement weather or at temperatures below 40 degrees F, or above 100 degrees F or if freezing weather is anticipated within 24 hours after application. Do not use frozen materials.

1.8 WARRANTIES

A. Furnish manufacturer’s 30 year warranty providing coverage against water leakage through roofing system.
   1. Make repairs to roofing system required due to defects in materials or workmanship resulting in water leakage into or through roofing system.
   2. Include cost of labor and materials necessary to make required repairs.
   3. Cover all roofing system components including roofing membrane, built-up and meta flashings, high wall waterproof flashings, roof insulation, expansion joint covers, and preflashed accessories.
   4. Not limited to specific dollar amount.
   5. Transferable to subsequent building owners during warranty period.
   6. Include coverage for wind speeds up to 90 MPH. Any wind speed coverage exceeding 55 mph or projects with code requirements must be reviewed by approved manufacturer advisor.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
   1. Carlisle Syntec, Inc. (www.carlisle-syntec.com)
   2. Firestone Building Products Co. (www.firestonebpco.com)
   3. GAF Materials Corp. (www.gaf.com)
   4. Genflex Roofing Systems. (www.genflex.com)
   5. Johns Manville. (www.jm.com)

6. Versico, Inc. (www.versico.com)

B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. Rigid Roof Insulation:
   1. Type: ASTM C1289, Type V, Grade 2, rigid polyisocyanurate.
   2. Edges: Square.
   3. Thermal resistance: Minimum R value of 30.0.

B. Sheathing Board:
   1. Type: ASTM C1177/C1177M, square cut ends and edges.
   2. Surfacing: Fiberglass mat with non-asphaltic coating.
   3. Mold resistance: 10, tested to ASTM D3273.
   4. Size: 48 x 48 inches x 1/2 inch thick.
   5. Source: DensDeck Prime Roof Board by GP Gypsum Corporation (www.gp.com) or approved substitute.

C. Roof Membrane:
   1. Type: ASTM D6878, thermoplastic polyolefin (TPO), ultraviolet resistant, reinforced.
   2. Size: Maximum sheet size permitted by application and job conditions.
   3. Thickness: 80 mils. reinforced
   4. Color: Ultra White.

D. Flashing Sheet: Manufacturer's standard flashing sheet, color to match membrane.

2.3 ACCESSORIES

A. Accessories: By manufacturer of roofing system, including adhesives, tapes, solvents, sealants, water cutoff mastic, and prefabricated pipe flashings.

B. Walkway Pads: Preformed resilient pads, recommended by roofing manufacturer, minimum 1/2 inch thick.

C. Fasteners: Hot-dip galvanized or fluoropolymer coated steel, approved by roofing system manufacturer, type and length suited to project conditions.

D. Sheathing Board and Insulation Fasteners: Hot-dip galvanized or fluoropolymer coated steel, approved by FM and roofing system manufacturer, type and length suited to project conditions, with galvanized steel plates.

E. Nailers and Curbs:
   1. Preservative treated wood, specified in Section 06 1000.
   2. Nailers: 3-1/2 inch face dimension x insulation thickness.

F. Metal Flashings: Specified in Section 07 6200.

PART 3 EXECUTION

3.1 PREPARATION

A. Remove projections that could puncture membrane from substrate.

B. Clean substrate of loose and foreign material, oil, and grease.

C. Complete roof penetrations and preparation for drains, flashings, and other penetrations prior to beginning roofing.

D. Protect adjacent and underlying surfaces.

3.2 INSTALLATION - GENERAL

A. Install roofing system in accordance with roofing system manufacturer's instructions, NRCA Manual, and approved Shop Drawings.

3.3 INSTALLATION OF TAPERED INSULATION

A. Apply panels with edges perpendicular to deck flutes. Locate ends over solid bearing.

B. Mechanically fasten to substrate in FM fastening pattern.

C. Fit panels to other panels and at perimeter and around penetrations with maximum 3/8 inch voids.

3.4 INSTALLATION OF SHEATHING BOARD

A. Apply panels with edges offset from those in tapered insulation.

B. Mechanically fasten to substrate in FM fastening pattern.

C. Fit panels to other panels and at perimeter and around penetrations with maximum 3/8 inch voids.

3.5 INSTALLATION OF ROOF MEMBRANE

A. Position sheets without stretching; minimize wrinkles. Allow membrane to relax before proceeding.

B. Provide minimum 5-1/2 inch lap at joints between adjacent sheets.

C. Splice sheets by solvent welding or heat welding method.

D. Bond membrane to substrate with full adhesive bed.

E. Fasten membrane to perimeter nailers with fasteners spaced 6 inches on center maximum.

F. Daily Seal:
   1. Ensure that water does not flow beneath completed sections of roof.
   2. Temporarily seal loose edge of membrane with night seal when weather is threatening.
   3. When work is resumed, pull sheet free before continuing installation.

3.6 INSTALLATION OF FLASHINGS

A. Construct in accordance with roofing system manufacturer's standard details.

B. Juncture of Horizontal and Vertical Surfaces:
   1. Use longest practical length flashing to minimize joints.
   2. Complete splice between flashing and main roof sheet before bonding flashing to vertical surface. Extend splice 3 inches beyond fasteners that attach membrane to horizontal surface.
   3. Adhere flashing to substrate with full bed of adhesive.
   4. Fasten top of flashing at 12 inches on center maximum, under metal flashing.

C. Penetrations through Membrane:
   1. Flash pipe with premolded pipe flashings wherever possible.
   2. Where molded pipe flashings cannot be installed, use field fabricated pipe seals.
   3. Seal clusters of pipes and unusually shaped penetrations with minimum 2 inch high flashing containing pourable sealer.

D. Roof Drains:
   1. Taper insulation around drain to provide smooth transition from roof surface to drain clamping ring.
   2. Seal between membrane and drain base with water cutoff mastic.

3.7 INSTALLATION OF WALKWAY PADS

A. Clean underside of pad; set pads in full adhesive bed.

B. Leave 2 inch space between pieces.

END OF SECTION

SECTION 07 6200

SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Gutters and downspouts.
   2. Flashings at roof systems.
   3. Counterflashings at utility penetrations.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.
   2. Section 07 5400 – Thermoplastic Membrane Roofing.
   3. Section 07 9200 - Joint Sealers.

1.2 REFERENCES

A. ASTM International (ASTM):
   1. A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
   2. B32 – Standard Specification for Solder Metal.
   3. B370 – Standard Specification for Copper Sheet and Strip for Building Construction.

B. Copper Development Association (CDA) – Contemporary Copper, A Handbook of Sheet Copper Fundamentals, Design, Details and Specifications.

C. Sheet Metal and Air Conditioning Manufacturer's Association International (SMACNA) – Architectural Sheet Metal Manual.

1.3 SUBMITTALS

A. Submittals for Review:
   1. Shop Drawings: Show locations, types and thicknesses of metal, profiles, dimensions, fastening methods, provisions for expansion and contraction, and joint details.
   2. Samples: Each flashing and trim profile, minimum 12 inches long. Include corners where applicable.

B. Quality Control Submittals:
   1. Qualification Statement: Fabricator and installer qualifications per Section 01 4001.

1.4 QUALITY ASSURANCE

A. Fabricator and Installer Qualifications:
   1. Minimum 5 years documented experience in work of this Section.
   2. Successful completion of at least 3 projects of similar scope and complexity within past 5 years.

B. Mockups:
   1. Provide mockups of each flashing and trim component.
   2. Size: Minimum 4 feet wide.
   3. Locate where directed.
   4. Mockup to be approved by Architect and THC representative prior to commencing the Work.

PART 2 PRODUCTS

2.1 MATERIALS

A. Galvanized Steel Sheet:

1. ASTM A653/A653M, Structural Quality, G90 coating class, 24 gage core steel unless noted otherwise.
2. Where sheet metal is to be painted, apply phosphate film at factory.

2.2 ACCESSORIES

A. Solder: ASTM B32.

B. Fasteners: Hot-dip galvanized steel, with neoprene gasketed washers where exposed.

C. Joint Sealers: Specified in Section 07 9200.

2.3 FABRICATION

A. Fabricate components in accordance with SMACNA Manual and CDA Handbook.

B. Fabricate end caps, downspout outlets and headers, straps, brackets, and downspout strainers in profile to suit gutters and downspouts.

C. Pre tin edges of copper sheet.

D. Solder shop formed joints. After soldering, remove flux and wash clean.

E. Fabricate corners in single units with minimum 18 inch long legs.

F. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.

G. Form sections accurate to size and shape, square and free from distortion and defects.

H. Provide for thermal expansion and contraction in sheet metal:
   1. Gutters:
      a. Place expansion joints at maximum 50 feet on center.
      b. Locate expansion joints between downspouts; prevent water flow over joint.
   2. Other sheet metal:
      a. Provide expansion joints in sheet metal exceeding 15 feet in running length.
      b. Place expansion joints at 10 feet on center maximum and maximum 2 feet from corners and intersections.
   3. Joint width: Consistent with types and sizes of materials, minimum width 1/4 inch.

I. Unless otherwise indicated, provide minimum 3/4 inch wide flat lock seams; lap in direction of water flow.

J. Fabricate cleats and starter strips of same material as sheet metal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install flashing and sheet metal as indicated and in accordance with SMACNA Manual and CDA Handbook.

B. Install cleats and starter strips before starting installation of sheet metal. Fasten at 6 inches on center maximum.

C. Secure flashings with concealed fasteners where possible.

D. Fit flashings tight, with square corners and surfaces true and straight.

E. Seam and seal field joints.

F. Separate dissimilar metals with bituminous coating or non-absorptive gaskets.

G. Reglets:
    1. Install reglets true to line and level. Seal top of surface mounted reglet with joint sealer.
    2. Install flashings into reglets to form tight fit. Secure with lead or plastic wedges at 9 inches on center maximum. Seal remaining space with joint sealer.

H. Gutters: Secure with straps spaced maximum 36 inches on center and within 12 inches of ends.

I. Downspouts:
    1. Secure with straps spaced maximum 8 feet on center and within 2 feet of ends and elbows.
    2. Flash downspouts into gutters and fasten.
    3. Flash upper sections into lower sections minimum 2 inches at joints; fasten sections together.

J. Apply joint sealers as specified in Section 07 9200.

3.2 CLEANING

A. Clean sheet metal; remove slag, flux, stains, spots, and minor abrasions without etching surfaces.

END OF SECTION

SECTION 07 6300

ALUMINUM CORNICE

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Provide aluminum cornice work as shown on Drawings, as specified herein, and as needed for a complete and proper installation.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 SUBMITTALS

A. Submittals for Review:
   1. Shop Drawings: Show locations, types and thicknesses of metal, profiles, dimensions, fastening methods, provisions for expansion and contraction, and joint details.
   2. Samples: submit 18” long samples of each cornice profile.
   3. Submit color samples of exterior covering.
   4. Closeout documents, warranties, and manuals.

B. Quality Control Submittals:
   1. Qualification Statement: Fabricator and installer qualifications per Section 01 4001.

1.3 QUALITY ASSURANCE

A. Fabricator and Installer Qualifications:
   1. Minimum 5 years documented experience in work of this Section.
   2. Successful completion of at least 3 projects of similar scope and complexity within past 5 years.

B. Mockups:
   1. Provide mockups of each component.
   2. Size: Minimum 4 feet wide.
   3. Locate where directed.
   4. Mockup to be approved by Architect and THC representative prior to commencing the Work.

C. Use materials which shall be free from defects impairing strength, durability, and appearance; shall be of best commercial quality for purpose required; and shall comply with shop drawings.

1.4 WARRANTY

A. Warrant the product for one year after date of completed installation of product.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Use aluminum cornice as manufactured by Campbellsville Industries, Inc. (www.cvilleindustries.com) or approved substitute.

B. Use aluminum cornice design as shown on drawings, CI stock #66753/21.

2.2 MATERIALS

A. Use .032” aluminum sheet, 3003-H14 alloy, with available stock finishes for cornice profiles.

2.3 ACCESSORIES

A. Form cornice, small and large brackets, and mouldings in accordance with approved shop drawings.

B. Cast, stamp, form, and/or spin special ornaments in accordance with good and acceptable practices, and in accordance with approved shop drawings.

C. Small and large brackets to be custom formed form .027" Jarden Zinc soldered construction and given a shop applied finish to match cornice. Brackets to be shipped lose and attached and spaced by general contractor or others.

2.4 FABRICATION

A. Form true to profile from .032" aluminum.

B. Furnish in maximum 12'-0" lengths, and with minimum bends of 5/8"

C. Preassemble cornice sections in shop to greatest extent possible to minimize field splicing.

D. Furnish miter patterns and reassembly instructions properly marked for each cornice profile.

2.5 FINISHES

A. Use aluminum cladding with baked on Kynar 500 finish, Colonial White or approved substitute.

2.6 CAULKING

A. Clean and dry all surfaces to be caulked.

B. Apply with caulking gun, using nozzle of proper size to fit the joint width.

C. Use silicone caulking by Dow Corning or approved substitute.

PART 3 EXECUTION

3.1 PROJECT SITE CONDITIONS

A. Verify site conditions are suitable and accessible for delivery and installation.

B. Confirm that all preparatory work is in place in accordance with approved shop drawings before delivery and installation.

C. Report any discrepancies in writing.

3.2 INSTALLATION

A. Use skilled and experienced craftsmen familiar with metal work.

B. Miter all inside and outside corners in accordance with manufacturer's miter patterns. Manufacturer to provide pre-mitered corners for cornice if available.

C. Lap joints minimum 2".

D. Apply bead of caulking 1/2 inch from ends of inner and outer cornice sections.

E. Drill all holes; do not punch.

F. Secure overlapped joints with coated aluminum screws, nails, and/or fasteners.

3.2 CLEANING

A. Clean all debris caused by work of this section.

B. Keep the premises clean and neat at all times.

END OF SECTION

SECTION 07 6400

ALUMINUM DORMERS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Provide triangle shaped dormer work shown on drawings, as specified herein, and as needed for a complete and proper installation.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.
   2. Section 07 3100 – Metal Shingles.

1.2 SUBMITTALS

A. Submittals for Review:
   1. Shop Drawings: Show locations, types and thicknesses of metal, profiles, dimensions, fastening methods, provisions for expansion and contraction, and joint details.
   2. Samples: Submit color samples of exterior covering from any of UNA-CLAD standard stock finishes excluding non-exotic colors.
   3. Certificates of Insurance.
   4. Closeout documents, warranties, and manuals.

B. Quality Control Submittals:
   1. Qualification Statement: Fabricator and installer qualifications per Section 01 4001.

1.3 QUALITY ASSURANCE

A. Fabricator and Installer Qualifications:
   1. Minimum 5 years documented experience in work of this Section.
   2. Successful completion of at least 3 projects of similar scope and complexity within past 5 years.

B. Mockups:
   1. Provide mockups of each component.
   2. Size: Minimum 4 feet wide.
   3. Locate where directed.
   4. Mockup to be approved by Architect and THC representative prior to commencing the Work.

C. Use materials which shall be free from defects impairing strength, durability, and appearance; shall be of best commercial quality for purpose required; and shall comply with shop drawings.

1.4 WARRANTY

A. Warrant the product for one year after date of completed installation of product.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Use product as manufactured by Campbellsville Industries, Inc. (www.cvilleindustries.com) or approved substitute.

B. Use dormer design as shown on drawings.

2.2 MATERIALS

A. Use structural aluminum products according to the Construction Manual of the Aluminum Association, Inc., and shall be alloy 6061-T6.

B. Use .032” aluminum cladding, 3003-H14 alloy, with available UNA-CLAD stock .032” baked on Kynar finishes excluding metallic non-exotic.

C. Use .027” Jarden Zinc soldered flashing around perimeter.

2.3 ACCESSORIES

A. Form louver blades and firmly secure rivet to frames, and back with 18 x 18 aluminum screens.

B. Form cornices, mouldings, and ornaments in accordance with approved shop drawings.

C. Cast, stamp, form and/or spin special ornaments in accordance with good and acceptable practices, and in accordance with approved shop drawings.

2.4 FABRICATION

A. Fabricate structural aluminum framing with welded joints.

B. Form all exterior cladding with and acceptable sheet metal practices, and lock form all seams inasmuch as possible.

C. Conceal all exterior fasteners to maximum possibility.

D. Dormer roofs to have 5/8” thick plywood on exterior complete with ice and water shield installed on roof areas ready for Contractor or others to install roofing material.

E. C.I. to include a 12 inch wide .027” Jarden Zinc soldered flashing band around all dormer perimeter.

F. Use cadmium plated bolts, nuts, and washers for anchoring, unless anchoring materials are provided and installed by others.

2.5 FINISHES

A. Use aluminum cladding with Baked on Kynar 500 finish, Colonial Red or approved substitute.

B. Shop finish all aluminum castings, stampings, spinnings, and accessories. Units shall be caustic etched, primed with 2 heavy coats of primer, and finished with 2 heavy coats minimum of industrial vinyl or enamel finish electrostatically applied and air dried.

C. Clean all .027” Jarden Zinc to weather naturally.

D. Paint all aluminum surfaces in contact with steel with one heavy coat of zinc primer, and paint all steel surfaces with 2 heavy coats red lead or zinc chromate, followed by one coat of aluminized bituminous paint.

2.6 CAULKING

A. Clean and dry all surfaces to be caulked.

B. Apply with caulking gun, using nozzle of proper size to fit the joint width.

C. Use silicone caulking by Dow Corning or approved substitute.

PART 3 EXECUTION

3.1 PROJECT SITE CONDITIONS

A. Verify with Contractor that site conditions are suitable and accessible for delivery.

B. Confirm with Contractor that all preparatory work is in place in accordance with approved shop drawings before delivery.

3.2 INSTALLATION

A. Coordinate with other trades as required to assure proper and adequate installation.

B. Clean all soiled and dirty areas and touch up any scratches or abrasions to finish before lifting into position.

C. Install work with skilled workmen who are familiar with such work in accordance with approved shop drawings.

D. Provide crane to manufacturer for unloading for as long as required.

3.3 CLEAN-UP

A. Clean up all debris caused by work of this section.

B. Keep the premises clean and neat at all times.

END OF SECTION

SECTION 07 8100

APPLIED FIREPROOFING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Spray applied fireproofing for structural steel members in chases.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

A. ASTM International (ASTM):
   1. E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
   2. E119 - Standard Test Method for Fire Tests of Building Construction and Materials.
   3. E605 - Standard Test Method for Thickness and Density of Sprayed Fire-Resistive Material Applied to Structural Members.
   4. E736 - Standard Test Method for Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members.
   5. E761 - Standard Test Method for Com pressive Strength of Sprayed Fire-Resistive Materials Applied to Structural Members.

1.3 SUBMITTALS

A. Submittals for Review:
   1. Product Data:
      a. Include schedule indicating components to receive fireproofing, fireproofing designs, hourly ratings, and applied fireproofing thicknesses.
      b. Copies of each fire rated assembly design.
      c. Manufacturer's descriptive data and application instructions.

B. Quality Control Submittals:
   1. Qualification Statement: Applicator qualifications per Section 01 4001.
   2. Certificates of Compliance:
      a. Applicator's certification that selected designs will provide scheduled fire resistance rating in accordance with Building Code.
      b. Independent test reports confirming that materials meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Applicator Qualifications:
   1. Firm specializing in work of this Section with minim um 2 years experience.
   2. Approved by manufacturer of fireproofing material.

B. Products, Execution, and Thickness: Conform to approved fire rated assembly design requirements.

C. Fireproofing Designs: Certified to attain specified fire resistance ratings in accordance with ASTM E119.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to site with labels bearing fire hazard and fire resistance classifications.

B. Store materials off ground or floor in protected, dry area; discard materials that have been exposed to weather prior to use.

1.6 PROJECT CONDITIONS

A. Environmental Requirements:
1. Minimum 40 degrees F ambient and surface temperature for 24 hours prior to, during, and for 24 hours after application.
2. Provide ventilation to dry fireproofing after application.
3. Consult manufacturer's literature for application during adverse weather conditions.

1.7 SEQUENCING

A. Place clips, hanger supports, sleeves, and other attachments to fireproofing bases prior to application of fireproofing where these attachments can be anticipated in advance.

B. Do not position ducts, piping, conduit, and other suspended equipment that will interfere with uniform application until after application.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
1. Carboline AD/Southwest. (www.carboline.com)
2. Grace Construction Products. (www.graceconstruction.com)
3. Isolatek International. (www.cafco.com)

B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. Sprayed Fireproofing:
1. Type: Low density cementitious.
2. Dry density: ASTM E605; values for average and individual densities as required for fire resistance rating indicated but not less than 15 pcf.
3. Com pressive strength: ASTM E761; minimum 1,200 psf.
4. Bond strength: ASTM E736; minimum 200 psf when set and dry.

2.3 ACCESSORIES

A. Primers, Bonding Agents, and Attachment Devices: As recommended by fireproofing manufacturer.

B. Water: Clean and potable.

2.4 MIXES

A. Mix as recommended by manufacturer.

PART 3 EXECUTION

3.1 PREPARATION

A. Clean surfaces to receive fireproofing; remove oil, grease, dirt, loose paint, mill scale, and other materials that could impair bond.

B. Test painted steel surfaces to verify that paint will not impair bond.

3.2 APPLICATION

A. Apply primer to steel surfaces when required to ensure fireproofing adhesion.

B. Apply fireproofing in accordance with manufacturer's instructions and fire rated assembly design requirements.

C. Spray apply in as many coats as necessary to obtain required thickness and uniform density.

D. Apply to minimum individual and average in place densities as required by fire rated assembly design requirements.

E. Discard partially set, frozen, and caked materials. Stop application and revise mix if material does not adhere properly.

3.3 FIELD QUALITY CONTROL

A. Testing and Inspection Services:
   1. Verify that applied thickness, bond strength and density of sprayed fireproofing meets fire rating requirements.
   2. Verify that installation meets referenced test reports.
   3. Inspect minimum of 4 locations of 4 square feet each for each.
   4. Field inspection method for thickness and density: ASTM E605.
   5. Field inspection method for bond strength: ASTM E736.

3.4 ADJUSTING

A. Inspect members for complete coverage, cracking, and excessive shrinkage.

B. Patch damaged and cracked areas and those exhibiting excessive shrinkage in accordance with fire rated assembly design requirements.

C. Replace areas where excessive shrinkage or cracking is evident.

3.5 CLEANING

A. Clean adjacent and underlying surfaces of fireproofing.

END OF SECTION

SECTION 07 8123

INTUMESCENT MASTIC FIREPROOFING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Intumescent mastic fireproofing for structural steel members in shafts.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

A. ASTM International (ASTM) E119 - Standard Test Method for Fire Tests of Building Construction and Materials.

B. Underwriters Laboratories, Inc. (UL) - Fire Resistance Directory.

1.3 SUBMITTALS

A. Submittals for Review:
   1. Product Data:
      a. Copies of each UL design selected for each required fire resistance rating, including applicator's certification that selected design will provide scheduled fire resistance rating in accordance with Building Code.
      b. Manufacturer's literature for products furnished, including application instructions.

B. Quality Control Submittals:
   1. Qualification Statement: Restorer qualifications per Section 01 4001.
   2. Certificates of Compliance: Independent test reports confirming that materials meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Applicator Qualifications:
   1. Firm specializing in work of this Section with minim um 2 years experience.
   2. Approved by manufacturer of fireproofing material.

B. Products, Execution, and Thickness: Conform to accepted designs published in UL Directory.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to site with labels bearing designating fire hazard and fire resistance classifications.

B. Store materials off ground or floor in protected, dry area; discard materials which have been exposed to weather prior to use.

1.6 PROJECT CONDITIONS

A. Environmental Requirements:
   1. Minimum 40 degrees F ambient and surface temperature for 24 hours prior to, during and for 24 hours after application.
   2. Provide ventilation to dry fireproofing after application.
   3. Consult manufacturer's literature for application during adverse weather conditions.

1.7 SCHEDULING

A. Place clips, hanger supports, sleeves, and other attachments to fireproofing bases prior to application of fireproofing where these attachments can be anticipated in advance.

B. Do not position ducts, piping, conduit, and other suspended equipment that will interfere with uniform application until after application.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
   1. Albi Manufacturing.
   2. Isolatek International.

B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. Intumescent Mastic Fireproofing:
   1. Source: CAFCO SprayFilm W B 2, W B 3, or W B 4 by Isolatek International or approved substitute.
   2. Type: Thin film intumescent, tested to ASTM E119.
   3. Topcoat: SprayFilm Topseal, color to be selected.

2.3 ACCESSORIES

A. Primer: As recommended by fireproofing manufacturer.

2.4 MIXING

A. Mix materials in accordance with manufacturer’s instructions.

PART 3 EXECUTION

3.1 PREPARATION

A. Clean surfaces to receive fireproofing; remove oil, grease, dirt, loose paint, mill scale, and other materials that could impair bond.

B. Test painted steel surfaces to verify that paint will not impair bond.

C. Apply primer to steel surfaces if required by fireproofing manufacturer.

3.2 APPLICATION

A. Apply fireproofing in accordance with manufacturer's instructions and UL design requirements.

B. Apply in as many coats as necessary to obtain required thickness and uniform density.

C. Inspect members for complete coverage; correct unacceptable work and patch.

D. Patch damaged areas.

E. Replace areas where excessive shrinkage or cracking is evident.

3.3 CLEANING

A. Clean adjacent and underlying surfaces of deposits of fireproofing.

END OF SECTION

SECTION 07 8400

FIRESTOPPING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Firestopping perimeter of and penetrations through fire rated assemblies.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

A. ASTM International (ASTM):
   1. E814 - Standard Test Method for Fire Tests of Through-Penetration Firestops.
   2. E1966 - Standard Test Method for Fire-Resistive Joint System s.
   3. E2307 - Standard Test Method for Determining Fire Resistance of Perimeter Fire Barrier Systems Using Intermediate-Scale, Multi-Story Test Apparatus.

B. Underwriters Laboratories, Inc. (UL):
   1. 1479 - Fire Tests of Through-Penetration Firestops.
   2. 2079 - Fire Resistance of Building Joint System s.

1.3 SYSTEM DESCRIPTION

A. Provide continuous protection against passage of heat, fire, smoke, and gases at perimeter of and penetrations through rated assemblies.

1.4 SUBMITTALS

A. Submittals for Review:
   1. Product Data:
      a. Firestopping schedule; prepare in tabular form at and identify:
         1) Type of assembly receiving firestop and required fire rating.
         2) Type of penetrating item.
         3) Proposed firestop system.
      b. Include UL or equivalent details for each firestop system.
   2. Test Reports: Indicate conformance with ASTM E814, ASTM E1966, ASTM E2307, UL 1479, or UL 2079.

B. Quality Control Submittals:
   1. Certificates of Compliance: Indicate conformance of installed system s with specified requirements.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: Minimum 2 years documented experience in work of this Section.

B. Firestopping: Fire resistance rating equivalent to adjacent construction; tested to ASTM E814, ASTM E1966, ASTM E2307, UL 1479, or UL 2079.

1.6 PROJECT CONDITIONS

A. Do not apply sealants, mortars, or putties when temperature of substrate material and surrounding air is below 40 degrees F or is anticipated to drop below that temperature within 24 hours after installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
   1. Hilti, Inc. (www.us.hilti.com)
   2. Fire Barrier Moldable Putty + by 3M Fire Protective Products. (www.3m.com)

B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. Firestopping: One or more of the following:
   1. Silicone elastomer compound: Single or multiple component, low modulus, moisture curing silicone sealant.
   2. Ceramic sealant: Single component, moisture curing ceramic sealant.
   3. Intumescent sealant: Single component, water based intumescent sealant.
   4. Acrylic sealant: Single component acrylic sealant, suitable for painting.
   5. Putty: Single component ceramic fiber base putty or intumescent elastomer putty that expands on exposure to surface heat gain.
   6. Mortar: Hydraulic cementitious mortar.
   7. Pillows or blocks: Formed intumescent or mineral fiber pillows or blocks.
   8. Intumescent strips: Solvent free intumescent wrap strips.
   9. Mechanical devices: Incombustible fillers or silicone elastomer covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
   10. Cast-in-place devices: Containing intumescent material and smoke/water seals.

2.3 ACCESSORIES

A. Forming and Damming Materials: As recommended by firestopping manufacturer for intended use.
   1. Permanent: Mineral fiber board, mineral fiber matting, or mineral fiber putty.
   2. Temporary: Plywood, particle board, or other.

PART 3 EXECUTION

3.1 PREPARATION

A. Prepare openings to receive firestopping as directed by manufacturer:
   1. Remove incidental and loose materials from penetration opening.
   2. Remove free liquids and oil from involved surfaces and penetration components.
   3. Install damming materials to accommodate and ensure proper thickness and fire rating requirements and provide containment during installation.
   4. Remove combustible materials and materials not intended for final penetration seal system.

3.2 INSTALLATION

A. Install firestopping at perimeter of and penetrations through fire rated assemblies.

B. Apply materials in accordance with manufacturer's instructions.

C. Apply firestopping material in sufficient thickness to achieve required ratings.

D. Compress fibered material to achieve a density of 40 percent of its uncompressed density.

E. Place foamed material in layers to ensure homogenous density, filling cavities and spaces. Place sealant to completely seal junctions with adjacent dissimilar materials.

F. Place intumescent coating in sufficient coats to achieve rating required.

G. Remove dam material after firestopping material has cured.

H. Finish exposed surfaces to smooth, flush appearance.

END OF SECTION

SECTION 07 9200

JOINT SEALERS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Joint backup materials.
   2. Joint sealers.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

A. ASTM International (ASTM):
   1. C510 - Standard Test Method for Staining and Color Change of Single- or Multicomponent Joint Sealants.
   2. C719 - Standard Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement (Hockman Cycle).
   3. C794 - Standard Test Method for Adhesion-In-Peel of Elastomeric Joint Sealants.
   4. C834 - Standard Specification for Latex Sealing Com pounds.
   5. C919 - Standard Practice for Use of Sealants in Acoustical Applications.
   6. C920 - Standard Specification for Elastomeric Joint Sealants.
   7. C1193 - Standard Guide for Use of Joint Sealants.
   8. C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants.
   9. C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants.
   10. D2203 - Standard Test Method for Staining from Sealants.

1.3 SUBMITTALS

A. Submittals for Review:
   1. Product Data: Indicate sealers, primers, backup materials, bond breakers, and accessories proposed for use.
   2. Samples:
      a. 1/2 x 1/2 x 3 inch long joint sealer samples showing available colors.
      b. 6 inch long joint backup material samples.

B. Laboratory Pre-Construction Testing:
   1. Obtain representative samples of actual substrate materials.
   2. Test sealers and accessories for following:
      a. Adhesion: Test to ASTM C794 and ASTM C719; determine surface preparation and required primer.
      b. Compatibility: Test to ASTM C1087; determine that materials in contact with sealers do not adversely affect sealant materials or sealant color.
      c. Staining: Test to ASTM D2203, ASTM C510, or ASTM C1248; determine that sealants will not stain joint substrates.
      d. Pre-construction testing is not required when sealant manufacturer furnishes data acceptable to Architect based on previous testing for materials matching those of this Project.

1.4 PROJECT CONDITIONS

A. Do not apply sealers at temperatures below 40 degrees F unless approved by sealer manufacturer.

1.5 WARRANTIES

A. Furnish manufacturer’s 10 year warranty providing coverage for exterior sealers and accessories that

fail to provide air and water tight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
   1. BASF Building Systems. (www.buildingsystems.basf.com)
   2. Dow Corning Corp. (www.dowcorning.com)
   3. GE Silicones. (www.gesealants.com)
   4. Pecora Corp. (www.pecora.com)
   5. Sika Corp. (www.sikausa.com)
   6. Tremco, Inc. (www.tremcosealants.com)

B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. Joint Sealer Type 1:
   1. ASTM C920, Grade P, multiple component polyurethane type, self-leveling and slope grades.
   2. Movement capability: Plus or minus 25 percent.
   3. Color: To be selected from manufacturer's full color range.

B. Joint Sealer Type 2:
   1. ASTM C920, Grade NS, single component silicone type, non sag.
   2. Movement capability: Plus or minus 50 percent.
   3. Colors: To be selected from manufacturer's full color range.

C. Joint Sealer Type 3:
   1. ASTM C834, single component acrylic latex, non sag.
   2. Movement capability: Plus or minus 7-1/2 percent.
   3. Color: White.

D. Joint Sealer Type 4:
   1. ASTM C920, Grade NS, single component silicone, non-sag, mildew resistant.
   2. Movement capability: Plus or minus 25 percent.
   3. Colors: To be selected from manufacturer's full color range.

E. Joint Sealer Type 5:
   1. ASTM C834, single component acrylic latex, non-sag, non-hardening, recommended by manufacturer for acoustical applications.
   2. Movement capability: Plus or minus 7-1/2 percent.
   3. Color: White.

2.3 ACCESSORIES

A. Primers, Bondbreakers, and Solvents: As recommended by sealer manufacturer. B.

Joint Backing:
   1. ASTM C1330, closed cell polyethylene foam, preformed round joint filler, non-absorbing, non-staining, resilient, compatible with sealer and primer, recommended by sealer manufacturer for each sealer type.
   2. Size: Minimum 1.25 times joint width.

2.4 MIXES

A. Mix multiple component sealers in accordance with manufacturer's instructions.
   1. Mix with mechanical mixer; prevent air entrainment and overheating.
   2. Continue mixing until color is uniform.

PART 3 EXECUTION

3.1 PREPARATION

A. Remove loose and foreign matter that could impair adhesion. If surface has been subject to chemical contamination, contact sealer manufacturer for recommendation.

B. Clean and prim e joints in accordance with manufacturer's instructions.

C. Protect adjacent surfaces with masking tape or protective coverings. D.

Sealer Dimensions:

1. Minim um joint size: 1/4 x 1/4 inch.
2. Joints 1/4 to 1/2 inch wide: Depth equal to width.
3. Joints over 1/2 inch wide: Depth equal to one half of width.

3.2 APPLICATION

A. Apply products in accordance with manufacturer's instructions.

B. Install sealers and accessories in accordance with ASTM C1193.

C. Install acoustical sealers and accessories in accordance with ASTM C919.

D. Install joint backing to maintain required sealer dimensions. Com press backing approximately 25 percent without puncturing skin. Do not twist or stretch.

E. Use bondbreaker tape where joint backing is not installed.

F. Fill joints full without air pockets, embedded materials, ridges, and sags.

G. Tool sealer to smooth profile.

G. Apply sealer within manufacturer’s recommended temperature range.

H. Do not apply silicone sealants at areas prone to moisture infiltration.

3.3 CLEANING

A. Remove masking tape and protective coverings after sealer has cured.

B. Clean adjacent surfaces.

3.4 SCHEDULE

JOINT LOCATION OR TYPE	SEALER TYPE
Exterior Joints:	
Joints in horizontal surfaces subject to pedestrian or vehicular traffic	1
Joints in above-grade surfaces	2
Interior Joints:	
Joints in horizontal surfaces subject to pedestrian traffic	1
Joints in toilet rooms and countertops	4
Joints in acoustical assemblies	5
Other joints	3

END OF SECTION

SECTION 08 0386

VAULT DOOR RESTORATION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Restoration of damaged and missing hardware and locking devices.
   2. Refinishing.
   3. Restoration of decorative painting.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.
   2. Section 09 9100 - Painting.

1.2 SUBMITTALS

A. Quality Control Submittals:
   1. Qualification Statement: restorer qualifications per Section 01 4001.

1.3 QUALITY ASSURANCE

A. Restorer Qualifications:
   1. Minimum 5 years experience in work of this Section.
   2. Successful completion of at least 3 projects of similar scope and complexity within past 5 years.

B. Art Conservator Qualifications: Under provisions of section 09 9100.

C. Mockup:
   1. Size: As determined by Art Conservator.
   2. Illustrate complete restoration including decorative painting.
   3. Locate where directed.

PART 2 PRODUCTS

2.1 MATERIALS

A. Hardware: Reuse original hardware or provide new hardware to match original in type, material, size, profile, and finish.

2.2 ACCESSORIES

A. Primer Paint: Rust inhibiting alkyd type.

PART 3 EXECUTION

3.1 REPAIR AND REPLACEMENT OF HARDWARE

A. Restore existing hardware to working condition, or install new hardware.

B. Replace damaged and missing components.

C. Lubricate operable parts.

D. Adjust for smooth operation.

3.2 REFINISHING

A. Prepare surfaces for refinishing as specified in Section 09 9100.

B. Remove existing paints in manner to prevent damage to existing decorative painting.

C. Paint surfaces as specified in Section 09 9100.

D. Restore existing decorative painting under provisions of Section 09 9100.

END OF SECTION

SECTION 08 1113

HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Hollow steel doors and frames.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.
   2. Section 08 7100 - Door Hardware.
   3. Section 08 8000 - Glazing.

1.2 REFERENCES

A. American National Standards Institute (ANSI)
   1. A250.8 - Recommended Specifications for Standard Steel Doors and Frames.
   2. A250.11 - Recommended Erection Instructions for Steel Frames.

B. ASTM International (ASTM):
   1. A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
   2. A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Form ability.

C. National Fire Protection Association (NFPA) 80 - Standard for Fire Doors and Fire Windows.

D. Underwriters Laboratories (UL) 10C - Standard for Positive Pressure Fire Tests of Door Assemblies.

1.3 SUBMITTALS

A. Submittals for Review:
   1. Shop Drawings: Show locations, elevations, dimensions, model designations, fire and thermal ratings, preparation for hardware, and anchoring details.
   2. Product Data: Show elevations, dimensions, gages of metal, hardware reinforcing gages and locations, and anchor types.

1.4 QUALITY ASSURANCE

A. Doors: ANSI A250.8.
   1. Grade: II - Heavy Duty.
   2. Model: 2 - Seam less.
   3. Exterior doors: Minim um R value of 12.0.

B. Frames: ANSI A250.8, Grade II - Heavy Duty.

C. Fire Door and Frame Construction: Conform to UL 10C.

D. Installed Fire Rated Door and Frame Assemblies: Conform to NFPA 80.

1.5 DELIVERY, STORAGE AND HANDLING

A. Ship door frames with removable angle spreader; do not remove until frame is installed.

B. Store doors upright in protected, dry area, off ground or floor, with at least 1/4 inch space between individual units.

C. Do not cover with non-vented coverings that create excessive humidity.

D. Remove wet coverings immediately.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
1. Amweld Building Products LLC. (www.amweld.com)
2. Ceco Door Products. (www.cecodoor.com)
3. Curries Company. (www.curries.com)
4. Kewanee Corp. (www.kewaneecorp.com)
5. Pioneer Industries, Inc. (www.pioneerindustries.com)
6. Steelcraft. (www.steelcraft.com)

B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. Steel Sheet: ASTM A1008/1008M, cold rolled.

B. Galvanized Steel Sheet: ASTM A653/A653M, hot dipped, Structural Quality, Class G90 galvanized.

C. Door Core:
1. Interior non-fire-rated doors: Resin impregnated fibrous honeycomb.
2. Interior fire-rated doors: Rigid mineral fiberboard.
3. Exterior doors: Foamed-in-place polyurethane insulation.

2.3 ACCESSORIES

A. Glass, Glazing Sealers, and Accessories: Specified in Section 08 8000.

B. Primer: Zinc rich type.

2.4 FABRICATION

A. Fabricate doors and frames in accordance with ANSI A250.8.

B. Fabricate exterior doors and frames from galvanized galvannealed steel sheet.

C. Doors:
1. Fabricate from minimum 18 gage sheets.
2. Close top and bottom edges of doors with steel channel, minimum 16 gage, extending full width of door, and spot welded to both faces, with top channel flush and bottom channel recessed.

D. Frames:
1. Fabricate from minimum 16 gage sheets.
2. Close corner joints tight with trim faces mitered, continuously welded, and ground smooth.
3. Anchors:
   a. Provide one anchor at each jamb for each 30 inches of door height.
   b. Design anchors to provide positive fastenings to adjacent construction.
   c. Provide one floor anchor welded to each jamb.
4. Where frames will be filled with concrete or grout, install silencers in frames before erection.

E. Accurately form to required sizes and profiles.

F. Grind and dress exposed welds to form smooth, flush surfaces.

G. Do not use metallic filler to conceal manufacturing defects.

H. Fabricate with internal reinforcement for hardware specified in Section 08 7100; weld in place.

I. Glazing Stops:
   1. Manufacturer's standard, screw on type with mitered corners.
   2. Form stops from minimum 20 gage steel; prefit for field glazing.
   3. Locate screws within 1 inch of ends of stops and maximum 8 inches on center.
   4. Install glazing stops on secure side of frames.

2.5 FINISHES

A. Dress tool marks and surface imperfections to smooth surfaces.

B. Chemically treat and clean.

C. Touch up damaged metallic coatings.

D. Apply manufacturer's standard primer paint.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install doors and frames in accordance with ANSI A250.11.

B. Set plumb and level.

C. Secure to adjacent construction using fastener type best suited to application.

D. Install glass as specified in Section 08 8000.

E. Install hardware in accordance with Section 08 7100.

3.2 ADJUSTING

A. Touch up minor scratches and abrasions in primer paint to match factory finish.

END OF SECTION

SECTION 08 1433

STILE AND RAIL WOOD DOORS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Solid wood stile and rail doors.
   2. Factory finishing.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.
   2. Section 08 7100 - Door Hardware.
   3. Section 08 8000 - Glazing.

1.2 REFERENCES

A. Architectural Woodwork Institute/Architectural Woodwork Manufacturers of Canada/Woodwork Institute (AWI/AWMAC/WI) - Architectural Woodwork Standards.

B. National Fire Protection Association (NFPA) 80 - Standard for Fire Doors and Fire Windows.

C. Underwriters Laboratories (UL) 10C - Standard for Positive Pressure Fire Tests of Door Assemblies.

1.3 SUBMITTALS

A. Submittals for Review:
   1. Shop Drawings: Show locations, elevations, dimensions, fire ratings, and preparation for hardware.
   2. Samples:
      a. 12 x 12 inch door samples showing stile, rail, and panel.
      b. 6 x 12 inch wood samples showing selected stain color and finish.
   3. Mockup:
      a. Size: 2 ft. x 2 ft. corner showing stile, rail, and panel.
      b. Mockups to be approved by Architect and THC representative prior to commencing with the Work.

1.4 QUALITY ASSURANCE

A. Fire Door Construction: Conform to UL 10C.

B. Installed Fire Rated Door Assembly: Conform to NFPA 80.

1.5 DELIVERY, STORAGE AND HANDLING

A. Package doors in heavy plastic with identifying marks; slit plastic wrap on site to permit ventilation, but do not remove from plastic until ready to install.

B. Do not deliver doors until building is substantially water and weather tight and HVAC system is operational.

C. Store doors flat and level, with spacers between doors to allow for air circulation, in protected, dry area.

D. Maintain humidity in storage areas between 25 and 55 percent.

1.6 WARRANTIES

A. Furnish manufacturer's 2 year warranty providing coverage against defects in materials and workmanship and warpage beyond specified amount.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
1. Eggers Industries. (www.eggersindustries.com)
2. Industrial Millwork Corp. (www.lagdesign.com)
3. The Maiman Company. (www.maiman.com)
4. TruStile Doors (www.trustile.com)

B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. Stile and Rail Wood Doors:
1. Type: AWI Section 1400.
2. Grade: AWI Custom Grade.
3. Exposed wood: Sapele, plain sawn, of quality suitable for transparent finish.
4. Panels:
a. Raised type.
b. Panel core:
1) Interior doors: Medium Density Fiberboard.
2) Exterior doors: Exterior Grade Hardwood Plywood.
5. Adhesives:
a. Exterior doors: Type I - Waterproof.
b. Interior doors: Type II - Water Resistant.

2.3 ACCESSORIES

A. Glass and Glazing Accessories: Specified in Section 08 8000.

2.4 FABRICATION

A. Fabricate doors in accordance with AWI/AWMAC/WI Architectural Woodwork Standards, Section 9.
1. Grade: Premium.
2. Performance Level: Extra Heavy Duty.
3. Veneered panels: Book matched.

B. Prefitting; fit doors to frames at factory with following clearances:
1. Fire rated doors:
a. Width: Cut lock edge only; 3/16 inch maximum.
b. Height: Cut bottom edge only; 1 inch maximum.
2. Non-rated doors:
a. Width: Cut hinge and lock edges equally.
b. Height: Cut bottom edge only; maximum 3/4 inch.
3. Edge clearances:
a. Jambs and head: 1/8 inch maximum between door and frame.
b. Sills without thresholds: 1/8 inch maximum between door and top of finish floor.
c. Sills with thresholds: 1/4 inch maximum between door and top of threshold.
d. Meeting stiles of pairs: 1/8 inch maximum between doors.
4. Lock edge: Bevel 1/8 inch in 2 inches.

C. Premachining: Machine doors at factory to receive hardware specified in Section 08 7100.

2.5 FINISHES

A. Factory Finishing:
1. Factory finish doors in accordance with AWI/AWMAC/WI Architectural Woodwork Standards, Section 5.
2. Finish system: 2 - Laquer, Precatalyzed.

3. Color: To be selected from manufacturer's full color range.
4. Sheen: Satin.

PART 3 EXECUTION

3.1 PREPARATION

A. Condition doors to average humidity that will be encountered after installation.

3.2 INSTALLATION

A. Install doors in accordance with AWI/AWMAC/WI Architectural Woodwork Standards.

B. Install doors plumb and level.

C. If field cutting for height is necessary, cut bottom edge only, 3/4 inch maximum.

D. Seal field cut surfaces with paint.

E. Install door hardware in accordance with Section 08 7100.

F. Install glass as specified in Section 08 8000.

G. Installation Tolerances:
1. Warp: Maximum 1/4 inch in any 3'-0" x 7'-0" portion of door, measured with taut string or straight edge on concave face of door.

END OF SECTION

SECTION 08 3100

ACCESS DOORS AND PANELS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Access doors and frames for wall and ceiling surfaces.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

A. ASTM International (ASTM) A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Form ability.

B. Underwriters Laboratories (UL) 10B - Standard for Fire Tests of Door Assemblies.

1.3 SUBMITTALS

A. Submittals for Review:
   1. Product Data: Provide sizes, types, finishes, scheduled locations, and details of adjoining work.

1.4 QUALITY ASSURANCE

A. Fire Door Construction: Conform to UL 10B.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
   1. Babcock-Davis Hatchways, Inc. (www.babcockdavis.com)
   2. J.L. Industries. (www.jlindustries.com)
   3. Karp Associates, Inc. (www.karpinc.com)
   4. Milcor. (www.milcorinc.com)
   5. Nystrom Building Products, Inc.(www.nystrom.com)

B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. Steel Sheet: ASTM A1008/A1008M, cold rolled.

2.3 FABRICATION

A. Fabricate door frame of steel sheet:
   1. Doors 16 x 16 inches and smaller: Minimum 18 gage.
   2. Doors over 16 x 16 inches: Minimum 16 gage.
   3. Fabricate frames with flange type to suit installation conditions.

B. Fabricate non-rated door panels of minimum 14 gage steel sheet.

C. Fabricate fire rated door panels of two sheets of minimum 20 gage steel sheet. Fill core with

noncombustible insulation.

D. Weld, fill, and grind joints to flush and square appearance.

E. Hardware:
   1. Continuous steel hinges, 175 degree opening.
   2. Screwdriver operated cam latch.
   3. Automatic closers for fire rated doors.

2.4 FINISHES

A. Steel: One coat rust-inhibiting primer paint, sprayed and baked.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install units in accordance with manufacturer's instructions

B. Install plumb and level in openings. Secure rigidly in place.

C. Position units where indicated or where required to provide convenient access to concealed work requiring maintenance.

END OF SECTION

SECTION 08 5200

WOOD WINDOWS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Shop fabricated wood windows, with fixed and operable sash.
   2. Shop fabricated metal-clad wood windows, with fixed and operable sash.
   3. Shop glazing.
   4. Operating hardware.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.
   2. Section 08 8000 - Glazing.

1.2 REFERENCES

A. ASTM International (ASTM) B69 - Standard Specification for Rolled Zinc.

B. Architectural Woodwork Institute (AWI) - Architectural Woodwork Quality Standards.

1.3 SYSTEM DESCRIPTION

A. Design Requirements; design windows doors to withstand:
   1. Design wind pressure in accordance with Building Code, with maximum allowable deflection of L/180.
   2. Movement caused by an ambient temperature range of 120 degrees F and a surface temperature range of 160 degrees F.

1.4 SUBMITTALS

A. Submittals for Review:
   1. Shop Drawings: Include locations, dimensions, profiles, relationship to adjacent construction, and attachments.
   2. Samples: Window corner, minim um 12 x 12 inches, showing corner construction and cross section.

B. Quality Control Submittals:
   1. Qualification Statement: Fabricator qualifications per Section 01 4001.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications:
   1. Minimum 5 years experience in work of this Section.
   2. Successful completion of at least 3 projects of similar scope and complexity within past 5 years.

B. Conform to applicable accessibility code for locating hardware.

C. Mockup:
   1. Size: One full sized window unit.
   2. Locate where directed.
   3. Mockups to be approved by Architect and THC representative prior to commencing with the Work.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver units factory assembled, with sash installed in frame.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
   1. Re-View. (www.re-view.biz)

B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. Wood:
   1. Species and cut: Sapele, plain sawn, of quality suitable for opaque finish on exterior face and transparent finish on interior face.
   2. Grade: Graded in accordance with AW I Section 100, Premium Grade.
   3. Maximum moisture content: 6 percent.

B. Metal Cladding: Zinc sheet, ASTM B69, Type 1, alloy best suited to forming.

C. Glass and Glazing Accessories: Specified in Section 08 8000.

D. Hardware:
   1. Sash lift:
      a. Source: # R-09AD-FP1-605NL by House of Antique Hardware (www.houseofantiquehardware.com) or approved substitute.
      b. Finish: Unlacquered brass.
   2. Sash lock:
      a. Source: # R-09BM-8710-PB by House of Antique Hardware (www.houseofantiquehardware.com) or approved substitute.
      b. Finish: Unlacquered brass.
   3. Sash pulley:
      a. Source: # R-09SR-PBB-225-UL by House of Antique Hardware (www.houseofantiquehardware.com) or approved substitute.
      b. Finish: Unlacquered brass.

E. Sash Cord: Cotton cord with nylon core at wood windows.
   Chain at metal clad windows.

F. Sash Weights: As required to create proper counterbalance for each operable sash.

G. Weatherstripping: Bronze, spring folded for flexible fit.

END OF SECTION

SECTION 08 7100

DOOR HARDWARE

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Hardware for steel and wood doors.
2. Door seals.
3. Automatic operators.
4. Electromechanical and access control hardware.

B. Related Sections:
1. Division 01: Administrative, procedural, and temporary work requirements.
2. Section 08 1113 – Hollow Metal Doors and Frames.
3. Section 08 1433 – Stile and Rail Wood Doors.

1.2 SUBMITTALS

A. Submittals for Review:
1. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.
2. 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.
   a. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
   b. 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.
   c. Content: Include the following information:
      1) Type, style, function, size, label, hand, and finish of each door hardware item.
      2) Manufacturer of each item.
      3) Fastenings and other pertinent information.
      4) Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
      5) Explanation of abbreviations, symbols, and codes contained in schedule.
      6) Mounting locations for door hardware.
      7) Door and frame sizes and materials.
   d. 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.
3. Keying Schedule: Prepared under the supervision of the Owner, separate schedule detailing final keying instructions for locksets and cylinders in writing. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner to approve submitted keying schedule prior to the ordering of permanent cylinders.
4. Samples: Each hardware component, if requested. Samples will be returned for installation on Project.
5. Submittals to be approved by Architect and THC Representative prior to commencing with the Work.

B. Quality Control Submittals:
1. Qualifications: Installer qualifications, including previous projects.

C. Closeout Submittals:

1. Copy of approved hardware schedule.
2. Keying list.
3. Keys; tag with mark corresponding to keying schedule.

1.3 QUALITY ASSURANCE

A. Installer Qualifications:
1. Minimum 3 years documented experience in work of this Section.
2. Successful completion of minimum of 3 projects of similar scope and complexity within past 5 years.

B. Door Hardware Supplier Qualifications:
1. Minimum 5 years documented experience in work of this Section.
2. 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.

C. Source Limitations: Obtain each type and variety of Door Hardware specified in the Related Sections from a single source, qualified supplier unless otherwise indicated.

1.4 DELIVERY, STORAGE AND HANDLING

A. Pack hardware items separately, with fasteners, installation instructions, and templates.

B. Mark containers with item number corresponding to hardware schedule.

1.5 MAINTENANCE

A. Extra Materials: Five extra locksets.

PART 2 PRODUCTS

2.1 DOOR HARDWARE

A. Door Operator (A1):
1. Source: Norton 6300 Series - Low Energy ADA Door Operator (www.nortondoorcontrols.com) or approved substitute.
a. Provide per accessibility drawings, including power supply, battery back-up, associated wall-mounted release buttons, coordination with electric and non-electric hardware items.
b. Finish: Statuary Bronze.

B. Acoustical Seals (AC):
a. Source: Pemko S773 (www. Assabloydooraccessories.com) or approved substitute.
b. Finish: Dark Brown.

C. Astragal Seal (AS):
1. Source: No. 136SDKB by National Guard Products (www.ngp.com) or approved substitute.
2. Finish: Dark Bronze.

D. Deadbolts:
1. Deadbolt (B1)
a. Source: No. DL3013 by Corbin Russwin (www.corbin-russwin.com) or approved substitute.
b. Function: Standard Cylinder x Thumb Turn.
c. Finish: Satin Brass.
d. Strike boxes: Steel.
e. Cylinders: Six pin, solid brass.
f. Keys: Solid brass or nickel silver.
1. Keying:
a. Master key locks in one group.
b. Key alike, cross key, or otherwise key as directed by Owner.
c. Provide four keys for each lock and six master keys.
d. Inscribe keys with lock manufacturer.

E. Closers:
   1. Contemporary (C1):
      a. Source: 4400 Series by Yale (www.yalecommercial.com) or approved substitute.
      b. Finish: Statuary Bronze.
      c. Adjustable opening force and delayed closing in accordance with applicable accessibility code.
   2. Concealed (C2):
      a. Source: 91 Series by Rixson (www.rixson.com) or approved substitute.
      b. Finish: Statuary Bronze.
      c. Adjustable opening force and delayed closing in accordance with applicable accessibility code.

F. Door Stops:
   1. Floor Mounted (D1):
      a. Source: No. C0561 by Rejuvenation Hardware (www.rejuvenation.com) or approved substitute.
      b. Finish: Unlacquered Brass.
   2. Wall Mounted (D2):
      a. Source: No. C0384 by Rejuvenation Hardware (www.rejuvenation.com) or approved substitute.
      b. Finish: Unlacquered Brass.

G. Door Holders (DH):
   1. Source: No. C3338 by Rejuvenation Hardware (www.rejuvenation.com) or approved substitute.
   2. Finish: Unlacquered Brass.

H. Door Sweep (DS):
   1. Source: No. 200NDKB by National Guard Products (www.ngp.com) or approved substitute.
   2. Finish: Dark Bronze.

I. Hinges:
   1. Period Hinge (H1):
      a. No. W-04HH-500-ABH by House of Antique Hardware (www.houseofantiquehardware.com) or approved substitute.
      b. Finish: Solid Brass with exclusive hand-applied patina.
   2. Contemporary Hinge (H2):
      a. No. R-04EM-96215ST-AB by House of Antique Hardware (www.houseofantiquehardware.com) or approved substitute.
      b. Finish: Antique Brass.
   3. Contemporary Hinge (H3):
      a. Source: No. 1045.102 by Baldwin Hardware (www.baldwinhardware.com) or approved substitute.
      b. Finish: Vintage Brass.

J. Kick Plates:
   1. Period (K1):
      a. Source: No. RS-06BA-A09-609-X by House of Antique Hardware (www.houseofantiquehardware.com) or approved substitute.
      b. Finish: Solid Brass with Antique Finish.
   2. Contemporary (K2):
      a. Source: No. 194S by Hager Companies. (www.hagerco.com) or approved substitute.
      b. Finish: Satin Brass.

K. Latchsets:
   1. Period Latchset (L1):
      a. Source: No. R-01DE-BLK-SRML-AB by House of Antique Hardware (www.houseofantiquehardware.com) or approved substitute. Substitute black porcelain door knob with ADA compliant lever handle.
      b. Finish: Solid Brass with Antique Brass finish.
   2. Contemporary Latchset (L2):
      a. Source: No. TL3700 Series by Corbin Russwin (www.corbin-russwin.com) or approved substitute.
      b. Lever: No. 111

c. Trim: V Rose
d. Finish: Satin Brass.

3. Contemporary Push/Pull Set (L3):
   a. Source: No. 1804 Heavy Duty Cast Pull Plate with matching Push Plate by Trimco (www.trimcohardware.com) or approved substitute.
   b. Finish: Satin Brass.

L. Magnetic Locks (ML): CODE CHECK
1. Source: M62 by Securitron (www.assaabloyesh.com) or approved substitute.
2. Provide per security drawings, including power supply, battery back-up, associated motion sensors, associated wall-mounted release buttons, applicable Z brackets (for concealing mag lock).

M. Smoke Seals (SS):
1. Source: Pemko S88 (www.pemko.com) or approved substitute.
2. Finish: Dark Brown.

N. Thresholds:
1. Metal (T1):
   a. Source: Saddle Threshold 8 Inch by Wm. A. Kilian Hardware Co. (www.kilianhardware.com) or approved substitute.
   b. Finish: Architectural Bronze (Brass).
2. Wood (T2):
   a. Profile and material as indicated on Drawings.
3. Marble (T3):
   a. Profile and material as indicated on Drawings.

O. Weatherstripping (W):
1. Source: No. 5050B by National Guard Products, Inc. (www.ngp-inc.com) or approved substitute.
2. Finish: Brown.

P. Panic Devices:
1. Push Bar (X1):
   a. Source: 90 Series by Sargent (www.assaabloy.com) or approved substitute. Concealed vertical rod type.
   b. Finish: Satin Brass.
   c. Outside Trim: To be selected from manufacturer's full range of selections.
   d. Cylinders: Same as specified above for deadbolts.
2. Push Pad (X2):
   a. Source: 80 Series by Sargent (www.assaabloy.com) or approved substitute. Concealed vertical rod type.
   b. Finish: Satin Brass.
   c. Outside Trim: To be selected from manufacturer's full range of selections.
   d. Cylinders: Same as specified above for deadbolts.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install hardware in accordance with approved hardware schedule and manufacturer's instructions.

B. Install mortise items flush with adjacent surfaces.

C. Use templates provided by manufacturer.

D. Install deadbolts, closers, and trim after finish painting.

E. Mount closers so that closers and closer arms are not visible on corridor or public side of doors or on exterior of building.

F. Mounting Heights - Finished Floor to Center Line of:
   1. Locksets: 38 inches.
   2. Dead locks: 48 inches.
   3. Top hinge: Maximum 10 inches from frame head.
   4. Bottom hinge: Maximum 12-1/2 inches from floor.
   5. Intermediate hinges: Equally spaced.

3.2 PROTECTION

A. Protect hardware until finish work is completed.

3.3 ADJUSTING

A. Adjust doors to operate with maximum opening forces in accordance with applicable accessibility code.

3.4 DOOR HARDWARE SETS

A. The door 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. The supplier is responsible for handing and sizing all products as listed in the door hardware sets. Quantities listed are for each pair of doors, or for each single door.

C. Manufacturer's Abbreviations:

OT – OTHER	YA - YALE
RU – CORBIN RUSSWIN	NO - NORTON
SU – SECURITRON	RO - ROCKWOOD
HS – HES	PE - PEMKO
RF – RIXSON	MK – MCKINNEY

HARDWARE SETS

Set: 1.00

Doors: 101.2, 110.1

4	Period Hinge (H1)	Reference 08 7100 - Part 2		OT
1	Period Latchset (L1)	Reference 08 7100 - Part 2		OT
1	Cylinder x Thumb Turn Deadbolt (B1)	DL3013 AP	606	RU
1	Overhead Concealed Closer (C2)	91N x coordinate with frame and fire rating	690	RF
1	Wood Threshold (T2)	Reference 08 7100 - Part 2		OT
1	Acoustical Seal (AC)	S773D x H&J		PE

Set: 1.01

Doors: 112.1, 201.1, 202.1

4	Period Hinge (H1)	Reference 08 7100 - Part 2		OT
1	Period Latchset (L1)	Reference 08 7100 - Part 2		OT
1	Cylinder x Thumb Turn Deadbolt (B1)	DL3013 AP	606	RU
1	Overhead Concealed Closer (C2)	91N x coordinate with frame and fire rating	690	RF
1	Acoustical Seal (AC)	S773D x H&J		PE
1	Door Holder (DH)	Reference 08 7100 - Part 2		OT
1	Wood Threshold (T2)	Reference 08 7100 - Part 2		OT

Set: 1.02

Doors: 101.1, 110.2

4	Period Hinge (H1)	Reference 08 7100 - Part 2		OT
1	Period Latchset (L1)	Reference 08 7100 - Part 2		OT
1	Cylinder x Thumb Turn Deadbolt (B1)	DL3013 AP	606	RU
1	Door Stop (D2)	Reference 08 7100 - Part 2		OT
1	Acoustical Seal (AC)	S773D x H&J		PE

Set: 1.03

Doors: 211.1, 310.1

4	Period Hinge (H1)	Reference 08 7100 - Part 2		OT
1	Period Latchset (L1)	Reference 08 7100 - Part 2		OT
1	Cylinder x Thumb Turn Deadbolt (B1)	DL3013 AP	606	RU
1	Overhead Concealed Closer (C2)	91N x coordinate with frame and fire rating	690	RF
1	Door Stop (D2)	Reference 08 7100 - Part 2		OT
1	Wood Threshold (T2)	Reference 08 7100 - Part 2		OT
1	Door Holder (DH)	Reference 08 7100 - Part 2		OT

Set: 1.04

Doors: 102.1, 107.2, 107.3, 109.1, 116.1, 301.1, 302.1, 313.1

4	Period Hinge (H1)	Reference 08 7100 - Part 2		OT
1	Period Latchset (L1)	Reference 08 7100 - Part 2		OT
1	Cylinder x Thumb Turn Deadbolt (B1)	DL3013 AP	606	RU
1	Overhead Concealed Closer (C2)	91N x coordinate with frame and fire rating	690	RF
1	Wood Threshold (T2)	Reference 08 7100 - Part 2		OT
1	Door Holder (DH)	Reference 08 7100 - Part 2		OT

Set: 1.05

Doors: 112.2, 202.2, 202.3

4	Period Hinge (H1)	Reference 08 7100 - Part 2		OT
1	Period Latchset (L1)	Reference 08 7100 - Part 2		OT
1	Cylinder x Thumb Turn Deadbolt (B1)	DL3013 AP	606	RU
1	Door Stop (D1)	Reference 08 7100 - Part 2		OT
1	Acoustical Seal (AC)	S773D x H&J		PE
1	Door Holder (DH)	Reference 08 7100 - Part 2		OT

Set: 1.06

Doors: 105.1, 206.1, 305.1

4	Period Hinge (H1)	Reference 08 7100 - Part 2		OT
1	Period Latchset (L1)	Reference 08 7100 - Part 2		OT
1	Overhead Concealed Closer (C2)	91N x coordinate with frame and fire rating	690	RF
1	Door Stop (D1)	Reference 08 7100 - Part 2		OT
1	Wood Threshold (T2)	Reference 08 7100 - Part 2		OT
1	Door Holder (DH)	Reference 08 7100 - Part 2		OT

Set: 1.07

Doors: 204.1

4	Period Hinge (H1)	Reference 08 7100 - Part 2		OT
1	Period Latchset (L1)	Reference 08 7100 - Part 2		OT
1	Door Stop (D1)	Reference 08 7100 - Part 2		OT
1	Door Holder (DH)	Reference 08 7100 - Part 2		OT

Set: 1.08

Doors: 115.1, 210.1, 309.1

4	Period Hinge (H1)	Reference 08 7100 - Part 2		OT
1	Magnetic Lock (ML)	M62 x dress cover x brackets to suit application		SU
1	Push Bar Exit Device (X1)	Reference 08 7100 - Part 2		OT
1	Surface Closer (C1)	4400 x arm to suit application	690	YA
1	Metal Threshold (T1)	Reference 08 7100 - Part 2		OT
1	Smoke Seal (SS)	S88D x H&J		PE
1	ElectroLynx Harness	QC-C1500P		MK
1	Power Supply	By Security		OT
1	Card Reader	By Security		OT

Set: 1.09

Doors: 113.2, 207.1, 209.1, 306.1, 308.1

4	Period Hinge (H1)	Reference 08 7100 - Part 2		OT
1	Push Bar Exit Device (X1)	Reference 08 7100 - Part 2		OT
1	Overhead Concealed Closer (C2)	91N x coordinate with frame and fire rating	690	RF
1	Wood Threshold (T2)	Reference 08 7100 - Part 2		OT
1	Acoustical Seal (AC)	S773D x H&J		PE

Set: 2.00

Doors: 106.1, 111.1, 114.1, 120.1

8	Period Hinge (H1)	Reference 08 7100 - Part 2		OT
2	Push Bar Exit Device (X1)	Reference 08 7100 - Part 2		OT
2	Overhead Concealed Closer (C2)	91N x coordinate with frame and fire rating	690	RF
4	Period Kick Plate (K1)	Reference 08 7100 - Part 2		RO
1	Metal Threshold (T1)	Reference 08 7100 - Part 2		OT
1	Weatherstripping (W)	S88D X H&J		PE
2	Door Sweep (DS)	315DN TKSP8 x DW		PE
2	Astragal Seal (AS)	369DS X DH		PE

Set: 2.01

Doors: 113.1, 218.1, 314.1

8	Period Hinge (H1)	Reference 08 7100 - Part 2		OT
2	Push Bar Exit Device (X1)	Reference 08 7100 - Part 2		OT
2	Overhead Concealed Closer (C2)	91N x coordinate with frame and fire rating	690	RF
1	Wood Threshold (T2)	Reference 08 7100 - Part 2		OT
1	Acoustical Seal (AC)	S773D x H&J		PE

Set: 3.00

Doors: 104.1, 109.3, 312.1

4	Contemporary Hinge (H2)	Reference 08 7100 - Part 2		OT
1	Contemporary Latchset (L2)	TL3710 111V	606	RU
1	Cylinder x Thumb Turn Deadbolt (B1)	DL3013 AP	606	RU
1	Door Holder (DH)	Reference 08 7100 - Part 2		OT

Set: 3.01

Doors: 118.1

4	Contemporary Hinge (H2)	Reference 08 7100 - Part 2		OT
1	Contemporary Latchset (L2)	TL3710 111V	606	RU
1	Cylinder x Thumb Turn Deadbolt (B1)	DL3013 AP	606	RU
1	Overhead Concealed Closer (C2)	91N x coordinate with frame and fire rating	690	RF
1	Wood Threshold (T2)	Reference 08 7100 - Part 2		OT
1	Door Holder (DH)	Reference 08 7100 - Part 2		OT

Set: 3.02

Doors: 202.4, 302.3, 304.1

4	Contemporary Hinge (H2)	Reference 08 7100 - Part 2		OT
1	Contemporary Latchset (L2)	TL3710 111V	606	RU
1	Cylinder x Thumb Turn Deadbolt (B1)	DL3013 AP	606	RU
1	Door Holder (DH)	Reference 08 7100 - Part 2		OT

Set: 3.03

Doors: 205.1

4	Contemporary Hinge (H2)	Reference 08 7100 - Part 2		OT
1	Contemporary Latchset (L2)	TL3710 111V	606	RU
1	Cylinder x Thumb Turn Deadbolt (B1)	DL3013 AP	606	RU
1	Door Stop (D2)	Reference 08 7100 - Part 2		OT
1	Marble Threshold (T3)	Reference 08 7100 - Part 2		OT
1	Acoustical Seal (AC)	S773D x H&J		PE
1	Overhead Concealed Closer (C2)	91N x coordinate with frame and fire rating	690	RF
1	Door Holder (DH)	Reference 08 7100 - Part 2		OT

Set: 3.04

Doors: 212.1, 214.1, 214.2, 311.1

4	Contemporary Hinge (H2)	Reference 08 7100 - Part 2		OT
1	Contemporary Latchset (L2)	TL3710 111V	606	RU
1	Cylinder x Thumb Turn Deadbolt (B1)	DL3013 AP	606	RU
1	Door Stop (D1)	Reference 08 7100 - Part 2		OT
1	Marble Threshold (T3)	Reference 08 7100 - Part 2		OT
1	Acoustical Seal (AC)	S773D x H&J		PE
1	Overhead Concealed Closer (C2)	91N x coordinate with frame and fire rating	690	RF
1	Door Holder (DH)	Reference 08 7100 - Part 2		OT

Set: 3.05

Doors: 213.1

4	Contemporary Hinge (H2)	Reference 08 7100 - Part 2		OT
1	Contemporary Latchset (L2)	TL3710 111V	606	RU
1	Cylinder x Thumb Turn Deadbolt (B1)	DL3013 AP	606	RU
1	Door Stop (D1)	Reference 08 7100 - Part 2		OT
1	Acoustical Seal (AC)	S773D x H&J		PE

Set: 4.00

Doors: 216.1

3	Contemporary Flat Tip Hinge (H3)	Reference 08 7100 - Part 2		OT
1	Contemporary Latchset (L2)	TL3710 111V	606	RU
1	Magnetic Lock (ML)	M62 x dress cover x brackets to suit application		SU
1	Cylinder x Thumb Turn Deadbolt (B1)	DL3013 AP	606	RU
2	Contemporary Kick Plate (K2)	K1050 8" x DW-2" BEV CSK	US10B	RO
1	Door Stop (D1)	Reference 08 7100 - Part 2		OT
1	Metal Threshold (T1)	Reference 08 7100 - Part 2		OT
1	Smoke Seal (SS)	S88D x H&J		PE
1	ElectroLynx Harness	QC-C1500P		MK
1	Power Supply	By Security		OT
1	Card Reader	By Security		OT
1	Door Holder (DH)	Reference 08 7100 - Part 2		OT
1	Surface Closer (C1)	4400 x arm to suit application	690	YA

Set: 4.01

Doors: 002.2, 004.2

3	Contemporary Flat Tip Hinge (H3)	Reference 08 7100 - Part 2		OT
1	Contemporary Latchset (L2)	TL3710 111V	606	RU
1	Cylinder x Thumb Turn Deadbolt (B1)	DL3013 AP	606	RU
2	Contemporary Kick Plate (K2)	K1050 8" x DW-2" BEV CSK	US10B	RO
1	Door Stop (D1)	Reference 08 7100 - Part 2		OT
1	Metal Threshold (T1)	Reference 08 7100 - Part 2		OT
1	Smoke Seal (SS)	S88D x H&J		PE
1	Door Holder (DH)	Reference 08 7100 - Part 2		OT

Set: 4.02

Doors: 008.1

3	Contemporary Flat Tip Hinge (H3)	Reference 08 7100 - Part 2		OT
1	Contemporary Latchset (L2)	TL3710 111V	606	RU
1	Cylinder x Thumb Turn Deadbolt (B1)	DL3013 AP	606	RU
2	Contemporary Kick Plate (K2)	K1050 8" x DW-2" BEV CSK	US10B	RO
1	Door Stop (D1)	Reference 08 7100 - Part 2		OT
1	Metal Threshold (T1)	Reference 08 7100 - Part 2		OT
1	Smoke Seal (SS)	S88D x H&J		PE
1	Surface Closer (C1)	4400 x arm to suit application	690	YA

Set: 4.03

Doors: 401.1

3	Contemporary Flat Tip Hinge (H3)	Reference 08 7100 - Part 2			OT
1	Contemporary Latchset (L2)	TL3710 111V	606		RU
1	Cylinder x Thumb Turn Deadbolt (B1)	DL3013 AP	606		RU
2	Contemporary Kick Plate (K2)	K1050 8" x DW-2" BEV CSK	US10B		RO
1	Metal Threshold (T1)	Reference 08 7100 - Part 2			OT
1	Smoke Seal (SS)	S88D x H&J			PE
1	Door Holder (DH)	Reference 08 7100 - Part 2			OT

Set: 4.04

Doors: 004.1

3	Contemporary Hinge (H3)	Reference 08 7100 - Part 2			OT
1	Push Pad Exit Device (X2)	Reference 08 7100 - Part 2			OT
1	Surface Closer (C1)	4400 x arm to suit application	690		YA
2	Contemporary Kick Plate (K2)	K1050 8" x DW-2" BEV CSK	US10B		RO
1	Metal Threshold (T1)	Reference 08 7100 - Part 2			OT
1	Smoke Seal (SS)	S88D x H&J			PE

Set: 4.05

Doors: 011.1

3	Contemporary Flat Tip Hinge (H3)	Reference 08 7100 - Part 2		OT	
1	Magnetic Lock (ML)	M62 x dress cover x brackets to suit application		SU	⚡
1	Push Pad Exit Device (X2)	Reference 08 7100 - Part 2		OT	
1	Electric Strike (rim exit device)	9500 x coordinate with low energy door operator	613	HS	⚡
1	SMART Pac Bridge Rectifier	2005M3		HS	⚡
1	Low Energy ADA Door Operator (A1)	6300 Series to suit application	690	NO	⚡
2	Contemporary Kick Plate (K2)	K1050 8" x DW-2" BEV CSK	US10B	RO	
1	Metal Threshold (T1)	Reference 08 7100 - Part 2		OT	
1	Weatherstripping (W)	S88D X H&J		PE	
1	Door Sweep (DS)	315DN TKSP8 x DW		PE	
1	ElectroLynx Harness	QC-C1500P		MK	⚡
1	Power Supply	By Security Tech		OT	
1	Card Reader	By Security Tech		OT	
2	Touchless Low Energy Door Operator Wall Switch		700	NO	⚡

Set: 4.06

Doors: 107.1, 116.2

4	Contemporary Flat Tip Hinge (H3)	Reference 08 7100 - Part 2			OT
1	Contemporary Latchset (L2)	TL3710 111V	606		RU
1	Cylinder x Thumb Turn Deadbolt (B1)	DL3013 AP	606		RU
1	Door Stop (D1)	Reference 08 7100 - Part 2			OT
1	Metal Threshold (T1)	Reference 08 7100 - Part 2			OT
1	Door Holder (DH)	Reference 08 7100 - Part 2			OT

Set: 4.07

Doors: 102.2, 109.2

4	Contemporary Flat Tip Hinge (H3)	Reference 08 7100 - Part 2		OT
1	Contemporary Latchset (L2)	TL3710 111V	606	RU
1	Cylinder x Thumb Turn Deadbolt (B1)	DL3013 AP	606	RU
1	Metal Threshold (T1)	Reference 08 7100 - Part 2		OT
1	Door Holder (DH)	Reference 08 7100 - Part 2		OT

Set: 4.08

Doors: 009.1, 012.1

3	Contemporary Flat Tip Hinge (H3)	Reference 08 7100 - Part 2		OT
1	Contemporary Push/Pull Set (L3)	Reference 08 7100 - Part 2		OT
2	Contemporary Kick Plate (K2)	K1050 8" x DW-2" BEV CSK	US10B	RO
1	Metal Threshold (T1)	Reference 08 7100 - Part 2		OT
1	Door Holder (DH)	Reference 08 7100 - Part 2		OT
1	Surface Closer (C1)	4400 x arm to suit application	690	YA

END OF SECTION

SECTION 08 7113

AUTOMATIC DOOR OPERATORS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Power door operators.
   2. Controls.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

A. American National Standards Institute/Builders Hardware Manufacturers Association (ANSI/BHMA) A156.19 - Power Assist and Low Energy Power Operated Doors.

1.3 SUBMITTALS

A. Submittals for Review:
   1. Shop Drawings:
      a. Indicate head conditions, dimensions, components, anchorage, and electrical characteristics and connection requirements.
      b. Identify installation tolerances, routing of power and control lines, and locations of operating equipment.
   2. Product Data: Provide data on system components, sizes, features, and finishes.
   3. To be approved by Architect and THC representative prior to commencing the Work.

B. Project Record Documents:
   1. Operation and Maintenance Data.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
   1. Besam, Inc. (www.besam.com)
   2. Dorma Group. (www.dorma.com)
   3. Horton Automatics. (www.hortondoors.com)
   4. LCN Closers. (www.lcnclosers.com)
   5. Dor-O-Matic. (www.dor-o-matic.com)
   6. Stanley Access Technologies. (www.stanleyaccesstechnologies.com)

B. Substitutions: Under provisions of Division 01.

2.2 MANUFACTURED UNITS

A. Door Operators:
   1. Type: ANSI/BHMA A156.19, overhead exposed, low energy.
   2. Model: ED 800 Series by Dorma or approved substitute.
   3. Mounting: Push side, top jamb.
   4. Adjustable spring power, sweep speed, latch speed, and backcheck for manual operation.
   5. Delay time, opening time/opening force, opening angle, and door width selectors adjustments for power operation.
   6. Low energy/power assist selector switch.

B. Actuators:
   1. Wall mounted push button type.
   2. 6 inch diameter stainless steel plate with universal accessibility symbol.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install equipment in accordance with manufacturer's instructions.

B. Make connections between power supply and operator and between operator and controls.

3.2 ADJUSTING

A. Adjust for smooth and proper operation.

END OF SECTION

SECTION 08 8000

GLAZING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Glass for other sections referencing this Section.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

A. ASTM International (ASTM):
   1. C509 - Standard Specification for Elastomeric Cellular Preform ed Gasket and Sealing Material.
   2. C864 - Standard Specification for Dense Elastomeric Com pression Seal Gaskets, Setting Blocks, and Spacers.
   3. C920 - Standard Specification for Elastomeric Joint Sealants.
   4. C1036 - Standard Specification for Flat Glass.
   5. C1048 - Standard Specification for Heat-Treated Flat Glass-Kind HS, Kind FT, Coated and Uncoated Glass.
   6. C1115 - Standard Specification for Dense Elastomeric Silicone Rubber Gaskets and Accessories.
   7. C1294 - Standard Test Method for Compatibility of Insulating Glass Edge Sealants with Liquid-Applied Glazing Materials.
   8. C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants.
   9. E330 - Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors By Uniform Static Air Pressure Difference.
   10. E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings.
   11. E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation.

B. Glass Association of North America (GANA):
   1. Engineering Standards Manual.
   2. Glazing Manual.

C. Insulating Glass Manufacturers Alliance (IGMA) SIGMA TM-3000 - Glazing Guidelines for Sealed Insulating Glass Units.

D. National Fenestration Rating Council (NFRC):
   1. 100 - Procedure for Determining Fenestration Product Thermal Properties.
   2. 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficients at Norm al Incidence.
   3. 300 - Procedures for Determining Solar Optical Properties of Simple Fenestration Products.

1.3 SYSTEM DESCRIPTION

A. Glass Thicknesses:
   1. Indicated thicknesses are minimum s; select actual glass thicknesses by analyzing loads and conditions.
   2. Size glass to withstand positive and negative wind pressure acting normal to plane in accordance with Building Code as measured in accordance with ASTM E330.
   3. Provide glass in thicknesses and strengths to m eet or exceed following criteria:
      a. Com ply with ASTM E1300.
      b. Probability of breakage: 8 lites per 1000 wind load for load duration of 3 seconds.

B. Thermal and Optical Performance Properties: Provide glass meeting specified performance properties, based on manufacturer's published test data for units of thickness indicated:

1. U-factor: Per NFRC 100 expressed as Btu/square foot x hour x degree F.
2. Solar heat gain coefficient: Per NFRC 200.
3. Solar optical properties: Per NFRC 300.

1.4 SUBMITTALS

A. Submittals for Review:
1. Product Data: Descriptive data and performance attributes for insulated glass.
2. Samples: Submit samples of each glass type.
3. To be approved by Architect and THC representative prior to commencing the Work.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements: Provide tempered safety glass for locations subject to hum an impact as required by Building Code.

B. Perform Work in accordance with GANA Glazing Manual and SIGMA TM-3000.

1.6 PROJECT CONDITIONS

A. Perform glazing when ambient temperature is above 40 degrees F.

B. Perform glazing on dry surfaces.

1.7 WARRANTIES

A. Insulating Glass Units: Provide manufacturer's 10 year warranty against material obstruction of vision through unit due to:
1. Intrusion of dust or moisture.
2. Internal condensation.
3. Film formation on internal glass surfaces caused by failure of herm etic seal except failure caused in whole or in part by breakage or fracturing of any portion of glass surface.

B. Glass Coatings: Provide manufacturer's 10 year warranty against peeling, cracking, or deterioration of coating under norm al conditions.

PART 2 PRODUCTS

2.1 MATERIALS - GLASS

A. Clear Glass: ASTM C1036, Type 1 transparent flat, Class 1 clear, Quality q3 glazing select.

B. Clear Tempered Glass: ASTM C1048, Type 1 transparent flat, Class 1 clear, Quality q3 glazing select, Kind FT fully tempered.

C. Clear Heat Strengthened Glass: ASTM C1048, Type 1 transparent flat, Class 1 clear, Quality q3 glazing select, Kind HS heat strengthened.

2.2 ACCESSORIES

A. Setting Blocks: ASTM C864, neoprene or EPDM, or ASTM C1115, silicone; 80 to 90 Shore A durometer hardness.

B. Spacers: ASTM C864, neoprene or EPDM, or ASTM C1115, silicone; 50 to 60 Shore A durometer hardness.

C. Glazing Gaskets:
1. Dense compression gaskets: ASTM C864, neoprene or EPDM, or ASTM C1115, silicone or thermoplastic polyolefin rubber, molded or extruded shape to fit glazing channel retaining slot; black color.
2. Soft compression gaskets: ASTM C509, Type II, black, molded or extruded, neoprene, EPDM, silicone or

thermoplastic polyolefin rubber, of profile and hardness required to maintain watertight seal; black color.

D. Glazing Sealant: ASTM C920, Type S, Grade NS, Class 25; single component silicone, low modulus, non-sag, color to be selected from manufacturer's full color range.

E. Sealant Backing: ASTM C1330, Type O, size and density to control glazing sealant depth and produce optimum glazing sealant performance.

F. Primer: As recommended by glazing sealant manufacturer.

G. Glazing Compound: Modified oil type, non-hardening, knife grade consistency, color to be selected from manufacturer's full color range.

2.3 FABRICATION

A. Heat Strengthened and Tempered Glass:
1. Comply with ASTM C1048.
2. Process in horizontal position so that inherent roller distortion will run parallel to building floor lines after installation.

B. Sealed Insulating Glass:
1. Comply with ASTM E2190.
2. Fabricate spacer bar frame of tubular aluminum filled with desiccant.
3. Bond spacer bar frame to glass panes with twin primary seals.
4. Fill space outside frame to glass edge with elastomeric sealant.

C. Low-E Coated Glass: Apply low-emissivity coating to scheduled glass surface.

D. Fabrication Tolerances: ASTM C1036 and ASTM C1048.

E. Glass Identification:
1. Apply manufacturer's label indicating type and thickness to each light of glass. Show position of exterior face when installed, where applicable.
2. Etch manufacturer's label on each light of tempered glass.

PART 3 EXECUTION

3.1 PREPARATION

A. Clean glazing rabbets; remove loose and foreign matter.

B. Remove protective coatings on metal surfaces.

C. Clean glass just prior to installation.

3.2 INSTALLATION - GENERAL

A. Install glass in accordance with glass manufacturer's instructions.

B. Maintain manufacturer's recommended edge and face clearances between glass and frame members.

3.3 INSTALLATION - GASKET GLAZING METHOD

A. Fabricate gaskets to fit openings; allow for stretching of gaskets during installation.

B. Set soft compression gasket against fixed stop or frame with bonded miter cut joints at corners.

C. Set glass centered in openings on setting blocks.

D. Install removable stops and insert dense compression gaskets at corners, working toward centers of glass, compressing glass against soft compression gaskets to produce weathertight seal.

E. Seal joints in gaskets.

F. Allow gaskets to protrude past face of glazing stops.

3.4 INSTALLATION - SEALANT GLAZING METHOD

A. Apply sealant to full depth of permanent stops.

B. Press glass into sealant with slight lateral movement to ensure adhesion.

C. Apply sealant to full depth of removable stops. Secure stops in position, forcing contact with sealant bead and completely filling joint.

3.5 INSTALLATION - COMPOUND GLAZING METHOD

A. Locate and secure glass using glazing clips.

B. Fill voids between glass and stops with glazing compound; tool to straight line. Slope to exterior for watershed.

3.6 PROTECTION

A. After installation, mark glass with an 'X' using removable plastic tape.

3.7 SCHEDULE

A. Type GL-1:
   1. Description:
      a. Outboard lite: Minim um 1/8 inch thick clear glass, heat strengthened or tempered where required, with low-e coating on No. 2 surface.
      b. Inboard lite: 1/8 inch thick clear glass, tempered where required.
   2. Total unit thickness: 5/8 inch.
   3. Performance characteristics:
      a. Visible light transmittance: 69 percent.
         Visible reflectance: 11 percent outdoors; 13 percent indoors. Solar energy transmittance: 33 percent.
         Solar energy reflectance: 41 percent outdoors. U-value: 0.33 daytime.
         Shading coefficient: 0.52.
         Solar heat gain coefficient: 0.45.
         Relative heat gain: 108.
   4. Locations: exterior wood windows and glazed doors.

B. Type GL-2:
   1. Description: Minimum 3/16 inch thick clear tempered glass.
   2. Locations: Interior doors and glazed openings at locations subject to human impact.

C. Type GL-3:
   1. Description: 3/16 inch thick fire rated clear glass.
   2. Locations: Transom windows and doors leading to fire stair.

D. Type GL-4:
   1. Description: 3/16 inch thick laminated safety glass.
   2. Locations: Glass guardrails at window openings.

E. Type GL-5:
   1. Description: 1/2 inch thick clear tempered glass; ease and polish exposed edges.
   2. Locations: All-glass entrances.

END OF SECTION

SECTION 08 9100

LOUVERS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Fixed louvers and frames.
2. Insect screens.

B. Related Sections:
1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

A. Air Movement and Control Association International, Inc. (AMCA) Standard 500 - Test Methods for Louvers, Dampers and Shutters.

B. American Architectural Manufacturers Association (AAMA) 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Architectural Extrusions and Panels.

C. ASTM International (ASTM):
1. B221 - Standard Specification for Aluminum and Aluminum -Alloy Extruded Bars, Rods, W ire, Profiles, and Tubes.
2. E330 - Standard Test Method for Structural Performance of Exterior Window, Curtain Walls, and Doors under the influence of Wind Loads.

1.3 SYSTEM DESCRIPTION

A. Design Requirements: Design louvers to withstand:
1. Design wind pressure in accordance with Building Code, with m axim um allowable deflection of L/180, tested in accordance with ASTM E330.
2. Movement caused by an ambient temperature range of 120 degrees F and a surface temperature range of 160 degrees F.

B. Performance Requirements: Bear AMCA Certified Ratings Seal for air performance.

1.4 SUBMITTALS

A. Submittals for Review:
1. Shop Drawings: Include locations, elevations, sections, dimensions, materials, finishes, attachment, and relationship to adjacent construction.
2. Samples:
   a. 3 x 3 inch coating samples showing available colors.
   b. 6 inch long blade samples.
3. To be approved by Architect and THC Representative prior to commencing with the Work.

B. Quality Control Submittals:
1. Certificates of Compliance: AMCA licensed test data.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
1. Airline Products, Inc. (www.airlinelouvers.com)
2. Airolite Company. (www.airolite.com)
3. Construction Specialties, Inc. (www.c-sgroup.com)
4. Industrial Louvers (www.industriallouvers.com)

5. Ruskin Co. (www.ruskin.com)

B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. Aluminum: ASTM B221, 6063-T5 or T6 alloy and temper.

B. Screen: 16 x 18 mesh aluminum.

2.3 COMPONENTS

A. Metal Louvers:
1. Type: Fixed blade.
2. Depth: 4 inches.
3. Blade profile: Water baffle.
4. Free area: Minimum 50 percent.

2.4 ACCESSORIES

A. Anchors: Hot-dip galvanized steel or stainless steel, type best suited to application.

2.5 FABRICATION

A. Fabricate frame and blades from minimum 0.81 inch thick aluminum.

B. Fit components to hairline joints. Weld connections, with welds ground smooth and filled.

C. Join vertical mullions with I-shaped slip connection.

D. Fabricate horizontal mullions to appear as single louver.

E. Mount screen in rewireable U-shaped frame.

2.6 FINISHES

A. Aluminum: Fluoropolymer coating, AAMA 2605, containing minimum 70 percent PVDF resins, color to be selected from manufacturer's full color range.

PART 3EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions and approved Shop Drawings.

B. Set plumb, level, and rigid, with flush hairline joints.

C. Anchor to supporting construction.

D. Prevent contact of alum inum and dissim ilar m etals by use of zinc rich paint, bitum inous coating, or Non-absorptive gaskets.

E. Install screen on inside face.

3.2 ADJUSTING

A. Install in accordance with manufacturer's instructions and approved Shop Drawings.

END OF SECTION

SECTION 09 2200

METAL SUPPORT ASSEMBLIES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Metal stud partition framing.
   2. Suspended metal channel ceiling framing.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

A. ASTM International (ASTM):
   1. A591/A591M - Standard Specification for Steel Sheet, Electrolytic Zinc-Coated, for Light Coating W eight (Mass) Applications.
   2. A641 - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
   3. A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic and Non-metallic-Coated for Cold-Formed Framing Members.
   4. C645 - Standard Specification for Non-Load (Axial) Bearing Steel Studs, Runners (Track), and Rigid Furring Channels for Screw Application of Gypsum Board.
   5. C754 - Standard Practice for Installation of Steel Framing Members to Receive Screw-Attached Gypsum W all board, Backing Board, or Water-Resistant Backing Board.

B. Gypsum Association (GA) GA-600 - Fire Resistance Design Manual.

C. Underwriters Laboratories, Inc. (UL) - Fire Resistance Directory.

1.3 SUBMITTALS

A. Submittals for Review:
   1. Product Data: Illustrate framing types, gages, and locations.

1.4 QUALITY ASSURANCE

A. Fire Resistance Ratings:
   1. Construct assemblies to achieve fire resistance ratings indicated on Drawings, in accordance with referenced GA or UL design number.
   2. If requirements of assembly numbers referenced conflict with Contract Document requirements, conform to assembly requirements.

B. Deflection Limits:
   1. Limit deflection of partitions to following limits, based on 5 PSF uniform design load.
      a. Partitions to receive tile or plaster: L/360.
      b. Other partitions: L/120.
   2. If partition height exceeds stud manufacturer's limiting height for applicable loading and deflection, install bracing above ceiling, decrease stud spacing, or increase stud gage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
   1. Dietrich Metal Framing, Inc. (www.dietrichmetalframing.com)
   2. Marino Ware Industries. (www.marinoware.com)
   3. Unimast, Inc. (www.unimast.com)

B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. Steel: ASTM A1003/1003M, Class G40 hot dip galvanized.

2.3 COMPONENTS

A. Provide components in accordance with ASTM C645.

B. Studs: Non-load bearing rolled steel, channel shaped, punched for utility access.

C. Top and Bottom Runners:
   1. Same material and finish as studs, channel shaped.
   2. Deflection compensating top runners: Deep leg runners with slotted screw holes; perm it plus or minus 1/2 inch movement of overhead structure without damage to partition.

D. Suspended Ceiling Framing:
   1. Runner channels: 1-1/2 inches deep, cold rolled, channel shaped, 16 gage core steel.
   2. Furring channels: Hat shaped, 7/8 inch deep, 25 gage core steel.

E. Shaft Wall Framing: CT Shaftwall System by Marino Ware Industries or approved substitute, consisting of C-H studs, jam b struts, E-studs, and J-runners.

2.4 ACCESSORIES

A. Fasteners: 3/8 inch long pan head screws.

B. Wire: ASTM A641, galvanized steel.
   1. Hanger wire: 8 gage.
   2. Tie wire: 18 gage, soft annealed.

C. Furring Channel Clips: Galvanized steel.

PART 3 EXECUTION

3.1 INSTALLATION OF PARTITION FRAMING

A. Install in accordance with ASTM C754 and manufacturer's instructions.

B. Attach top and bottom runner channels at ends and 24 inches on center maximum.

C. Position studs vertically in runners, spaced maximum 16 inches on center unless indicated otherwise.

D. Install deflection compensating top runner at partitions extending to structure. Cut studs 1/2 inch shorter than required length and fit into top runner. Fasten studs to top runner in manner permitting runner movement.

E. Locate studs maximum 2 inches from door frames and abutting construction.

F. Use double studs on both sides of openings in partitions.

G. Install horizontal runner as header above openings in partitions. Install studs from header to top runner.

H. Provide wood or metal bracing in partitions to receive and support fixtures, trim, accessories and other applied items.

END OF SECTION

SECTION 09 2300

GYPSUM PLASTERING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Gypsum plaster.
   2. Lath and mesh.
   3. Trim.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

A. ASTM International (ASTM):
   1. C28 - Standard Specification for Gypsum Plaster.
   2. C588 - Standard Specification for Gypsum Base for Veneer Plasters.
   3. C631 – Standard Specification for Bonding Compounds for Interior Plastering.
   4. C842 - Standard Practice for Application of Interior Plaster.
   5. C844 - Standard Practice for Application of Gypsum Base to Receive Gypsum Veneer Plaster.

B. Gypsum Association (GA) 201 - Using Gypsum Board for Walls and Ceilings.

1.3 SUBMITTALS

A. Submittals for Review:
   1. Product Data: Manufacturer's descriptive data and application instructions.
   2. Samples: 12 x 12 inch sample showing finish coat in proposed texture.

B. Quality Control Submittals:
   1. Qualification Statement: Applicator qualifications per Section 01 4001.

C. Mockup:
   1. Provide minimum 10 ft. x 10 ft. mockup of plaster application.
   2. Illustrate plaster patching and bonding techniques with surface texture.
   3. Mockups to be approved by Architect and THC representative prior to commencing with the Work.

1.4 QUALITY ASSURANCE

A. Applicator Qualifications:
   1. Minimum 5 years experience in work of this Section.
   2. Successful completion of at least 3 projects of similar scope and complexity within past 5 years.

1.5 PROJECT CONDITIONS

A. Environmental Requirements:
   1. Do not apply plaster when ambient or substrate temperature is less than 50 degrees F nor more than 85 degrees F.
   2. Maintain minimum ambient temperature of 50 degrees F during and after application of plaster.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
   1. GP Gypsum Division. (www.gp.com)

2. National Gypsum Co. (www.nationalgypsum.com)
3. United States Gypsum Co. (www.usg.com

B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. Plaster Base Material: ASTM C28, gypsum mill aggregated type.

B. Finishing Plaster: ASTM C28, mixture of gauging plaster and lime.

C. Aggregate: Natural sand, size, color, and texture to closely match original plaster.

D. Gypsum Lath: ASTM C37, perforated fire rated type, 1/2 inch thick x maximum practical length.

E. Water: Clean and potable.

2.3 ACCESSORIES

A. Patching Compound: Premixed, containing gypsum and aggregate.

B. Tape: Woven glass fiber type, 4 inches wide.

C. Tie Wire: ASTM A641, galvanized steel minimum 18 gage.

D. Bonding Agent: ASTM C631; type recommended for bonding plaster directly to masonry and plaster surfaces.

E. Trim Accessories:
1. Material: Formed steel, minim um 26 gage core steel, hot dip galvanized finish, expanded flanges.
2. Corner bead: Beaded edge, of longest practical length, size and profile to suit application.
3. Casing bead: Thickness governed by plaster thickness, of longest practical length, square edge.
4. Control joint: Accordion profile with minimum 2 inch flanges each side, of longest practical length.
5. Corner reinforcement: Shaped to permit complete embedment in plaster, minimum 2 inches wide.

F. Fasteners: Type and size suited to application, galvanized.

2.4 MIXES

A. Scratch, Brown, and Finish Coats: Mix gypsum, additives, and aggregate in proportions to match original plaster. Add water to achieve workable consistency.

B. Patching Compound: Mix in accordance with manufacturer's instructions.

PART 3 EXECUTION

3.1 PREPARATION

A. Remove damaged plaster back to a point at which sound material is reached.

B. Remove loose and foreign matter that could impair adhesion.

C. Clean surfaces with commercial wall cleaners to remove any grease or oil film prior to adhesive application. Do not use adhesive application over loose paint or plaster. Provide pull test.

3.2 APPLICATION OF GYPSUM LATH

A. Install in accordance with GA 201.

B. Install panels perpendicular to framing members, with lath face exposed. Stagger end joints of alternate courses. Butt ends tight, with maximum 1/8 inch gap.

C. Secure to framing at maximum 12 inches on center.

D. Cut and secure lath at each side of control joints.

E. Place corner reinforcement diagonally over lath across corners immediately above and below openings. Secure to lath only.

3.3 INSTALLATION OF ACCESSORIES

A. Install casing beads where plaster abuts dissimilar material or stops with edge exposed.

B. Install corner beads at external corners.

C. Install control joints at ceilings:
   1. At maximum 50 feet on center.
   2. Where ceiling framing changes direction.

D. Install control joints at walls:
   1. At changes in backup material.
   2. At maximum 30 feet on center.
   3. Above one jamb of openings in partitions.

E. Set level and true to line.

3.4 APPLICATION OF PLASTER

A. Apply bonding agent in accordance with manufacturer’s instructions.

B. Apply scratch and brown coats to match thickness of existing plaster.

C. Apply plaster in accordance with ASTM C842 and manufacturer's instructions.

D. Apply finish coat to minimum 1/8 inch thickness. Finish to flat, smooth, hard troweled surface.

E. Finish surfaces with neat, sharp corners and intersections.

F. Perform work in panels to nearest natural break form ed by intersections, corners, trim, and accessories.

G. Installation Tolerance: Surfaces true to 1/8 inch in 10 feet.

3.5 ADJUSTING

A. Repair or replace damaged, discolored and defective plaster. Match patched areas to surrounding plaster.

END OF SECTION

SECTION 09 2313

ACOUSTICAL PLASTERING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Acoustical plastering.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

A. ASTM International (ASTM):
   1. C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
   2. E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
   3. E605 - Standard Test Method for Thickness and Density of Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members.
   4. E761 - Standard Test Method for Compressive Strength of Sprayed Fire-Resistive Material Applied to Structural Members.

1.3 SUBMITTALS

A. Submittals for Review:
   1. Product Data: Manufacturer's literature for products furnished, including application instructions.
   2. Samples: 12 x 12 inch plaster samples showing proposed color and texture.

B. Quality Control Submittals:
   1. Qualification Statement: Applicator qualifications per Section 01 4001.
   2. Certificate of Compliance: Manufacturer's certification or independent test reports confirming that materials meet or exceed specification requirements.

C. Mockup:
   1. Provide minimum 10 ft. x 10 ft. mockup of plaster application.
   2. Illustrate plaster patching and bonding techniques with surface texture.
   3. Mockups to be approved by Architect and THC representative prior to commencing with the Work.

1.4 QUALITY ASSURANCE

A. Applicator Qualifications:
   1. Minimum 5 years experience in work of this Section.
   2. Successful completion of at least 3 projects of similar scope and complexity within past 5 years.
   3. Certified or approved by acoustical plaster manufacturer.

B. Fire Hazard Characteristics: Maximum flame spread/smoke developed rating: 15/15, tested to ASTM E84.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to site with labels designating fire hazard characteristics.

B. Store materials off ground or floor in protected, dry area; discard materials that have been exposed to weather prior to use.

1.6 PROJECT CONDITIONS

A. Environmental Requirements:
   1. Do not apply plaster when air or surface temperature is less than 40 degrees F, nor when such temperatures are anticipated within 24 hours after application.
   2. Consult manufacturer for application procedures during excessively humid or other adverse weather conditions.

1.7 WARRANTY

A. Provide manufacturer's 5 year warranty against flaking, cracking, peeling, excessive dusting, and loss of adhesion to substrate.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
   1. Pyrok,Inc.

B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. Acoustical Plaster System:
   1. 25mm thick StarSilent acoustical plaster system with minimum NRC 0.80.
   2. Acoustical panels: Recycled crushed glass.
   3. Joint compound.
   4. Base coat plaster.
   5. Top coat plaster, smooth finish.
   6. Clear coat of Valspar applied to the finish.

2.3 ACCESSORIES

A. Fasteners: Type recommended by system manufacturer; minimum 5/8 inch penetration into framing

2.4 MIXES

A. Mix base and top coats as recommended by manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION OF ACOUSTICAL PANELS

A. Install system in accordance with manufacturer's instructions.

B. Accurately cut acoustical panels to fit around openings and projections.

C. Apply panels with ends and edges occurring over supports. Stagger end joints in adjacent rows.

D. Mechanically fasten panels to framing. Place fasteners minimum 3/8 inch from edges of panels; drive heads slightly below surface. Stagger fasteners at abutting edges.

E. Apply joint compound to panel edges and over fasteners. Allow to dry, then sand smooth and flush.

3.2 APPLICATION OF PLASTER

A. Apply in accordance with manufacturer's instructions.

B. Discard partially set, frozen, and caked materials. Stop application and revise mix as required if material does not properly adhere.

C. Finish surfaces to match approved samples.

D. Provide uniform color and texture.

3.3 ADJUSTING

A. Inspect areas for complete coverage and uniform color and texture; remove unacceptable work.

B. Patch damaged and cut areas.

C. Replace areas where excessive shrinkage or cracking has occurred.

END OF SECTION

SECTION 09 2900

GYPSUM BOARD

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Acoustical insulation.
   2. Gypsum board.
   3. Taping and bedding of gypsum board.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.
   2. Section 07 9200 - Joint Sealers.

1.2 REFERENCES

A. ASTM International (ASTM):
   1. C475 - Standard Specification for Joint Com pound and Joint Tape for Finishing Gypsum Board.
   2. C665 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Wood Frame and Light Construction Buildings.
   3. C1002 - Standard Specification for Steel Drill Screws for the Application of Gypsum Board.
   4. C1047 - Standard Specifications for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
   5. C1178 - Standard Specification for Glass Mat Water-Resistant Gypsum Backing Panel.
   6. C1396 - Standard Specification for Gypsum Board.
   7. D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.

B. Gypsum Association (GA):
   1. GA-214 - Levels of Gypsum Board Finish.
   2. GA-216 - Recommended Specifications for the Application and Finishing of Gypsum Board.
   3. GA-600 - Fire Resistance Design Manual.

C. Underwriters Laboratories, Inc. (UL) - Fire Resistance Directory.

1.3 SUBMITTALS

A. Submittals for Review:
   1. Product Data: Illustrate panel product types, thicknesses, and locations; acoustical insulation; and accessories.

1.4 QUALITY ASSURANCE

A. Fire Resistance Ratings:
   1. Construct assemblies to achieve fire resistance ratings indicated on Drawings, in accordance with referenced GA or UL design num ber.
   2. If requirements of assembly numbers referenced conflict with Contract Document requirements, conform to assembly requirements.

1.5 PROJECT CONDITIONS

A. Do not install gypsum board until building is substantially weathertight.

B. Maintain temperature in spaces in which work is being perform ed above 50 degrees F during and after installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
   1. CertainTeed Gypsum, Inc. (www.certainteed.com)
   2. GP Gypsum Corporation. (www.gp.com)
   3. National Gypsum Co. (www.nationalgypsum.com)
   4. Temple-Inland. (www.templeinland.com)
   5. United States Gypsum Co.(www.usg.com)

B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS - GYPSUM PANELS

A. Gypsum Board: ASTM C1396, Type X; 48 inches wide x thickness indicated, maximum practical length, tapered edge.

B. Gypsum Backing Board:
   1. ASTM C1178, Type X, fiberglass m at faced; 48 inches wide x thickness indicated, maximum practical length, water resistant; apply to walls at toilet rooms.
   2. Mold resistance: Minim um 10, tested to ASTM D3273.

C. Shaft W all Liner: ASTM C1396; 1 inch thick x 24 inches wide, maximum practical length, square edges.

2.3 ACCESSORIES

A. Fasteners: ASTM C1002, Type S screws, minimum 5/8 inch penetration into framing.

B. Acoustical Insulation: ASTM C665, Type I, glass fiber com position, unfaced.

C. Adhesive: Type recommended by gypsum panel manufacturer.

D. Trim Accessories: ASTM C1047.
   1. Material: Formed steel, minimum 26 gage core steel, hot dip galvanized finish, expanded flanges.
   2. Corner reinforcement: GA-216, Type CB-100 x 100.
   3. Casing: GA-216, Type LC.
   4. Control joint.

E. Acoustical Sealer: Specified in Section 07 9200.

F. Joint Treatment Materials: Reinforcing tape and joint com pound; ASTM C475.

PART 3 EXECUTION

3.1 INSTALLATION OF GYPSUM PANELS

A. Install panels and accessories in accordance with ASTM C754, GA-216, and manufacturer's instructions.

B. Accurately cut panels to fit around openings and projections. Do not tear face paper or break gypsum core.

C. Apply panels at non fire-rated assemblies in most economical manner, with ends and edges occurring over supports.

D. Apply panels at fire-rated assemblies as required by design assembly.

E. Stagger joints on opposite sides of partitions.

F. Do not locate joints to align with edges of openings unless a control joint is installed.

G. Mechanically fasten single layer panels to framing. Place fasteners minimum 3/8 inch from edges of panels; drive heads slightly below surface. Stagger fasteners at abutting edges.

H. Apply face layer of double layer applications with joints offset from those in base layer; secure with mechanical fasteners to framing or with adhesive to base layer.

I. At deflection compensating head tracks, cut panels 1/2 inch short of structure at head; do not secure panels to top runner channel.

J. W here recessed item s occur in fire rated partitions, box item on all sides with gypsum board as required to maintain continuity of fire rating.

3.2 INSTALLATION OF ACOUSTICAL PARTITIONS

A. Extend acoustical partitions past intersecting non-acoustical partitions.

B. Install acoustical insulation:
   1. Butt to framing members and adjacent construction.
   2. Carry around pipes, wiring, outlets, and other construction without voids.
   3. Press against one gypsum board surface to form slight air space on opposite side.

C. Seal acoustical partitions at perimeter and around penetrations:
   1. Apply continuous bead of sealer between gypsum panel edges and adjacent construction.
   2. Seal space between gypsum panels at control joints, prior to installing metal control joint.
   3. Apply sealer to penetrations through partitions.

3.3 INSTALLATION OF SHAFTWALL SYSTEM

A. Install in accordance with manufacturer's instructions.

B. Cut liner panels 3/4 inch less than wall height; install vertically between runners.

C. Progressively install succeeding studs and liner panels.

D. Apply gypsum panels to one or both sides as required by fire assembly description.

E. Provide shaft cants at horizontal projections over 2 inches in width within elevator shafts. Install strips of gypsum board or sheet metal at 70 degree angle extending from projection up wall; screw to each stud.

3.4 INSTALLATION OF ACCESSORIES

A. Install in accordance with manufacturer's instructions.

B. Install corner reinforcement at outside corners. Use single lengths where length of corner does not exceed standard length.

C. Install casings where indicated and where gypsum board abuts dissimilar materials or stops with edge exposed.

D. Install control joints at ceilings:
   1. At maxim um 50 feet on center.
   2. Where ceiling framing changes direction.

E. Install control joints at walls and partitions:
   1. At changes in backup material.
   2. At maximum 30 feet on center.
   3. Above one jamb of openings in partitions.

3.5 JOINT TREATMENT

A. Treat joints and fasteners in gypsum board in accordance with GA-214.

B. Levels of Finish:
   1. Surfaces in plenums: Level 1 finish.
   2. Surfaces to receive tile: Level 2 finish.
   3. Surfaces to receive paint: Level 4 finish.

END OF SECTION

SECTION 09 3000

TILING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Tile floor and wall finishes.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.
   2. Section 07 9200 - Joint Sealers.

1.2 REFERENCES

A. American National Standards Institute (ANSI):
   1. A108/A118/A136.1 - American National Standard for Installation of Ceramic Tile.
   2. A108.19 Specifications for Interior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs.
   3. A137.1 - Specifications for Ceramic Tile.
   4. A137.3 – Specifications for Gauged Porcelain Tile and Gauged Porcelain Tile Panels/Slabs.
   5. A326.3 – American National Standard Test Method for Measuring Dynamic coefficient of Friction of Hard Surface Flooring Materials.

B. ASTM International (ASTM):
   1. C1028 - Standard Test Method for Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method.
   2. D4263 - Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.

C. Tile Council of North America (TCNA) - Handbook for Ceramic Tile Installation.

1.3 SUBMITTALS

A. Submittals for Review:
   1. Product Data: Manufacturer's installation, cleaning, and maintenance instructions.
   2. Samples:
      a. Tile: 1 x 1 inch samples showing available colors.
      b. Grout: 1/2 x 1/2 x 3 inch long samples showing available colors.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Minimum 2 previous projects installing Gauged Porcelain Panels / Slabs.

B. Tile and Trim Units: Meet ANSI A137.1, Standard Grade.

C. Gauged Porcelain Tiles and Gauged Porcelain Tile Panels / Slabs: Meet ANSI A137.3.

D. Interior Installation of Gauged Porcelain Tile Panels / Slabs by Thin-Bed Method bonded with Modified Dry-Set Cement Mortar: Meet ANSI A108.19.

E. Static Coefficient of Friction for Floor Tile: Minimum 0.42, tested to ASTM A326.3.

F. Mockup:
   1. Size: 4 x 4 feet.
   2. Show: Tile colors and patterns, joint profile, and control joint.
   3. Locate where directed.
   4. Mockups to be approved by Architect and THC representative prior to commencing with the Work.

G. Submit complete system warranty for large format tile installation.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver mortar, adhesive, and grout containers bearing hallmark certifying compliance with reference standards.

B. Protect adhesive containers from freezing and overheating according to manufacturer's instructions.

1.6 PROJECT CONDITIONS

A. Environmental Requirements: Maintain minimum ambient temperature of 50 degrees F during and after installation.

1.7 MAINTENANCE

A. Extra Materials: 2 percent of each tile, panel / slab.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers - Tile:
1. American Marazzi Tile, Inc. (www.marazzitile.com)
2. American Olean Tile Co., Inc. (www.aotile.com)
3. Dal-Tile Corp. (www.daltileproducts.com)
4. Florida Tile Industries, Inc. (www.floridatile.com)
5. Interceramic USA. (www.interceramicusa.com)
6. Crossville Tile (www.crossvilleinc.com)
7. Summitville Tiles, Inc. (www.summitville.com)

B. Acceptable Manufacturers - Setting and Grouting Materials:
a. BASF Corporation (www.buildingsystems.basf.com)
b. Bostik Findley. (www.bostik-us.com)
c. Custom Building Products (www.custombuildingproducts.com).
d. Laticrete International, Inc. (www.laticrete.com)
e. Mapei Corp. USA. (www.mapei.com)
f. TEC. (www.tecspecialty.com)

C. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. Basement Restrooms:
1. Wall Tile:
a. Source: Buenos Aires Mood Series by Crossville Tile or approved substitute.
b. Size: 18 x 36 inch and 6 x 36 inch.
c. Colors: To be selected from manufacturer's full color range.
d. Surface finish: Unpolished porcelain.

2. Floor Tile:
a. Source: Laminam iNaturali Pietra Di Savoia by Crossville Tile or approved substitute.
b. Size: as indicated in Drawings, coordinate with Architect.
c. Colors: To be selected from manufacturer's full color range.
d. Surface finish: Natural

B. Unisex Restrooms:
1. Wall Tile:
a. Source: Rittenhouse Square Glazed Ceramic by Dal-Tile or approved substitute.
b. Size: 3 x 6 x 5/16 inch thick.
c. Colors: To be selected from manufacturer's full color range.

d. Surface finish: Bright glazed.
e. Trim units: wall bullnose and cove base to match wall tile.

2. Floor Tile:
a. Source: Laminam iNaturali Pietra Di Savoia by Crossville Tile or approved substitute.
b. Size: as indicated in Drawings, coordinate with Architect.
c. Colors: To be selected from manufacturer's full color range.
d. Surface finish: Natural

C. Corridors:
1. Floor Tile:
a. Source: Laminam iNaturali Pietra Di Savoia by Crossville Tile or approved substitute.
b. Size: custom cut from 1m x 3m slab to match original control joint pattern
c. Colors: To be selected from manufacturer's full color range.
d. Surface finish: Natural

1.1 ACCESSORIES

A. Crack Isolation Membrane: ANSI A118.12.

B. Latex-Portland Cement Mortar: ANSI A118.15, for large and heavy tiles, polymer modified dry set type.

C. Organic Adhesive: ANSI A136.1, Type 2, thin set bond type.

E. Grout:
1. ANSI A118.6, polymer modified dry set type, sanded.
2. Colors: To be selected from manufacturer's full color range.

F. Joint Sealers: Specified in Section 07 9200.

PART 3 EXECUTION

3.1 PREPARATION

A. Clean and bead blast surfaces to remove loose and foreign matter that could impair adhesion.

B. Remove ridges and projections. Fill voids and depressions with patching compound compatible with setting materials.

C. Install self-leveling floor topping as required to level floor surface.

D. Install crack isolation membrane.

E. Install minimum 3/16” bond coat underneath large format tile flooring.

F. Allowable Substrate Tolerances:
1. Maxim um variation in substrate surface: 1/8 inch in 10 feet.
2. Maxim um height of abrupt irregularities: 1/32 inch.

G. Test concrete substrate to ASTM D4263; do not install tile until surfaces are sufficiently dry.

3.2 INSTALLATION

A. Method:
1. Walls: ANSI A108.4, thin set with organic adhesive.
2. Floors: ANSI A108.5, thin set with latex-portland cement mortar.
3. Large Format Floor Tiles: ANSI A108.19, thin-bed method bonded with modified dry-set cement mortar.

B. Minimize pieces less than one half size. Locate cuts to be inconspicuous.

C. Lay tile to pattern furnished by Architect. Do not interrupt tile pattern through openings.

D. Joint Width: 1/8 inch, plus or minus 1/16 inch. Match original joint width at corridor floors.

E. Make joints watertight, without voids, cracks, excess mortar, grout, or silicone. Align joints in wall and floor of same-sized tile.

F. Fit tile around projections and at perimeter. Smooth and clean cut edges. Ensure that trim will completely cover cut edges.

G. Install Trim:
   1. Inside corners: Cove units.
   2. Outside corners: Bead units.
   3. Base: Base units.
   4. Exposed tile ends: Bullnose units.

H. Allow tile to set for a minimum of 48 hours before grouting.

I. Grout tile joints in accordance with ANSI A108.10 without excess grout.

J. Control Joints:
   1. Provide control joints at:
      a. Changes in backup material.
      b. Changes in plane.
      c. Over joints in substrate.
      d. Maximum 24 feet on center.
   2. Form joints per TCNA Method EJ-171.
   3. Install joint backing and joint sealer as specified in Section 07 9200.

3.3 ADJUSTING

A. Remove and replace pieces that have been damaged during installation.

3.4 PROTECTION

A. Provide protection for completed work using non-staining sheet covering.

B. Prohibit traffic on tile floors for minimum 3 days after installation.

END OF SECTION

SECTION 09 6400

WOOD FLOORING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Wood strip flooring.
2. Sanding and finishing.

B. Related Sections:
1. Division 01: Administrative, procedural, and temporary work requirements.
2. Section 06 1000 – Rough Carpentry.

1.2 REFERENCES

A. ASTM International (ASTM) D2394 – Standard Test Method for Simulated Service Testing of Wood and Wood-Base Finish Flooring.

1.3 SUBMITTALS

A. Submittals for Review:
1. Samples: 24 x 24 inch flooring samples.

1.4 QUALITY ASSURANCE

A. Installer Qualifications:
1. Minimum 5 years experience in work of this Section.
2. Successful completion of at least 3 projects of similar scope and complexity within past 5 years.

B. Static Coefficient of Friction: Minimum 0.60, tested to ASTM D2394.

C. Mockup:
1. Size: Minimum 4 x 8 feet.
2. Show: Flooring size, pattern, and finish.
3. Locate where directed.
4. Mockups to be approved by Architect and THC Representative prior to commencing with the Work.

1.5 PROJECT CONDITIONS

A. Do not install flooring until overhead and adjacent work is complete.

B. Environmental Requirements: Maintain following conditions in areas to receive flooring for minimum 72 hours prior, during, and after installation.
1. Temperature: 65 degrees F minimum.
2. Humidity: 50 percent maximum.

PART 2 PRODUCTS

2.1 MATERIALS

A. Wood Strip Flooring:
1. Species: Reclaimed Old Growth Long Leaf Pine.
2. Grade, profile, appearance and size: To match original flooring.
3. Moisture content: Average of 6 to 9 percent with maximum 5 percent outside of this range; maximum of 12 percent on any individual piece.

B. Finishing Materials: as specified in Section 00 3138

C. Sandpaper: No. 2/0 silicone carbide.

D. Steel Wool: No. 2.

PART 3 EXECUTION

3.1 PREPARATION

A. At least 72 hours prior to beginning installation, stack flooring in areas to receive flooring to allow to reach prevailing temperature and humidity.

3.2 INSTALLATION OF FLOORING

A. Place flooring perpendicular to substrate and square with room.

B. Offset end joints in adjacent rows 12 inches minimum. Butt ends and edges to moderate contact.

C. Cut flooring to fit at perimeter and around penetrations with maximum ¼ inch gaps.

D. Blind nail through tongue edge. Face nail last piece in each row, with nails located under wall base or perimeter trim.

3.3 FINISHING

A. Clean floor just prior to sanding.

B. Sand with drum type sander; use hand held sander in corners and adjacent to walls.

C. Sand second time at right angle to direction of first sanding.

D. Sweep and vacuum floor. Remove remaining traces of sawdust with damp towel.

E. Finish flooring as specified in Section 00 3138

3.4 PROTECTION

A. Close off areas to traffic for minimum 24 hours after completion of finishing.

B. Provide temporary protective coverings until ready for final cleaning.

END OF SECTION

SECTION 09 6516

RESILIENT SHEET FLOORING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Custom linoleum sheet flooring.
2. Edgings.

B. Related Sections:
1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

A. ASTM International (ASTM):
1. E648 - Standard Test Method for Flooring Radiant Panel Test.
2. F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
3. F2034 - Standard Specification for Sheet Linoleum Floor Covering.
4. ASTM F 2195 – Standard Specification for Linoleum Tile Flooring Type I.

1.3 SUBMITTALS

A. Submittals for Review:
1. Product Data: Provide data on specified products, describing physical and performance characteristics.
2. Samples:
a. Flooring: 12 x 12 inch samples showing available colors.
b. Edgings: 4 inch long samples showing available colors.
3. Submittals to be approved by Architect and THC Representative prior to commencing with the Work.

B. Quality Control Submittals:
1. Qualifications Statement: Installer qualifications per Section 01 4001.
2. Certificates of Compliance: Certification from an independent testing laboratory that flooring meets fire hazard classification requirements.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Minimum 2 years documented experience in work of this Section.

B. Fire Hazard Classification: Class I rated, tested to ASTM E648.

1.5 PROJECT CONDITIONS

A. Maintain temperature in spaces to receive flooring between 70 and 90 degrees F for 24 hours before, during, and for minimum 48 hours after installation.

B. Maintain minimum temperature of 55 degrees F after flooring is installed, except as otherwise specified.

1.6 MAINTENANCE

A. Extra Materials: 2 percent of each color and pattern.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
   1. Armstrong World Industries, Inc.
   2. Forbo Flooring Systems

B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. Sheet Flooring:
   1. Product: Custom waterjet Marmoleum by Forbo or approved substitute.
   2. Color and pattern: match historic pattern noted in the Drawings.
   3. Thickness: as required to achieve 30-year system service life
   4. Backing: Polyester.

2.3 ACCESSORIES

A. Leveling Compound: White, premixed, latex based.

B. Adhesive: Water based, waterproof, recommended by flooring manufacturer.

C. Edgings: Preformed rubber, profile required to suit conditions, color to be selected from manufacturer's full color range.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that concrete floors have cured a minimum 28 days and do not exhibit negative alkalinity, carbonization, or dusting.

3.2 PREPARATION

A. Clean substrate of loose and foreign matter that could impair bond.

B. Fill cracks, voids, and depressions in substrate with leveling compound.

C. Grind off high spots and projections in substrate; leave smooth and level to 1/4 inch in 10 feet.

D. Test substrate for moisture content to ASTM F1869; do not install flooring until moisture emission level is acceptable to flooring manufacturer.

3.3 INSTALLATION

A. Install flooring in accordance with manufacturer's instructions.

B. Lay out flooring to minimize seams, located as inconspicuously as possible.

C. Spread only enough adhesive to permit installation of materials before initial set.

D. Lay flooring with seams parallel to building lines.

E. Overlap and double cut seams using straight edge.

F. Roll flooring with floor roller to eliminate entrapped air and ensure bond with adhesive. Work toward edges of sheets. Hand roll seams on both sides, working toward seams.

G. Scribe flooring to walls, columns, cabinets, and other appurtenances to produce tight joints. Ensure that base, trim, plates, or escutcheons will completely cover cut edges.

H. Extend flooring into recesses and under equipment.

I. Terminate flooring at centerline of door openings where adjacent floor finish is dissimilar.

3.4 INSTALLATION OF EDGINGS

A. Install strips where flooring abuts dissimilar flooring materials; secure to subfloor.

B. Center strips under doors where flooring terminates at door openings.

C. Install in longest practical lengths; butt ends tight.

D. Scribe to abutting surfaces.

3.5 PROTECTION

A. Do not allow traffic on flooring until adhesives have set. Cover areas subject to traffic with protective covering.

END OF SECTION

SECTION 09 6723

RESINOUS FLOORING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Decorative resinous flooring.

B. Related Sections:
1. Division 01: Administrative, procedural, and temporary work requirements.
2. Section 03 3300 – Cast-in-Place Concrete
3. Section 07 9200 - Joint Sealers.

1.2 REFERENCES

A. ASTM International (ASTM):
1. C579 – Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings and Polymer Concretes
2. C307 – Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, Monolithic Surfacings.
3. C580 – Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortar, Grouts, Monolithic Surfacings, and Polymer Concretes.
4. D6905 – Standard Test Method for Impact Flexibility of Organic Coatings.
5. D695 – Standard Test Method for Compressive Properties of Rigid Plastics.
6. D638 – Standard Test Method for Tensile Properties of Plastics.
7. D790 – Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
8. D2240 – Standard Test Method for Rubber Property
9. D4541 – Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
10. D4060 – Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.
11. D570 – Standard Test Method for Water Absorption of Plastics.
12. E96 – Standard Test Methods for Water Vapor Transmission of Materials.
13. E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.

1.3 SUBMITTALS

A. Submittals for Review:
1. Product Data: Manufacturer's installation, cleaning, and maintenance instructions.
2. Samples: Submit samples of specified decorative quartz flooring system. Samples should be construed as examples of finish only.
3. Mockup: Apply mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   a) Apply full thickness mockup on 3 feet x 3 feet floor area selected by Architect.
   b) Include 36 inch length of integral cove base
   c) Simulate finished lighting conditions for Architect’s review of mockup.
   d) Approved mockups may become part of completed Work if undisturbed at time of Substantial Completion.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Submit letter from manufacturer stating applicator is approved to install the decorative quartz flooring system.

B. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and form source recommended by manufacturer of primary materials.

C. Warranty: Submit copy of manufacturers standard warranty.

1.5 DELIVERY, STORAGE AND HANDLING

A. Materials should be delivered in original sealed containers, clearly marked with supplier's name, brand name and type of material.

B. Storage and Handling: Recommended material storage temperature is 75 degrees. Handle products to avoid damage to container. Do not store for long periods in direct sunlight.

1.6 PROJECT CONDITIONS

A. Environmental Requirements:
1. Do not proceed with application of materials when substrate temperature is less than 50 degrees. It is recommended to maintain a minimum concrete temperature of 50 degrees for a minimum of 48 hours before, during and after installation, or until cured.
2. Concrete must be free of hydrostatic, capillary or moisture vapor pressure. Substrates in contact with ground must have a properly installed, effective vapor barrier to help prevent potential problems resulting from hydrostatic, capillary or moisture vapor pressure. Moisture content of concrete not to exceed four pounds per 1,000 square feet per 24 hours when tested by the referee or quantitative calcium chloride test method.
3. Do not apply materials unless surface to receive coating is clean and dry.

PART 2 PRODUCTS

A. Drawings based on Neoquartz by Neogard:

1.	Crack and joint filler:	70718/70719 flexible epoxy.
2.	Fillers:	P1934 fumed silica and 86364 blended aggregates.
3.	Base coat:	70714/70715 clear epoxy.
4.	Aggregate:	Colored Quartz Aggregate to be approved by Architect.
5.	Seal coat:	70734/70735 clear epoxy.
6.	Exterior seal coat:	70805/7952 or Acrylithane HS2/99951 clear.
7.	Sealant:	70991 or other polyurethane sealant approved by Neogard.

B. Base Coat Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:

1.	Compressive strength:	10,900 psi
2.	Tesile strength:	1,700 psi
3.	Flexural strength:	4,200 psi
4.	Modulus of elasticity:	1.16 x 10^6 psi
5.	Heat resistance:	Pass
6.	Impacted load:	Pass @ ≤ 112 lbs.

C. Seal Coat Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:

1.	Compressive strength:	11,000 psi
2.	Tesile strength:	8,000 psi
3.	Elongation:	14%
4.	Flexural strength:	10,000 psi
5.	Flexural modulus:	400,000 psi
6.	Shore D Hardness:	82
7.	Adhesion:	400 psi
8.	Impact resistance:	Passes 16 ft./lbs.
9.	Taber abrasion:	89 mg/1,000 rev
10.	Water resistance:	<2%
11.	MVT @ 20 mils:	0.10 perm
12.	Fungus & bacteria:	No support of growth under TT-P-34
13.	Flame spread:	Class I
14.	Smoke density:	58.9%

D. Mixes:
1. Comply with manufacturer's instructions for mixing procedures.
2. Carefully measure and mix components together.
3. Carefully pre-mix quartz aggregate to match desired color pattern.

. 2.3 ACCESSORIES

A. Primer: Type recommended by manufacturer for substrate and body coats indicated.

B. Reinforcing Membrane: Flexible resin formulation that is recommended by manufacturer for substrate and primer and body coats indicated and that prevents substrate cracks from reflecting through resinous flooring.

C. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.

PART 3 EXECUTION

3.1 PREPARATION

A. Concrete substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
   1. Roughen concrete substrates as follows:
      a) Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
      b) Comply with ASTM C811 requirements unless manufacturer's written instructions are more stringent
   2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written instructions.
   3. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.

      a) Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with application of resinous flooring only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. of slab area in 24 hours.
      b) Perform plastic sheet test, ASTM D 4263. Proceed with application only after testing indicates absence of moisture in substrates.
      c) Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
   4. Alkalinity and Adhesion Testing: Verify that concrete substrates have pH within acceptable range. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.

B. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.

C. Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.

D. Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written instructions.

3.2 APPLICATION

A. General: Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.

   1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
   2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
   3. At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.

B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.

C. Apply reinforcing membrane to substrate cracks.

D. Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details including those for taping, mixing, priming, troweling, sanding, and topcoating of cove base. Round internal and external corners.

1. Integral Cove Base: 4 inches high.

E. Apply self-leveling slurry body coats in thickness indicated for flooring system.

1. Broadcast aggregates at rate recommended by manufacturer and, after resin is cured, remove excess aggregates to provide surface texture indicated.

F. Apply troweled or screeded body coats in thickness indicated for flooring system. Hand or power trowel and grout to fill voids. When cured, remove trowel marks and roughness using method recommended by manufacturer.

G. Apply grout coat, of type recommended by resinous flooring manufacturer, to fill voids in surface of final body coat and to produce wearing surface indicated.

H. Apply topcoats in number indicated for flooring system and at spreading rates recommended in writing by manufacturer.

I. Protect resinous flooring from damage and wear during the remainder of construction period.

3.3 PROTECTION

A. After completion of application, do not allow heavy traffic on coated surfaces for a period of at least 48 hours at 75 degrees, or until completely cured 7 days at 70 degrees.

END OF SECTION

SECTION 09 9100

PAINTING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Texturing of gypsum board.
   2. Surface preparation and field application of paints.
   3. Decorative stenciling.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.
   2. Section 00 3138 – Historic Paint and Finish Analysis Report.

1.2 REFERENCES

A. ASTM International (ASTM) D4442 - Standard Test Method for Direct Moisture Content Measurement of Wood and Wood-Base Materials.

B. Society for Protective Coatings (SSPC) - Painting Manual.

1.3 SUBMITTALS

A. Submittals for Review:
   1. Product Data: Manufacturer's data on materials proposed for use. Include:
      a. Product designation and grade.
      b. Surface preparation materials and procedures.
      c. Product analysis and performance characteristics.
   2. Samples:
      a. 3 x 6 inch samples of each coating system on representative substrate. Step back successive coats so that all coats remain exposed. Indicate type of material used for each coat.
      b. 12 x 12 inch texture samples on gypsum board backing.
   3. Paint Schedule: Detailed schedule indicating type and location of surface, coating materials, and number of coats to be applied.

B. Quality Control Submittals:
   1. Qualification Statement: Applicator qualifications per Section 01 4001.

1.4 QUALITY ASSURANCE

A. Applicator Qualifications:
   1. Minimum 5 years experience in work of this Section.
   2. Successful completion of at least 3 projects of similar scope and complexity within past 5 years.

B. Mockups:
   1. Construct mockup panels for interior wall finishes, 4 feet wide x full height.
   2. Show: Each color and texture.
   3. Locate where directed.
   4. Mockups to be approved by Architect and THC Representative prior to commencing with the Work.

1.5 DELIVERY, STORAGE AND HANDLING

A. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

B. Paint Materials: Store at ambient temperature from 45 to 90 degrees F in ventilated area, or as required by manufacturer's instructions.

1.6 PROJECT CONDITIONS

A. Do not apply materials when surface and ambient temperatures or relative humidity are outside ranges required by manufacturer.

B. Provide lighting level of 80 footcandles measured mid-height at substrate surface.

1.7 MAINTENANCE

A. Extra Materials: 1 gallon of each color and sheen.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
1. Benjamin Moore and Co. (www.benjaminmoore.com)
2. Devoe Paint Co. (www.devoepaint.com)
3. Fuller O'Brien Paints. (www.fullerpaint.com)
4. I.C.I. Paints. (www.icipaintstores.com)
5. Kelly-Moore Paints. (www.kellymoore.com)
6. PPG Architectural Finishes, Inc. (www.pittsburghpaints.com)
7. Pratt and Lambert Paints. (www.prattandlambert.com)
8. Sherwin Williams. (www.sherwin-williams.com)

B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. Paints: As scheduled at end of Section, or approved substitute.

2.3 ACCESSORIES

A. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials required to achieve specified finishes; commercial quality.

B. Patching Materials: Latex filler.

C. Fastener Head Cover Materials: Latex filler.

2.4 MIXES

A. Uniformly mix to thoroughly disperse pigments.

B. Do not thin in excess of manufacturer's recommendations.

PART 3 EXECUTION

3.1 EXAMINATION

A. Test shop applied primer for compatibility with subsequent coatings.

B. Measure moisture content of surfaces using electronic moisture meter. Do not apply coatings unless moisture content of surfaces are below following maximums:
1. Gypsum board and plaster: 12 percent.

2. Wood: 15 percent, measured to ASTM D4442.

3.2 PREPARATION

A. General:
1. Protect adjacent and underlying surfaces.
2. Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.
3. Correct defects and clean surfaces capable of affecting work of this section.
4. Seal marks that may bleed through surface finishes with shellac.

B. Impervious Surfaces: Remove mildew by scrubbing with solution of trisodium phosphate and bleach. Rinse with clean water and allow to dry.

C. Gypsum Board:
1. Fill minor defects with filler compound. Spot prime defects after repair.
2. Apply light orange peel texture in accordance manufacturer's instructions.

D. Plaster:
1. Fill hairline cracks, small holes, and imperfections with latex patching plaster. Finish smooth and flush with adjacent surfaces.
2. Wash and neutralize high alkali surfaces.

E. Galvanized Steel: SSPC Method SP1 - Solvent Cleaning.

F. Aluminum: SSPC Method SP1 - Solvent Cleaning.

G. Uncoated Ferrous Metals:
1. SSPC Method SP2 - Hand Tool Cleaning or Method SP3 - Power Tool Cleaning.
2. Spot prime paint after repairs.

H. Shop Primed Ferrous Metals:
1. SSPC Method SP2 - Hand Tool Cleaning or Method SP3 - Power Tool Cleaning.
2. Feather edges to make patches inconspicuous.
3. Prime bare steel surfaces.

I. Interior Wood:
1. Wipe off dust and grit.
2. Seal knots, pitch streaks, and sappy sections with sealer.
3. Fill nail holes and cracks after primer has dried; sand between coats.

J. Exterior Wood:
1. Remove dust, grit, and foreign matter.
2. Seal knots, pitch streaks, and sappy sections.

K. Existing Surfaces:
1. Remove loose, flaking, powdery, and peeling paints.
2. Lightly sand glossy painted surfaces.
3. Fill holes, cracks, depressions and other imperfections with patching compound; sand flush with surface.
4. Remove oil, grease, and wax by scraping; solvent wash and thoroughly rinse.
5. Remove rust by wire brushing to expose base metal.

3.3 APPLICATION

A. Apply primer or first coat immediately after surface preparation is complete to prevent recontamination.

B. Do not apply finishes to surfaces that are not dry.

C. Apply coatings to minimum dry film thickness recommended by manufacturer.

D. Apply each coat of paint slightly darker than preceding coat unless specified otherwise.

E. Apply coatings to uniform appearance without laps, sags, curtains, holidays, and brush marks.

F. Allow applied coats to dry before next coat is applied.

G. Sand between coats on interior wood and metal surfaces.

H. Match final coat to approved color samples.

I. Decorative Stenciling:
   1. Lay out stenciling using templates.
   2. Apply paint to lines and colors indicated on Drawings.

J. Mechanical and Electrical Components:
   1. Paint factory primed equipment.
   2. Remove unfinished and primed louvers, grilles, covers, and access panels; paint separately.
   3. Paint exposed and insulated pipes, conduit, boxes, ducts, hangers, brackets, collars, and supports unless factory finished.
   4. Do not paint name tags or identifying markings.
   5. Paint exposed conduit and electrical equipment in finished areas.

K. Do not Paint:
   1. Surfaces indicated on Drawings or specified to be unpainted or unfinished.
   2. Surfaces with factory applied finish coat or integral finish.
   3. Architectural metals, including brass, bronze, stainless steel, and chrome plating.

3.4 ADJUSTING

A. Touch up or refinish disfigured surfaces.

3.5 CLEANING

A. Remove paint from adjacent surfaces.

3.6 PAINT SCHEDULE

A. Types of paint listed herein are set forth as standard of quality and type of coating required for each type of surface.
   1. Paint exposed surfaces of types listed in Paint Schedule.
   2. Paint other exposed surfaces not specifically listed with not less than two coats of appropriate type of coating.

B. Prime coat shall consist of touch up only on shop primed and existing surfaces.

SUBSTRATE	PRIMER	TOP COATS
Exterior Surfaces:		
Ferrous and galvanized metals	One coat Kem Bond HS Universal Metal Primer	Two coats Industrial Enamel HS
Galvanized metals	One coat Galvite HS	Two coats All Surface Enamel

SUBSTRATE	PRIMER	TOP COATS
Wood, opaque finish	One coat A-100 Exterior Oil Wood Primer	Two coats A-100 Exterior Latex Satin
Wood, transparent finish	None	Two coats WoodScapes Solid Color Semi-Transparent Exterior Stain Cuprinol Clear Deck and Siding Finish
Interior Surfaces:		
Plaster and gypsum board, flat finish	One coat PrepRite Classic Latex Primer	Two coats ProMar 200 Interior Latex Flat Wall Paint
Plaster and gypsum board, enamel finish	One coat PrepRite Classic Latex Primer	Two coats ProMar 200 Interior Latex Egg-Shell Enamel
Ferrous and galvanized metals	One coat All Surface Enamel Latex Primer	Two coats ProClassic Interior Alkyd Semi-Gloss Enamel
Wood, opaque finish	One coat PrepRite Wall and Wood Interior Primer/Undercoater	Two coats ProMar 200 Interior Latex Semi-Gloss Enamel
Wood, transparent finish	One coat Wood Classics Interior Stain	Two coats Wood Classics Polyurethane Varnish, Satin

NOTE: Reference Section 00 3138 – Historic Paint and Finish Analysis Report.

END OF SECTION

SECTION 10 1200

BULLETIN BOARDS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Exterior bulletin boards.

B. Related Sections:
1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 SUBMITTALS

A. Submittals for review:
1. Shop Drawings: Include unit elevations, dimensions, materials, finishes, and attachment.
2. Product Data: Include product description, components, materials, and finishes.
3. Samples: 3 x 3 inch finish samples showing available colors.

PART 2 PRODUCTS

2.1 MANUFACTURED UNITS

A. Bulletin Board:
1. Source: Model ENC34TBCF Outdoor Double Bulletin Board by Displays2Go (www.displays2go.com) or approved substitute.
2. Type: Non-illuminated, with hinged doors.
3. Case construction: Anodized satin aluminum frame
4. Doors: Shatter resistant acrylic doors, continuously hinged, fully gasketed perimeter, provided with pull and keyed lock. Furnish six keys.
5. Back panel: Black self-healing recycled rubber tack surface.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions and approved Shop Drawings.

B. Set plumb, level, and rigid.

END OF SECTION

SECTION 10 1400

SIGNAGE

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Plastic interior panel signs.
2. Building directory.
3. Dedication plaques.
4. Dedication cornerstone.
5. Time capsule stone plaque.

B. Related Sections:
1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 SUBMITTALS

A. Shop Drawings: Include sign locations, sizes, mounting heights, and content.

B. Product data: For each type of sign specified, including details of construction relative to materials, dimensions of individual components, anchorage details, accessories, profiles, and finishes. Include not less than half-size details of wording and graphic layout.

C. Samples:
1. 3 x 3 inch sign samples showing available colors.
2. After color selection, submit typical sign illustrating pictograms, characters, and Braille indications.

D. Warranty: Submit manufacturer's standard warranty document executed by authorized company official.

E. Submittals to be approved by Architect and THC Representative prior to commencing with the Work.

1.3 QUALITY ASSURANCE

A. New Sign Fabricator Qualifications: Firm experienced in producing signs similar to those indicated for this Project, with a record of successful in-service performance, and sufficient production capacity to produce sign units required without causing delay in the Work.

B. Single-Source Responsibility: For each sign type required, obtain signs from one source of a single manufacturer.

C. Design Concept: The Specifications indicate sizes, profiles, and dimensional requirements of signs and are based on the specific types and models indicated. Sign units by other manufacturers may be considered provided deviations in dimensions and profiles do not change the design concept as judged by the Architect.

D. Regulatory Requirements: Products shall meet requirements of the Americans With Disabilities Act Accessibility Guidelines (ADAAG), Texas Accessibility Standards (TAS), and other local amendments and modifications.

1.4 PROJECT CONDITIONS

A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication to ensure proper fitting. Show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay.

1.5 PRODUCT HANDLING AND PROTECTION

A. Deliver materials to Project site in original packages, containers, or bundles, labeled with manufacturer's name, product brand name, and lot number.

B. Store materials inside, under cover and dry, protected from weather, direct sunlight, surface contamination, aging, corrosion, and damage from construction traffic and other causes.

C. Protect material accessories from being bent or damaged.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
1. Mohawk Sign Systems, Inc. (www.mohawksign.com)
2. APCO Graphics, Inc. (www.apcosigns.com)
3. Best Sign Systems, Inc. (www.bestsigns.com)
4. Seton Identification Products (www.seton.com)

B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. INTERIOR PANEL SIGNS
1. General: Sand-Carved hard plastic ES/MP plastic laminate, in sizes and thicknesses indicated, with a minimum flexural strength of 16,600 psi when tested according to ASTM D790, with a minimum allowable continuous service temperature of 176 deg F (80 degC). Provide in colors and finishes as selected from the manufacturer's standards.
a. Fasteners: Use concealed fasteners fabricated from metals that are not corrosive to the sign material and mounting surface.
b. Anchors and Inserts: Use non-ferrous metal or hot-dipped galvanized anchors and inserts for installation. Use toothed steel or lead expansion bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.
c. Colored for plastic laminate: Use colored coatings, including inks and paints for copy and background colors, that are recommended by manufacturer and are non-fading for the application intended.
d. Graphic Content and Style: Provide sign copy that complies with the requirements indicated for size, style, spacing, content, position, material, finishes, and colors of letters, numbers, and other graphic devices.

PART 3 EXECUTION

3.1 INSTALLATION

A. General: Locate sign units and accessories where indicated, using mounting methods of the type described and in compliance with the manufacturer's instructions. Install signs level, plumb, and at the height indicated with sign surfaces free from distortion or other defects.

B. Wall-Mounted Panel Signs: Attach panel signs to wall surfaces, according to the requirements of the American Disability Act, at 60" above the finished floor to the centerline of the sign on the latch side of the door, using the method indicated below. If there is less than 18" between door casing and intersecting wall, center sign horizontally in the space available. If there is more than 18" between door frame and intersecting wall, locate sign 3" from door casing. Where there is no wall space to the latch side of the door, including at double leaf doors, signs shall be placed on the nearest adjacent wall.

C. Shim Plate Mounting: Provide 1/8-inch-thick concealed aluminum shim plates with predrilled and countersunk holes, at locations indicated, and where other mounting methods are not practicable. Attach the plate with fasteners and anchors suitable for secure attachment to the substrate. Attach panel sign units to the plate using the method specified above.

D. Install Signs: level, plumb, and at the height indicated, with sign surfaces free from distortion or other defects in appearances.

3.2 CLEANING AND PROTECTION:

A. After installation, clean soiled sign surfaces according the manufacturer's instructions. Protect units from damage until acceptance by the Owner.

B. Repair scratches and other damage which might have occurred during installation. Replace components where repairs were made but are still visible to the unaided eye from a distance of five feet.

3.3 INTERIOR SIGNAGE SCHEDULE:

A. All signage to be in compliance with the Americans with Disabilities Act of 1990 and the Texas Accessibility Standards. Mount new signage according the mounting height requirements of ADA. Refer to schedule for signage types, sign text copy, and graphics. Signs listed below are based on a sand carved ¼" thick hard phenolic ES/MP plastic laminate, unless noted otherwise. Reference attachment for directory signage design.

Room No.	Quantity	Inscription	Interior/Exterior	Size (H x W)
Elevator door	1	Elevator Note: Sign to be designed and placed as per code	Interior	8-1/2" x 6"
001	1	Mechanical	Interior	3" x 6"
002	1	Break Room	Interior	3" x 6"
003	1	Stair	Interior	3" x 6"
005	1	Elevator Control	Interior	3" x 6"
008	1	Mechanical	Interior	3" x 6"
009	1	Men Note: Include the international symbol for accessibility	Interior	8-1/2" x 6"
012	1	Women Note: Include the international symbol for accessibility	Interior	8-1/2" x 6"

Room No.	Quantity	Inscription	Interior/Exterior	Size (H x W)
Elevator door	1	Elevator Note: Sign to be designed and placed as per code	Interior	8-1/2" x 6"
101	1	Justice of the Peace	Interior	8-1/2" x 6"
102	1	JP Clerks	Interior	8-1/2" x 6"
103	1	IT Closet	Interior	3" x 6"
104	1	JP Clerks	Interior	3" x 6"
107	2	Bailiff	Interior	8-1/2" x 6"
108	2	AV	Interior	3" x 6"
109	1	County Court at Law Judge's Assistant	Interior	8-1/2" x 6"
110	1	County Court at Law Judge	Interior	8-1/2" x 6"
112	1	Jury Room	Interior	8-1/2" x 6"
112	1	Jury Room	Interior	3" x 6"

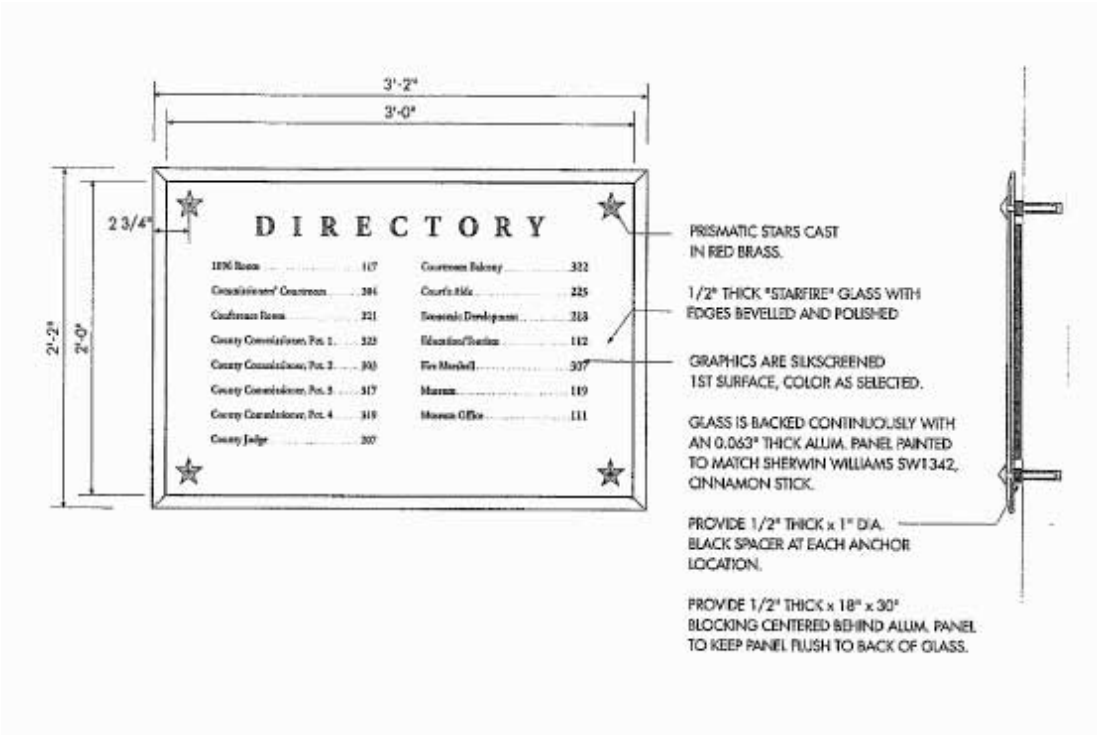
113	2	JP & County Court at Law Courtroom	Interior	8-1/2” x 6”
115	1	Stair	Interior	8-1/2” x 6”
116	1	County Commissioners	Interior	8-1/2” x 6”
117	1	Conference Room	Interior	3” x 6”
118	1	Conference Room	Interior	8-1/2” x 6”
	1	Directory	Interior	26” x 38”
	1	Dedication Plaque Cast bronze plaque with raised graphics (satin finish). Background is pebble or leatherette textured (dark oxidized finish).	Interior	36” x 24”
	1	Dedication cornerstone Limestone cornerstone to be located above original cornerstone	Exterior	V.I.F.
	1	Time Capsule Dedication Plaque Cast bronze plaque with raised graphics (stain finish). Background is pebble or leatherette textured (dark oxidized finish). Install plaque on limestone and place on grade adjacent to cornerstone.	Exterior	36” x 24”

Room No.	Quantity	Inscription	Interior/Exterior	Size (H x W)
Elevator door	1	Elevator Note: Sign to be designed and placed as per code	Interior	8-1/2” x 6”
201	1	Court Reporter	Interior	8-1/2” x 6”
202	1	Jury Room	Interior	8-1/2” x 6”
203	1	IT Closet	Interior	3” x 6”
204	1	Break Room	Interior	3” x 6”
206	1	Restroom Note: Include the international symbol for accessibility	Interior	8-1/2” x 6”
208	3	Courtroom	Interior	8-1/2” x 6”
210	1	Stair	Interior	8-1/2” x 6”
212	1	Restroom Note: Include the international symbol for accessibility	Interior	8-1/2” x 6”

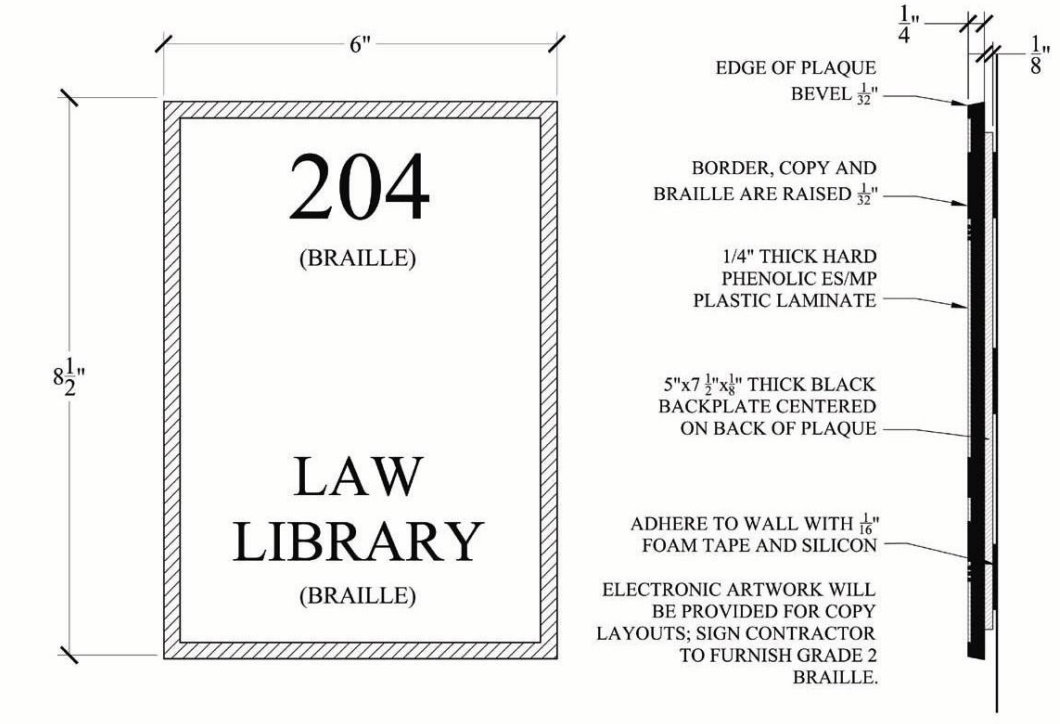
213	1	County Judge	Interior	3” x 6”
214	1	Private Restroom	Interior	3” x 6”
215	1	County Judge	Interior	8-1/2” x 6”

Room No.	Quantity	Inscription	Interior/Exterior	Size (H x W)
Elevator door	1	Elevator Note: Sign to be designed and placed as per code	Interior	8-1/2” x 6”
301	1	County Purchasing	Interior	8-1/2” x 6”
302	1	County Treasurer	Interior	8-1/2” x 6”
303	1	IT Closet	Interior	3” x 6”
304	1	County Treasurer	Interior	3” x 6”
307	3	Courtroom	Interior	8-1/2” x 6”
309	1	Stair	Interior	8-1/2” x 6”
311	1	Restroom Note: Include the international symbol for accessibility	Interior	8-1/2” x 6”
312	1	County Auditor	Interior	3” x 6”
313	1	County Auditor	Interior	8-1/2” x 6”
	1	Attic	Interior	3” x 6”

Directory Sign



Interior Room Sign



Dedication Cornerstone

Match 1965 Dedication Cornerstone with the following information:

Creta L. (Spanky) Carter II	County Judge
Gary Whitlock	Commissioner
Stan Barker	Commissioner
Jerry Magness	Commissioner
Dean Lackey	Commissioner

Include Contractor and Architect information

Time Capsule Dedication Plaque

Match Dedication Plaque shown below. Confirm exact size and wording with County.

END OF SECTION

SECTION 10 1460

ACCESSIBLE PARKING SIGNS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Exterior post mounted accessible parking signs.

B. Related Sections:
1. Division 01 - Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

A. ASTM International (ASTM):
1. A123/A123M - Zinc (Hot-Galvanized) Coatings on Iron and Steel Products.
2. A500 - Cold-Form ed Welded and Seam less Carbon Steel Structural Tubing in Rounds and Shapes.
3. A653/A653M - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
4. C94 - Ready-Mixed Concrete.

1.3 SUBMITTALS

A. Submittals for Review:
1. Shop Drawings: Include location, size, mounting height, and content of each sign.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Conform to applicable accessibility code for size, color, content, and height of signs.

PART 2 PRODUCTS

2.1 MATERIALS

A. Galvanized Steel Sheet: ASTM A653/A653M, Structural Quality, G90 coating

class. B. Steel Tube: ASTM A500.

2.2 ACCESSORIES

A. Concrete: ASTM C94, minimum 2500 PSI com pressive strength at 28 days, 3 to 5 inch slump.

B. Fasteners: Galvanized steel, type best suited to application, with vandal resistant heads.

2.3 FABRICATION

A. Signs:
1. Material: 1/8 inch thick galvanized steel sheet.
2. Graphics: Silk screened border, universal handicapped symbol, and characters as required.
3. Finish: Semigloss baked enamel.

B. Posts: 2 inch diameter galvanized steel tube with steel plate cap welded on, hot dip galvanized after fabrication to ASTM A123/A123M, G90 coating class.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install signs in accordance with approved Shop Drawings.

B. Set plumb, level, and secure.

C. Dome top of concrete footing to shed water.

D. Brace signs until concrete has set.

E. Secure signs to posts with two fasteners.

END OF SECTION

SECTION 10 2116

PLASTIC TOILET COMPARTMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Solid plastic toilet partitions.
   2. Solid plastic urinal screens.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.
   2. Section 10 2813 - Toilet Accessories.

1.2 SUBMITTALS

A. Submittals for Review:
   1. Shop Drawings: Include layout, dimensions, materials, panel construction, finishes, hardware, and accessories.
   2. Samples: 3 x 3 inch panel samples showing available colors.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
   1. Accurate Partitions Corp. (www.accuratepartitions.com)
   2. Ampco Products, Inc. (www.ampco.com)
   3. Global Steel Products Corp. (www.globalpartitions.com)
   4. Scranton Products. (www.scrantonproducts.com

) B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. Phenolic Sheet: Solid phenolic core manufactured of multiple layers of phenolic resin-impregnated Kraft paper com pressed under heat and pressure, with heat-fused melamine laminate facings.

B. Head Rail: Hollow, extruded aluminum, with anti-grip surface and cast wall sockets.

C. Hardware: Plated steel, stainless steel, or aluminum.
   1. Hinges: Gravity rising or non-rising spring tension actuated; conceal operable parts in door.
   2. Latches: Sliding type requiring maximum 5 pound force to operate, with emergency release operation.
   3. Coat hook and door stop: Combination type with rubber tip.
   4. Door strike and keeper with rubber bum per.

2.3 ACCESSORIES

A. Fasteners: Stainless steel, theft resistant where exposed.

2.4 FABRICATION

A. Configurations:
   1. Toilet partitions: Floor mounted, headrail braced.
   2. Urinal screens: Wall hung, continuously supported.

B. Construction:
   1. Solid phenolic sheet with square edges.
   2. Panels: Minim um 1/2 inch thick.
   3. Doors and pilasters: Minim um 3/4 inch thick.

C. Provide cutouts for toilet room accessories specified in Section 10 2813. Mark locations for partition mounted accessories.

D. Pilaster Shoes: Form ed stainless steel.

2.5 FINISHES

A. Panels, Doors, and Pilasters: Color to be selected from manufacturer's full color range.

B. Hardware and Accessories:
   1. Stainless steel: No. 4 satin.
   2. Chrome plated steel: Bright polished.
   3. Aluminum: Clear anodized.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer’s instructions and approved Shop Drawings.

B. Set partitions straight, plumb, level, and aligned.

C. Provide 3/8 to 1/2 inch vertical clearances between walls and panels and between walls and end pilasters.

D. Attach panel and head rail brackets to walls using appropriate anchor devices.

E. Adjust for floor variations with screw jack integral in pilasters. Conceal floor fastenings with pilaster shoes.

F. Equip doors with two hinges, door latch, door strike and keeper, and bum per/coat hook. Provide one additional bum per/hook on inside of outswinging doors.

3.2 ADJUSTING

A. Adjust hardware for proper operation.

B. Adjust door hinges to hold door open 10 degrees when not latched.

C. Sand out and polish minor scratches and abrasions to match factory finish.

END OF SECTION

SECTION 10 2813

TOILET ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Toilet accessories.
   2. Framed mirrors.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

A. ASTM International (ASTM):
   1. A123/A123M - Standard Specification for Zinc (Hot-Galvanized) Coatings on Iron and Steel Products.
   2. A269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
   3. A480/A480M - Standard Specification for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
   4. A666 - Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
   5. B456 - Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.
   6. C1036 - Standard Specification for Flat Glass.

1.3 SUBMITTALS

A. Submittals for Review:
   1. Product Data: Manufacturer's brochures showing sizes, details of function, finishes, and attachment methods.
   2. Samples: One of each accessory.

1.4 QUALITY ASSURANCE

A. Conform to applicable accessibility code for locating accessories.

1.5 WARRANTIES

A. Furnish manufacturer’s 5 year warranty providing coverage against mirror silver spoilage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Contract Documents are based on products by Bobrick Washroom Equipment Co. (www.bobrick.com)

B. Equivalent products by the following manufacturers are acceptable:
   1. A and J Washroom Accessories. (www.ajwashroom .com)
   2. American Specialties, Inc. (www.americanspecialties.com)
   3. Bradley Corp. (www.bradleycorp.com)
   4. General Accessory Mfg. Co. (www.gamcousa.com)
   5. Koala Corp.

C. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. Stainless Steel:
1. Sheet: ASTM A480/A480M or ASTM A666; Type 304, rollable tem per.
2. Tubing: ASTM A269.

B. Galvanized Steel: ASTM A366.

C. Mirror Glass: ASTM C1036, Type I, Class 1, Quality q1, 3/16 inch thick.

2.3 ACCESSORIES

A. Fasteners: Stainless steel where exposed, hot dip galvanized where concealed; type best suited to substrate conditions.

2.4 FABRICATION

A. Use stainless steel for exposed surfaces; galvanized steel m ay be used in concealed locations.

B. Form exposed surfaces from single sheet of stock, free from joints, and flat, without distortion.

C. Weld joints of fabricated components and grind smooth.

D. Fabricate grab bars of tubing, free of visible joints, return to wall with end attachment flanges.

E. Fabricate soap dispensers to operate with less than 5 pound force.

F. Provide hangers, adapters, anchor plates, and accessories required for installation.

G. Key locks alike; furnish six keys.

H. Shop assemble units and package complete with anchors and fittings.

I. Mirrors:
1. Frame: One piece, roll formed stainless steel channel, 1/2 x 1/2 inch, with corners mitered.
2. Mirror: Apply one coat of silver, one coat of electroplated copper, and one coat of organic mirror backing com pound to back surface of glass.
3. Backing: Galvanized steel sheet.
4. Isolate glass from frame and backing with resilient, waterproof padding.

2.5 FINISHES

A. Stainless Steel: No. 4 satin.

B. Galvanizing: ASTM A123/A123M to 1.25 ounces per square foot.

C. Chrome Plating: ASTM B456, Type SC 2, polished finish.

D. Polyethylene: White.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Set plumb, level, square, and rigid.

3.2 SCHEDULE

DESCRIPTION	MODEL NO.
Grab Bar	B-6806
Toilet Tissue Dispenser	B-2840
Soap Dispenser, Surface Mounted	B-4112
Automatic Soap Dispenser, Countertop Mounted	B-858
Paper Towel Dispenser and Waste Receptacle	B-38032
Tilt Mirror	B-294 2430
Towel Dispenser	B-262
Waste Receptacle	B-2260
Changing Station (Koala Kare)	KB110-SSRE
Seat Cover Dispenser and Toilet Tissue Dispenser, single	B-3474
Seat Cover Dispenser, Toilet Tissue Dispenser and Sanitary Napkin Disposal, single	B-3574
Seat Cover Dispenser and Toilet Tissue Dispenser, double	B-347
Seat Cover Dispenser, Toilet Tissue Dispenser and Sanitary Napkin Disposal, double	B-357

END OF SECTION

SECTION 10 4413

FIRE EXTINGUISHERS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Portable fire extinguishers.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

A. National Fire Protection Association (NFPA) 10 - Portable Fire Extinguishers.

B. Underwriters Laboratories (UL):
   1. 299 - Dry Chemical Fire Extinguishers.
   2. 711 - Rating and Fire Testing of Fire Extinguishers.

1.3 SUBMITTALS

A. Submittals for Review:
   1. Shop Drawings: Indicate cabinet locations and mounting heights.
   2. Product Data: Include data on extinguishers, operational features, materials, finishes, and anchorage.

B. Closeout Submittals:
   1. Maintenance Data: Include test, refill, or recharge schedules and re-certification requirements.

1.4 QUALITY ASSURANCE

A. Provide fire extinguishers com plying with UL 711 and NFPA 10.

B. Conform to applicable accessibility code for locating extinguishers.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
   1. JL Industries. (www.jlindustries.com)
   2. Larsen's Mfg. Co. (www.larsensmfg.com)
   3. Potter Roemer. (www.potterroemer.com)

B. Substitutions: Under provisions of Division 01.

2.2 COMPONENTS

A. Extinguishers: Multi-purpose dry chemical type, UL 299, cast steel tank, Class 4A:60B:C, 10 pound nominal capacity.

2.3 ACCESSORIES

A. Mounting Hardware: Type best suited to application.

2.4 FINISHES

A. Extinguishers: Baked enamel, red.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install extinguishers in accordance with manufacturer's instructions.

B. Set plumb, level, and rigid.

C. Coordinate mounting locations and quantities with local Fire Marshal.

END OF SECTION

SECTION 10 7429

HISTORIC CUPOLA CLOCK TOWER

PART 1 GENERAL

1.1 SUMMARY

A. Provide Cupola work shown on the drawings, as specified herein, and as needed for a complete and proper installation:
   1. Prefabricated Aluminum Cupola assembly, including:
      a. Aluminum Structural framing.
      b. Aluminum cladding and Baked on Kynar finishes in color selected by the architect.
      c. U.L. approved system from base of cupola to top, with U.L. approved lightning air terminal.
      d. Clock system including dials, hands, numerals, movements and illumination.

B. Coordinate Cupola work of this section with General Conditions and Supplementary Conditions.

1.2 SUBMITTALS

A. Product Data: Include construction details, materials descriptions, dimensions of individual components, profiles, and finishes for each type of metal panel and accessory.

B. Submit comprehensive Shop Drawings clearly illustrating fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profile, corners, anchorages, trim, flashings, closures, and accessories; and special details. Distinguish between factory – assembly and field-assembly work. Include the following.
   1. Plan and elevations.
   2. Framing and Anchorage details.
   3. Flashing Details.
   4. Lightning protection air terminal mounted to Cupola Dome.
   5. Ventilation Louvers
   6. Accessory components.

C. If required provide stamp & sealed drawings of a Professional Engineer, licensed in the state of Texas on final approved drawings.

D. Submit Kynar color samples of exterior covering.

E. Samples for Initial selection; for factory-applied color finishes.

F. Submit certificates of insurance.

G. Submit close-out documents, warranties, and manuals.

H. Submittals to be approved by Architect and THC Representative prior to commencing the Work.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain prefabricated Cupola through one source from a single manufacture. Obtain as a complete unit, including necessary mounting hardware and accessories.

B. Use adequate number of skilled workmen who are thoroughly trained and experienced in the necessary crafts, and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

C. Use materials which shall be free from defects impairing strength, durability, and appearance; shall be of best commercial quality for purpose required; and shall comply with approved drawings.

D. Manufacturer Qualifications: A firm experienced in successfully producing manufactured exterior Cupolas similar to the size and complexity indicated for this project, and with sufficient production capacity to produce required Cupola assembly unit without causing delay in the work. Cupola manufacture to have a minimum of 25 (twenty five) years of continuous operation experience in the manufacture of specified product.

E. Submit examples of work of similar size, complexity, and historical significance for architect's review and approval 7 days prior to bid date.

F. Coordination of Work: Coordinate layout and installation of Cupola with adjacent construction, including, but not limited to, roofing and flashing construction.

G. Pre-installation Conference: Conduct conference at project site and include the General Contractor, cupola manufacturer/installer, representatives of trades involved in or affected by the installation of the Cupola and its coordination or integration with other materials and installations that have preceded or will follow, including, but not limited to roofing and flashing installers. Advise Architect and Owner of scheduled meeting date. Review methods and procedures related to Cupola assembly and installation, including, but not limited to, the following:

H. Materials Certification: Provide to the Architect with the Cupola manufacturer’s written certification that the assembly and materials being furnished comply with the specified requirements of the Contract Documents, including, but not limited to, ASTM and other referenced standards.

I. Meet with Owner, Architect, Owner's insurer if applicable, Owner's testing and inspecting agency representative, Cupola Manufacturer/Installer, and installers whose work interfaces with or affects installation or performance of the Cupola assembly.

J. Review methods and procedures related to Cupola installation, including manufacturer's installation written instructions.

K. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

L. Examine substrate attachment and structural conditions for compliance with requirements, including flatness and attachment to structural members.

M. Review structural loading limitations of interfacing construction both during and after installation of Cupola assembly.

N. Review flashings, special roof details, roof drainage, roof penetrations, and other construction that will affect Cupola assembly.

O. Review governing regulations and requirements for insurance, certificates, and testing and inspecting if applicable.

P. Review temporary protection requirements for Cupola assembly during and after installation.

Q. Review manufacturer's recommended periodic inspection and repair procedures that should be followed after completion of Cupola installation.

R. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.4 DELVIERY, STORAGE, AND HANDLING

A. Deliver Cupola, components, assemblies, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal roof panels for protection during transportation and handling.

B. Unload, store, and erect Cupola assembly in a manner to prevent bending, warping, twisting, and surface damage. (G.C. to supply Crane, crane operator, man-basket, lifts for the re-assembly and hoisting of Clock tower throughout duration of installation.)

C. Until ready for erection and final installation, store Cupola assemblies and components on manufacturer's transport platforms or pallets and covered with suitable weather tight and ventilated covering to ensure dryness. Do not store components in contact with other materials that might cause staining, denting, or other surface damage.

D. Protect strippable protective covering on metal panels from exposure to sunlight and high humidity, except to extent necessary for period of metal panel installation.

1.5 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of Cupola to be performed according to manufacturers' written instructions and warranty requirements.

B. Field Measurements: Verify locations and dimensions of anchorages by field measurements prior to fabrication of Cupola components and indicate measurements on Shop Drawings.
   1. Established Dimensions: Where field measurements cannot be made without delaying the Work, either establish framing and other dimensions and proceed with fabricating Cupola components without field measurements, or allow for adjustments of anchorages. Coordinate installation of anchorages and surrounding roof and framing construction to ensure that actual building dimensions, locations of structural members, and openings correspond to established dimensions.

1.6 WARRANTY

A. Cupola Warranty: Furnish manufacturer/installer’s written warranty, agreeing to replace/repair/restore defective materials and workmanship of prefabricated cupola during warranty period.

B. Warranty period: 1 year from date of Substantial Completion.

C. Warranty on Kynar Finishes: Kynar Manufacturer’s standard 20-year pro-rated warranty for Kynar finishes.

D. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:

E. Color fading more than 5 Hunter units when tested according to ASTM D 2244.

F. Chalking, checking, peeling, or failure of paint to adhere to bare metal.

H. Finish Warranty Period: Kynar applicator’s warranty period of 20 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Use product as manufactured by Campbellsville Industries, Inc., P.O. Box 278, 440 Taylor Blvd., Campbellsville, KY 42718, Phone: 800/467-8135.

B. Use Cupola per Campbellsville Industries Inc. basis of design as shown on drawings. Due to the degree of complexity and historical significance, no substitutions allowed.

2.2 MATERIALS

A. Structural Framing: A36 structural steel or 6061-T6 aluminum internal framing. Connections per fabricator. If required framing designed and engineered to withstand structural wind loads indicated on Drawings and in accordance with Indiana Uniform Statewide Building Code. If required provide comprehensive structural analysis data and framing drawings signed and sealed by the qualified professional engineer who is licensed in the state of Indiana and is responsible for their preparation. All connections to base angle shall be gusseted connections with gusset size and thickness; with number of rivets, their size and spacing determined by engineer. All angle connections shall fit within adjoining angle members, utilizing both flanges of members for welds, and no butt joining of angles shall be allowed. Pop rivets shall not be allowed in the connections of steel or aluminum structure or repairs of same.

B. Exterior Cladding of Cupola: Formed aluminum sheet metal fabrication, minimum .032”. Separate dissimilar metals with compatible materials. Provide exterior silicone sealant. Aluminum plate and welding are not allowed on exterior cladding material. All connections of cladding to structure shell be riveted connections and lock seams. No double-sided tape allowed. No welding of cladding is allowed. All joints shall be lock-formed according to accepted sheet metal practices with no lapping or raw edges exposed (vertical laps on cornices excepted)

C. Ornamental Elements: Fabricated special form elements by casting, forming, spinning or other fabrications methods determined by manufacturer. Prepare and finish metal to match general formed aluminum exterior, unless noted otherwise.

D. Fabricate elements to true dimensions with welded or soldered joints, ground smooth.

E. Jobsite Coordination: Cupola Manufacturer shall design Cupola assembly so as to have Cupola’s arrival, assembly and installation +/- 3 weeks, unless delayed by unpreparedness by General Contractor.

F. Use structural steel products according to ASTM specifications.

G. Use structural aluminum products according to the Construction Manual of the Aluminum Association, Inc., and shall be alloy 6061-T6.

H. Use .032” aluminum cladding 300-H14 allow, per UNA-CLAD standard finish colors, excluding metallic and or non-exotic colors per architect’s selection. Custom colors would be additional charges.

I. Interior of the cupola shall have a sprayed, thermally applied polyurethane installation to the interior cladding surface with a minimum thickness of ½” per manufacturer’s recommendations at the locations where the architectural structure comes in contact with the exterior cladding.

2.3 ACCESSORIES

A. Fabricate custom final true to dimensions, with welded or soldered joints, ground smooth, caustic etched, primed, and finish with two coats of a durable, exterior, shop-applied vinyl finish.

B. Form cornices, mouldings, and ornaments in accordance with approved drawings.

C. Cast, stamp, form, and/or spin special ornaments in accordance with good and acceptable practices, and in accordance with approved drawings.

D. Clock: Provide clock system shown on drawings, #R-7 Dials with Railroad Style as specified herein, and as needed for a complete and proper installation.

1. Use clock as manufactured by Campbellsville Industries, Inc., P.O. Box 278,440 Taylor Blvd., Campbellsville, KY 42718, Phone: 800/467-8135, E-mail: slceplc@cvilleindustries.com . Website: http://www.cvillcindustrics.com.
2. Fabricate structural framework to support dials and light frame from aluminum extrusions for specified series.
3. Handcraft and machine all gears, shafts, and bearings from rust resistant, ground, and polished stainless steel, brass, aluminum, and bronze, all of the highest quality. Mount all gears, shafts, and bearings in rigidly supported ¼" thick precision machined cast aluminum frame, which shall serve as a perpetual lubrication reservoir. Furnish weather resistant, painted galvannealed steel enclosure over gears and bearings.
4. Hands: Provide aluminum hands, style No. M-01, and furnish with black baked-on finish.
5. Use minimum ¼" white translucent Plexiglas for illuminated dials for non-metallic dials. Provide stock dial, style No. R-7. Railroad design Numerals per drawings and/or markers shall be injection molded plastic, black, and chemically bonded to dial.
6. Provide automated digital MC-100 controller capable of synchronizing both analog and digital secondary cloak as well as providing automatic and manual operation of bell/utility control units. Controller to be powered by a 120VAC supply and supplied with a 10-year lithium battery to provide battery backup during power outages. Includes liquid crystal display and 16-button keypad., with two-level password security. Controller to have four (4) programmable function circuits, available to 12 circuits, field selectable clock format, manual correction, easy menus driven programming, microprocessor based, have selectable time base, automatic Daylight Savings adjustment, perpetual Leap Year calendar, three program schedules, and have one (1) second to over four (4) days event duration.
7. Illumination of dials provided by means of our tandem-2 L.E.D. lighting, with electronic eye controller, and wiring in conduit down to junction boxes at cupolas base, ready for wiring and connection to power source by others. **(Note: Illumination to be ran on separate circuit)**.
8. Provide separate wiring for clock motor(s) and illumination system(s). Provide and install separate electrical circuits, 120 vac 60 hz, for clock system and illumination system. Clock movements to have their own dedicated line. Have movements, controller and light fixtures pre-wired and ready for project electrician to make wiring connection to electrical service.
9. Install all electrical work in accordance with local building and electrical codes. **(NOTE: Clocks to be on a dedicated line for clocks only).**
10. Dome shall be clad with formed 12"x12" simulated diagonal pattern on Dome roof only.
11. Lower Base Skirt framing and Lower Window section above windows to be clad with formed 6"x12" simulated shingle pattern.
12. Lower base window section shall have (16) Non-tapered 0' -8" dia. Fiberglass Columns. Columns to be shop primed and painted to match selected cladding finish color.
13. Arched Cornice above lower Window section and barreled section below clock section shall be 90 deg. locked formed from .032" Kynar finish.
14. Lower window section at base shall have C.L's stock B-500 Balusters with top and bottom Aluminum boxes shop painted to match cladding finish color.

15. C.I. shall fabricate our standard work ladders and platforms to aid with assembly, installation along with access for the owner's future clock maintenance and inspection.
16. Louvers shall be functional with form .032" Aluminum louver blades and firmly secure and rivet to frames, and back with 18 x 18 aluminum screen.

2.4 FABRICATION

A. Fabrication structural steel framing to conform to AWS standards.

B. Fabrication structural aluminum framing with cold driven aluminum rivets, limiting welding to secondary architectural members.

C. Form all exterior cladding with good and acceptable sheet metal practices, and lock form all seams inasmuch as possible.

D. Conceal all exterior fasteners to maximum possibility.

E. Use cadmium plated bolts, nuts, and washers for anchoring, unless anchoring materials are provided and installed by others.

2.5 FINISHES

A. Use aluminum cladding with Kynar 500 finish, from Cupola Manufacturer’s stock Kynar colors form UNA-CLAD standard stock finishes.

B. Shop finish all aluminum castings, stampings, spinnings, and accessories. Units shall be caustic etched, primed with 2 heavy coats of primer, and finished with 2 heavy coats minimum of industrial vinyl or enamel finish electrostatically applied and air dried to match surrounding Kynar finishes.

C. Paint all aluminum surfaces in contact with steel with one heavy coat of zinc primer and paint all steel surfaces with 2 heavy coats red lead or zinc chromate, followed by one coat of aluminized bituminous paint.

2.6 CAULKING

A. Clean and dry all surfaces to be caulked.

B. Apply with caulking gun, using nozzle of proper size to fit the joint width.

C. Use silicone caulking by Dow Corning, or approved equal.

PART 3 EXECUTION

3.1 PROJECT SITE CONDITIONS

A. Verify with owner or general contractor that site conditions are suitable and accessible for delivery and installation.

B. Confirm with owner or general contractor that all preparatory work is in place in accordance with approved shop drawings before delivery and installation.

C. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of cupola to be performed according to manufacturers written instructions and warranty requirements.

D. G.C./Others to provide a steel support platform similar to our D-3, 11’-4” centerline to centerline both ways of support platform to receive the Clock Tower Cupola.

3.2 INSTALLATION

A. Coordinate with other trades as required to assure proper and adequate installation.

B. Clean all soiled and dirty areas and touch up any scratches or abrasions to finish before lifting into position.

C. Install work with skilled workmen who are familiar with such work in accordance with approved shop drawings.

D. Provide equipment as needed for unloading and hoisting product into position for as long as required.

E. Assembly and installation of cupola on-site +/- (3) weeks. Manufacturer not responsible for in-climate weather or delays due to unpreparedness of jobsite by other associated trades and/or suppliers.

3.3 CLEAN-UP

A. Clean up all debris caused by work of this section.

B. Keep the premises clean and neat at all times.

END OF SECTION

SECTION 11 5213

PROJECTION SCREENS

PART 1 GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specifications sections, apply to work of this section.

B. Refer to Instructions to Bidders for substitution of materials and products.

1.2 DESCRIPTION OF WORK:

A. Projection screens required include:

1. Electric Ceiling Mounted Front Projection Screen

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. Acoustical ceilings.

B. Painting.

C. Electrical wiring, connections, and installation for remote control switches for electrically operated projected screens are specified in Division-16 sections.

1.4 QUALITY ASSURANCE:

A. Single Source Responsibility: Obtain each model of projection screens required from a single manufacturer as complete units, including all necessary mounting hardware and accessories.

B. Fire Performance Characteristics: Provide projection screen fabrics identical to those materials which have undergone testing and passed requirements for flame resistance as indicated below:

1. NFPA 701 per small scale test.
2. Federal Standard 191A/5903 for test method. FS GG-S-00172D(1) for flame resistance.
3. Mildew Resistance: Provide mildew resistant screen fabrics as determined by Federal Standard 191A/5760.

1.5 SUBMITTALS:

A. Product Data: Submit manufacturer's product data for each type of unit, information to include but not be limited to screen gain, image size, black drop if applicable, and any furnished options if applicable.

B. Wiring Diagram: Submit manufacturer's wiring diagram for electrically operated units.

C. Installation: Submit mounting details specific to each installation.

D. Maintenance: Submit manufacturer’s maintenance and care instructions.

1.6 DELIVERY, STORAGE, AND HANDLING:

A. Do not deliver projection screens until building is ready to be enclosed, other work within spaces where screens will be installed is substantially complete, and installation of screens is ready to take place.

B. Protect screens from damage during delivery, handling, storage, and installation.

PART 2 – PRODUCTS

2.1 ELECTRIC CEILING MOUNTED FRONT PROJECTION SCREEN:

A. General: Provide manufacturer's standard UL-listed and -marked units consisting of case, screen, motor, controls, mounting accessories and other components as required for a complete installation and complying with requirements indicated for screen surface, controls and for case, motor and screen under description of operation and type.

1. Screen Material:
   (1) HD Progressive 0.9
   (2) Completely seamless
   (3) Viewing surface flame and mildew resistant
2. Image Size:
   (1) Image Size: 160”W X 90” H
   (2) Bottom of image to be at 10’ 0” AFF
   (3) Provide extra Wireline thin steel cables as required to locate image at elevation shown on drawings. This extra drop amount needs to be calculated using the finished ceiling height dimension.
3. Screen Controls:
   (1) Provide dry contact input transmitter to raise and lower screen from relay contact from the control processor.
4. Screen Housing:
   (1) Screen Case: Extruded aluminum. Bottom panels form slot for passage of viewing surface, easily removable for access to motor and viewing surface.
5. Acceptable Products: (PS, Type 1)
   (1) Da-Lite Screen Company Wireline Advantage

PART 3 – EXECUTION

3.1 INSTALLATION

A. General: Install projection screens at locations indicated in compliance with screen manufacturer's instructions.

B. Install ceiling mounted projection screens with screen cases in position and relationship to adjoining work indicated, securely anchored to supporting structure, and in manner which produces a smoothly operating screen with plumb and straight vertical edges and plumb and flat viewing surfaces when lowered. During screen travel, no objects shall impact or interfere with screen surface.

C. Test electrically-operated units to verify that screen, controls, limit switches, closure and other operating components are in optimum functioning condition. Projection screens must be operated within three months of their delivery date from the manufacturer.

D. Set limit switches to allow image height above the floor as noted in the screen schedule above.

3.2 PROTECTION AND CLEANING:

A. Protect projection screens after installation from damage during construction. If despite such protection, damage occurs, remove and replace damaged components or entire unit as required to restore units to their original, undamaged condition.

END OF SECTION

SECTION 12 2113

HORIZONTAL LOUVER BLINDS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Horizontal slat louver blinds.
2. Operating hardware.

B. Related Sections:
1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 SUBMITTALS

A. Submittals for Review:
1. Product Data: Describe blind construction and finishes.
2. Samples: 3 inch long slat samples showing available colors.

1.3 PROJECT CONDITIONS

A. Do not install blinds until painting and finishing work is complete.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
1. Hunter Douglas, Inc. (www.hunterdouglas.com)
2. Levolor Contract. (www.levolor.com)
3. Springs Window Fashions Division, Inc. (www.springs.com

B. Substitutions: Under provisions of Division 01.

2.2 COMPONENTS

A. Louver Slats: 2 inches wide, solid wood horizontal slats with radiused corners; wood species to be selected.

B. Slat Support: Woven polypropylene ladders.

C. Head Rail: Prefinished, formed aluminum or steel box, internally fitted for hardware, pulleys, and bearings for blind operation.

D. Cord: Braided nylon or polypropylene.

E. Control Wand: Hollow extruded plastic, height of window opening less 12 inches.

F. Support Brackets: Suitable for wall or soffit mounting, formed metal to match head rail, allowing removal of head rail for maintenance without removing bracket.

G. Operation: Full range lift locking.

2.3 FABRICATION

A. Fabricate blinds to fit openings with uniform edge clearance of 1/4 inch.

B. At openings requiring multiple blind units, provide separate blind assemblies with space of 1/4 inch between assemblies, occurring at window mullion centers.

2.4 FINISHES

A. Slats: Stain and clear satin varnish, color to be selected from manufacturer's standards.

B. Head Rails and Brackets: Baked enamel, color to be selected from manufacturer's full color range.

C. Ladders and cords: Dyed to closely match slats.

D. Control Wands: Clear.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install blinds in accordance with manufacturer's instructions.

B. Secure with concealed fasteners.

C. Place intermediate head supports at maximum 48 inches on center.

D. Installation Tolerances:
1. Maximum gap at window opening perimeter: 1/4 inch.
2. Maximum offset from level: 1/8 inch.

3.2 ADJUSTING

A. Adjust blinds for proper operation.

END OF SECTION

SECTION 12 5000

CHAIRS AND PEWS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Wood chairs.
   2. Wood pews.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

A. Architectural Woodwork Institute (AWI) – Architectural Woodwork Quality Standards.

1.3 SUBMITTALS

A. Submittals for Review:
   1. Shop Drawings: Indicate sizes, dimensions, and room layouts.
   2. Product Data: Illustrate construction, materials, finishes and accessories.
   3. Samples: 6 x 6 inch wood and leather samples showing color and finish.

B. Quality Control Submittals:
   1. Qualification Statement: Installer qualifications per Section 01 4001.

1.4 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Minimum 5 years experience in work of this Section.
   2. Successful completion of at least 3 projects of similar scope and complexity within past 5 years.

B. Mockup:
   1. Provide mockup of one full size chair and pew unit.
   2. Include chair and pew back, seat, and ends.
   3. Locate where directed.
   4. Mockup to be approved by Architect and THC Representative prior to commencing with the Work.

1.5 PROJECT CONDITIONS

A. Do not install chairs and pews until:
   1. Space is enclosed and weatherproof.
   2. Wet work, painting, and overhead work in space is complete.
   3. Ambient temperature and humidity conditions can be maintained near those for final occupancy.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Selections based on chairs and pews by manufacturers listed below.

B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. Judge's Bench Chair:
   1. Source: Model No. 7667-6UE by Crocker Chair Company or approved substitute.
   2. Description: Spring edge seat, solid quarter sawn Oak, with upholstered seat and back.
   3. Dimensions: 20-1/2 inches between arms x 27-1/2 inches to top of back.
   4. Finishes:
      a. Wood: Manufacturer's standard stain and varnish, color to be selected from manufacturer's full color range.
      b. Seat and back: Leather, color to be selected from manufacturer's full color range, with brass brads.

B. Jury Box Chairs:
   1. Source: Model No. 5980BD Bolt Down Jury Swivel Arm Chair by Kurt Petersen or approved substitute.
   2. Description: Solid quarter sawn Oak, steel pedestal mounted, swiveling, with upholstered seat.
   3. Dimensions: 23-1/4 inches wide x 22 inches deep x 32 inches to top of back.
   4. Finishes:
      a. Wood: Manufacturer's standard stain and varnish, color to be selected from manufacturer's full color range.
      b. Seat: Leather, color to be selected from manufacturer's full color range, with brass brads.

C. Courtroom Chairs:
   1. Source: Model No. 5981 Jury Chair by Kurt Petersen or approved substitute.
   2. Description: Solid quartered Oak arm chair.
   3. Dimensions: 24 inches wide x 23-1/2 inches deep x 32-1/4 inches to top of back.
   4. Finishes:
      a. Wood: Manufacturer's standard stain and varnish, color to be selected from manufacturer's full color range.

D. Courtroom Pews:
   1. Source: Custom made. wood slat pews with metal supports.
   2. Description: Solid quartered Oak wood slat pew with metal supports that closely match historic pews at Hood County courthouse.
   3. Dimensions: Match historic.
   4. Finishes:
      a. Wood: Manufacturer's standard stain and varnish, color to be selected from manufacturer's full color range.
      b. Metal: painted black to match historic.

E. Courtroom Balcony Chairs:
   1. Source: Crusader by Irwin Seating Co. or approved substitute.
   2. Description: Solid quartered Oak wood bottom and back with metal supports.
   3. Aisle Standard: No.150 Bretton
   4. Dimensions: 22 inches wide
   5. Finishes:
      a. Wood: Manufacturer's standard stain and varnish, color to be selected from manufacturer's full color range.
      b. Metal: painted black to match historic.

F. Podiums:
   1. Source: Custom made.
   2. Description: Solid quarter sawn Oak wood with hidden rear wheels.
   3. Dimensions: 26.5 inches wide x 48 inches tall x 22 inch depth
   4. Finishes:
      a. Wood: Match courtroom furnishings.

END OF SECTION

SECTION 14 2123

ELECTRIC PASSENGER ELEVATORS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Electric elevator system.
2. Cab with doors, frames, and finishes.
3. Hoistway doors and frames.
4. Machines, controllers, hoistway equipment, and accessories.

B. Related Sections:
1. Division 01: Administrative, procedural, and temporary work requirements.
2. Finishes: Specific sections referenced.

1.2 REFERENCES

A. American Architectural Manufacturers Association (AAMA) 611 - Voluntary Specification for Anodized Architectural Aluminum01737.

B. ASME International (ASME):
1. A17.1 - Safety Code for Elevators and Escalators.
2. A17.2.3 - Inspector's Manual for Escalators and Moving Walks.

C. Association of Electrical and Medical Imaging Equipment Manufacturers (NEMA) LD-3 - High Pressure Decorative Laminates.

D. ASTM International (ASTM):
1. A36/A36M - Standard Specification for Carbon Structural Steel.
2. A167 - Standard Specification for Stainless and Heat-Resisting Chromium -Nickel Steel Plate, Sheet, and Strip.
3. A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
4. B209 - Standard Specification for Aluminum and Aluminum -Alloy Sheet and Plate.
5. B221 - Standard Specification for Aluminum and Aluminum -Alloy Extruded Bars, Rods, W ire, Profiles, and Tubes.

E. Engineered Wood Association (APA) PRP-108 - Performance Standards and Qualification Policy for Structural-Use Panels.

F. National Association of Architectural Metal Manufacturers (NAAMM) AMP 503 - Finishes for Stainless Steel.

G. National Fire Protection Association (NFPA) :
1. 70 - National Electrical Code.
2. 80 - Standard for Fire Doors and Fire Windows.

H. Underwriters Laboratories (UL) 10C - Standard for Positive Pressure Fire Tests of Door Assemblies.

1.3 SYSTEM DESCRIPTION

A. Selective Collective Operation:
1. Microprocessor based controller providing automatic operation by means of car and corridor buttons.
2. After all calls in system have been answered, park car at last landing served.

B. Control System: Provide smooth operation within following limits:
   1. Start of car motion to landing level at next landing on typical run: Maxim um 5.5 seconds.
   2. Door close to start of car motion with balanced load: Maxim um 0.9 seconds.
   3. Start of door closing at one landing to fully opened door position at next landing under balanced load conditions: Maxim um 9.5 seconds.
   4. Maintain performance times without hunting or excessive rollover at landings, and with maximum premature door opening of 3 inches from landing.

1.4 SUBMITTALS

A. Submittals for Review:
   1. Shop Drawings:
      a. Car floor plan, interior elevations, and reflected ceiling plan indicating finishes and locations of controls and fixtures.
      b. Driving machine, controller, motor generator, selector, governor, and other component locations.
      c. Car, counterweight, sheaves, machine and sheave beams, guide rails, buffers, ropes, and other components in hoistway.
      d. Rail bracket spacing and maximum loads imposed on guide rails requiring transfer to structure.
      e. Individual weight of principle components and load reactions at points of support.
      f. Loads on hoisting beams.
      g. Clearances and over travel.
      h. Location of traveling cables and connections for car light and telephone.
      i. Locations of access doors, doors, and frames.
      j. Expected heat dissipation of elevator equipment.
      k. Electrical characteristics and connection requirements.
   2. Samples: Illustrate cab interior finishes and car and hoistway door and frame finishes.
   3. Submittals to be approved by Architect and THC Representative prior to commencing with the Work.

B. Quality Control Submittals:
   1. Qualification Statement: Installer qualifications per Section 01 4001.

C. Closeout Submittals:
   1. Operation and Maintenance Data: Include operation instructions, wiring diagram s, parts list, lubrication and maintenance requirements, and safety procedures.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Minimum 5 years experience in work of this Section.
   2. Maintain service facility within 100 miles of project site.

B. Conform to applicable accessibility code for dimensions, locations, operations, and control types and locations.

C. Hoistway Doors and Frames:
   1. Construction: Conform to UL 10C.
   2. Installed assemblies: Conform to NFPA 80.

1.6 MAINTENANCE

A. Maintenance Service:
   1. Provide complete maintenance service for period of 3 months after Substantial Completion.
   2. Include systematic examination, adjustment and lubrication of equipment; repair worn parts using only original equipment parts complying with ASME A17.1, produced by manufacturer of equipment concerned.
   3. Replace wire ropes to maintain required factor of safety.
   4. Perform work without removing cars during peak traffic periods.
   5. Provide 24 hour emergency service during maintenance period.

6. Perform work using qualified and competent personnel.

B. Maintenance Proposal:
1. Submit proposal for maintenance of installed elevator work for period of 2 years after termination of 3 month maintenance.
2. Include stipulated sum for above stated time period with premiums due annually.
3. Base proposal based on same requirements specified for 3 month maintenance period.
4. Include copy of proposed maintenance agreement.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
1. Fujitech America, Inc. (www.fujitecamerica.com)
2. Kone, Inc. (www.us.kone.com)
3. Otis Elevator Co. (www.otis.com)
4. ThyssenKrupp Elevator.(www.thyssenkruppelevator.com)

B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. Steel:
1. Shapes: ASTM A36/A36M.
2. Sheet: ASTM A653/A653M, G60 hot-dip galvanized, stretcher leveled, Structural Quality.

B. Stainless Steel: ASTM A167, Type 304 or 316, rollable temper.

C. Aluminum: Anodizing quality.
1. Extrusions: ASTM B221.
2. Sheet: ASTM B209, alloy 6063.

D. Panel Products: APA Rated Sheathing, Exposure 1, Grade C-D, sanded.

E. Plastic Laminate: NEMA LD-3:
1. Backing sheet: Grade BLF.
2. Exposed surfaces: Grade VGP.

F. Paints:
1. Primer for steel: Alkyd.
2. Primer for wood: Alkyd primer/sealer.
3. Enamel: Semigloss alkyd.

2.3 COMPONENTS

A. Motors, Controllers, Controls, Buttons, Wiring, Devices, and Indicators: As required by NFPA 70 and ASME A 17.1.

B. Hoisting Machine: Gearless type, mounted on car guide rails, specifically manufactured and sized to perform with specified loads and speeds.

C. Controller:
1. Microprocessor based with AC drive.
2. On-board diagnostics or handheld service tool for servicing, troubleshooting, and adjusting.
3. Include hardware required to connect, transfer, and interrupt power, and to protect motor against overload.

4. Memory equipment shielded against line pollution.
5. Designed to accept reprogramming with minimal down time.
6. Protect contacts over 110 volts from accidental contact when controller doors are open.
7. Locate in remote control room.

D. Guide Rails, Ropes, Cables, Counterweights, Sheaves, Buffers, Attachment Brackets, and Anchors: Purpose designed, sized according to ASME A17.1 with safety factors.

E. Electrical Components:
1. Boxes, conduit, wiring, and devices: As required by NFPA 70.
2. Fittings: Steel compression type for electrical metallic tubing. Fittings with set screws acceptable only when a separate grounding conductor is also installed across the joint.
3. Spare conductors: Include 10 percent extra conductors and two pairs shielded audio cables in traveling cables. Do not parallel conductors to increase electrical current capacity unless individually fused.
4. Do not use armored flexible metal conduit as a grounding conductor.
5. Include wiring and devices for elevator equipment remote from hoistway. Provide components and wiring to suit machine layout.

F. Lubrication:
1. Provide grease fittings for lubricating bearings requiring periodic lubrication.
2. Grease cups: Automatic feed type.
3. Lubrication points: Visible and readily accessible.

G. Car:
1. Frame: Rigid and braced, rolled or forged steel sections, mounted on resilient isolators.
2. Platform : Steel frame with fireproofed plywood subflooring assembly, ready to receive finish flooring.

H. Cab:
1. Finishes: Scheduled at end of Section.
2. Operating panel:
   a. Operating controls:
      1) Illuminating call buttons for each landing, DOOR OPEN and DOOR CLOSE buttons, emergency stop switch, and alarm button.
      2) Keyed switches for hoistway access, door hold open, inspection initiation, exhaust fan, car light, and door protection system.
   b. Locate highest button in control panel maximum 54 inches above floor.
   c. Provide Braille designations adjacent to buttons in control panel. Locate Braille designations to the left of buttons. Provide raised star adjacent to main landing.
   d. Group emergency controls at bottom of operating panel; locate minimum 35 inches above floor.
3. Telephone: Vandal resistant, hands-free, integral type.
4. Car position indicator: LED display with 2-1/2 inch high numerals corresponding to each landing and directional arrows.
5. Emergency light: Low voltage type, battery operated.
6. Sound audible signal in car when car is stopping at or passing landing, minimum 20 decibels.

I. Cab Entrances:
1. Doors: 16 gage metal, hollow sandwich panel construction, flush design, rolled profiles, rigid construction; material and finish as scheduled at end of Section.
2. Frames: 16 gage metal; material and finish as scheduled at end of Section.
3. Thresholds: Non slip; material and finish as scheduled at end of Section.
4. Door operator:
   a. Direct current, operating car and landing doors simultaneously.
   b. Manually operable in event of power failure.
   c. Adjustable open time interval, canceled by registered car call.
5. Door protection system:
   a. Multiple infrared beam type, located at entrance to car, operating an electronic timing

device with adjustable door open.
b. Interruption of any beam prevents doors from closing or stops and reopens doors if doors are closing.
c. React to obstructions from sill to 72 inches above sill.
d. Remain effective for minimum 20 seconds.
e. If doors are held open for extended time by passenger standing in entrance, holding door, or pressing door open button, sound buzzer and resume closing of doors at reduced speed.

6. Keyed landing door unlocking devices: Locate at all landings.
7. Provide 2 inch high raised numbers with Braille designations flush mounted on each landing jamb to identify landing number, mounted maximum 60 inches above floor.

J. Landing Controls and Fixtures:
1. Landing call buttons:
a. Illuminating acrylic push buttons, minimum 3/4 inch diameter, raised or flush type.
b. Single up or down call button at each terminal landing.
c. Up and down call buttons at intermediate landings.
2. Landing lanterns:
a. Illuminating acrylic lanterns mounted adjacent to landing entrances.
b. Signals illuminate prior to car arrival, indicating direction of travel.
c. Provide audible signal when car is arriving at landing, minim um 20 decibels; one for up stops and two for down stops.

2.4 FINISHES

A. Surfaces Not Exposed to View:
1. Ferrous metals: Two coats primer.
2. Field welds: Two coats primer.
3. Wood: One coat primer and two coats enamel.

B. Surfaces Exposed to View:
1. Stainless Steel: NAAMM AMP 503; No. 4 satin.
2. Ferrous and galvanized metals: One coat primer, sprayed and baked, and two coats enamel, sprayed and baked, color to be selected from manufacturer's full color range.
3. Aluminum: Anodized coating; AAMA 611, Class I, to 0.0007 inch minimum thickness, clear.
4. Plastic laminate: Color to be selected from manufacturer's full color range.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with ASME A17.1 and manufacturer's instructions.

B. Arrange equipment so that elements requiring removal or maintenance are readily accessible without disturbing other components. Arrange for clear passage between components.

C. Install system components. Connect equipment to building utilities.

D. Set landing entrances in alignment with car openings and true with level sill lines.

E. Install guide rails to compensate for expansion and contraction movement.

F. Accurately machine and align guide rails. Form smooth joints with machined splice plates.

G. Install hoistway door thresholds, frames, and headers in hoistway walls. Set entrances in vertical alignment with car openings and plumb hoistway lines.

H. Grout thresholds.

I. Provide minimum time period between notification at landing of call answer and start of door closing in accordance with applicable accessibility code.

J. Adjust leveling devices to provide maximum 1/2 inch difference between cab and landing floor elevations under loaded conditions.

K. Adjust equipment for smooth and quiet operation.

L. Clean field welds; remove oxidation and residue. Apply touch up primer.

3.2 FIELD QUALITY CONTROL

A. Inspect completed installation in accordance with ASME A17.2.

B. Test elevator in presence of Owner and Architect.
1. Demonstrate proper operation and compliance with requirements of Contract Documents; make final adjustments as appropriate.
2. Demonstrate that group supervisory system functions properly during varying traffic loads.
3. Test landing to landing run times to demonstrate compliance with specified requirements.

C. Obtain inspections and permits and make tests required by governing authorities. Deliver test certificates and permits to Owner.

3.3 CLEANING

A. Clean hoistway surfaces; remove loose material from hoistways and pits. Remove water accumulated in pits.

B. Clean pits of dirt, oil and grease. Remove articles and material not necessary for maintenance and operation of elevators.

C. Remove protective coverings from finished surfaces; clean and polish surfaces.

3.4 SCHEDULE

A. Type: Based on Kone EcoSpace Machine-room-less electric traction passenger elevator.

B. Capacity: 2500 pounds.

C. Speed: 150 FPM.

D. Car Interior Dimensions: 6'-8" wide x 4'-3 deep x 8'-0" high.

E. Operational Modes:
1. Selective collective operation.
2. Inspection operation.

F. Landing Entrances:
1. Size: 3'-6" wide x 7'-0" high.
2. Type: Horizontal sliding, single leaf, left opening.
3. Corners: Welded type.
4. Material: Stainless steel.
5. Thresholds: Aluminum.

G. Cab (Kone Vintage Series or approved substitute):
1. Flooring: Roppe #995 Hammered Design Dark Grey.
2. Doors and front returns: Stainless steel.
3. Back wall: Satin brushed gold aluminum
4. Side walls: Satin Stainless Steel
5. Ceiling: LF-98 satin stainless steel.

6. Handrail: 4” flat satin stainless steel.
7. Thresholds: Aluminum
8. Ventilation: Two speed blower mounted above ceiling, with grille.
9. Lighting: Rectangular LED
10. Wall hooks: Manufacturer’s standard, stainless steel.
11. Removable protective wall mats: Provide one set.
12. Signalization: KSS 570 Flush
13. Telephone cabinet.
14. Car position indicator.
15. Emergency light mounted in front return above position indicator.

H. Landing Controls and Fixtures:
1. Call buttons mounted in stainless steel face plate.
2. Landing lanterns mounted in stainless steel face plate.

END OF SECTION

SECTION 14 4200

WHEELCHAIR LIFTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Electric vertical wheelchair lifts.
   2. Operating equipment and accessories.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

A. ASME International (ASME) A18.1 - Safety Standard for Platform Lifts and Stairway Chairlifts.

B. American Welding Society (AWS) D1.1 - Structural Welding Code - Steel.

1.3 SUBMITTALS

A. Submittals for Review:
   1. Shop Drawings: Indicate drive mechanism, lift construction, dimensions, control functions and operational description.
   2. Product Data: Submit data on signal and operating fixtures, lift design, layout, components, and schematic of wiring diagrams.
   3. Samples: Submit samples, 3 x 3 inches in size illustrating floor and prefinished metal components.
   4. Submittals to be approved by Architect and THC Representative prior to commencing with the Work.

B. Quality Control Submittals:
   1. Qualification Statement: Installer qualifications per Section 01 4001.

C. Closeout Submittals:
   1. Operation and Maintenance Data.

1.4 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Minimum 5 years experience in work of this Section.
   2. Successful completion of at least 3 projects of similar scope and complexity within past 5 years.

B. Regulatory Requirements: Comply with ASME A18.1.

C. Perform Work in accordance with ASME A18.1 and AWS D1.1.

D. Conform to applicable accessibility code for dimensions, locations, operation, and controls.

1.5 MAINTENANCE

A. Maintenance Service: Furnish service and maintenance of wheelchair lifts for period of one year from Date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Contract Documents are based on Lift-U Accessor I by Hogan Mfg., Inc. (www.hoganmfg.com)

B. Substitutions: Under provisions of Division 01.

2.2 COMPONENTS

A. Wheelchair Lift:
1. Rated net capacity: 1050 pounds.
2. Rated speed: 10 feet per minute minimum.
3. Operation: Electric motor driving four mechanically synchronized screw columns.

B. Controls:
1. Controls: Push button controls located at top and bottom landings, enabling lift to be called or sent to landing.
2. Electric strike latches and electric spring bolts for gates.
3. Emergency stop switch.
4. Emergency alarm.
5. Upper and lower limit switches.
6. Battery backup.
7. Emergency lowering.

C. Motors, Controllers, Controls, Buttons, Wiring, Devices, and Indicators: As required by NFPA 70 and ASME A 18.1.

D. Electrical Characteristics:
1. Electrical characteristics:
a. 115 VAC, 15 amp, three wire, single phase, 60 Hz.
b. 24 volt control circuit.

2.3 FINISHES

A. Steel:
1. Surface preparation: Clean and degrease metal surface.
2. Primer: Sprayed and baked.
3. Finish: Electrostatically applied powder coat; color to be selected from manufacturer's full color range.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with ASME A18.1.

B. Install system components and connect to building utilities and electrical service.

3.2 FIELD QUALITY CONTROL

A. Perform tests required by ASME A18.1.

B. Submit test and approval certificates issued by authorities having jurisdiction.

3.3 ADJUSTING

A. Adjust automatic floor leveling feature at each stop to stop platform within 1/4 inch of finished floor.

END OF SECTION

SECTION 21 0500

COMMON WORK RESULTS FOR FIRE SUPPRESSION

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. Piping materials and installation instructions common to most piping systems.
2. Mechanical sleeve seals.
3. Sleeves.
4. Escutcheons.
5. Grout.
6. Fire-suppression equipment and piping demolition.
7. Equipment installation requirements common to equipment sections.
8. Painting and finishing.
9. Concrete bases.
10. Supports and anchorages.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. CPVC: Chlorinated polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Mechanical sleeve seals.
2. Escutcheons.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Fire-Suppression Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes 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. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for fire-suppression installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for fire-suppression items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 21 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 21 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. Solvent Cements for Joining CPVC Plastic Piping: ASTM F 493.

2.4 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Available Manufacturers:

    a. Advance Products & Systems, Inc.
    b. Calpico, Inc.
    c. Metraflex Co.
    d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Stainless steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

    1. Underdeck Clamp: Clamping ring with set screws.

E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.

F. PVC Pipe: ASTM D 1785, Schedule 40.

G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.6 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.

    1. Finish: Polished chrome-plated.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

    1. Finish: Polished chrome-plated.

E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.

F. Split-Plate, Stamped-Steel Type: With exposed-rivet hinge, set screw or spring clips, and chrome-plated finish.

G. One-Piece, Floor-Plate Type: Cast-iron floor plate.

H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.7 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 21 Sections specifying piping systems.

B. 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 Coordination Drawings.

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 to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
c. Insulated Piping: One-piece, stamped-steel type with spring clips.

d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece cast-brass type with polished chrome-plated finish.
g. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.
h. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
i. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

M. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

N. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

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. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.

1) Seal space outside of sleeve fittings with grout.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

O. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using 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.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

P. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

Q. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

R. Verify final equipment locations for roughing-in.

S. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 21 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. 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 unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic 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. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

3.3 PAINTING

A. Painting of fire-suppression systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.4 CONCRETE BASES: Must be approved in writing by registered structural engineer.

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
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 the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's 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 anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete or Miscellaneous Cast-in-Place Concrete."

3.5 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor fire-suppression materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.6 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor fire-suppression materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.7 GROUTING

A. Mix and install grout for fire-suppression equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 21 0500

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SECTION 21 1000

WATER-BASED FIRE-SUPPRESSION 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. This Section includes the following fire-suppression piping inside the building:

1. Automatic wet-type, Class I standpipe systems.
2. Wet-pipe sprinkler systems.

B. Related Sections include the following:

C.

1. Division 21 Section "Electric-Drive, Centrifugal Fire Pumps" for fire pumps, pressure-maintenance pumps, and pump controllers.
2. Division 28 Section "Fire Detection and Alarm" for alarm devices not specified in this Section.

1.3 DEFINITIONS

A. CPVC: Chlorinated polyvinyl chloride plastic.

B. CR: Chlorosulfonated polyethylene synthetic rubber.

C. High-Pressure Piping System: Fire-suppression piping system designed to operate at working pressure higher than standard 175 psig.

D. PE: Polyethylene plastic.

E. Underground Service-Entrance Piping: Underground service piping below the building.

1.4 SYSTEM DESCRIPTIONS

A. Combined Standpipe and Sprinkler System: Fire-suppression system with both standpipe and sprinkler systems. Sprinkler system is supplied from standpipe system.

B. Automatic Wet-Type, Class I Standpipe System: Includes NPS 2-1/2 hose connections. Has open water-supply valve with pressure maintained and is capable of supplying water demand.

C. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.5 PERFORMANCE REQUIREMENTS

A. Standard Piping System Component Working Pressure: Listed for at least 175 psig.

B. High-Pressure Piping System Component Working Pressure: Listed for 250 psig minimum.

C. Fire-suppression standpipe system design shall be approved by authorities having jurisdiction.

1. Minimum residual pressure at each hose-connection outlet is the following:
   a. NPS 2-1/2 Hose Connections: 100 psig.

2. Unless otherwise indicated, the following is maximum residual pressure at required flow at each hose-connection outlet:
   a. NPS 2-1/2 Hose Connections: 175 psig.

D. Fire-suppression sprinkler system design shall be approved by authorities having jurisdiction.

1. Margin of Safety for Available Water Flow and Pressure: 10 psig, including losses through water-service piping, valves, and backflow preventers.

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.
   d. Extra-Hazard, Group 1 Occupancy: 0.30 gpm over 2500-sq. ft. area.
   e. Extra-Hazard, Group 2 Occupancy: 0.40 gpm over 2500-sq. ft. area.
   f. Special Occupancy Hazard: As determined by authorities having jurisdiction.

3. 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.

4. Total Combined Hose-Stream Demand Requirement: According to NFPA 13, unless otherwise indicated:

   a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
   b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.

1.6 SUBMITTALS

A. Product Data: For the following:

1. Piping materials, including dielectric fittings, flexible connections, and sprinkler specialty fittings.
2. Pipe hangers and supports.
3. Valves, including listed fire-protection valves, unlisted general-duty valves, and specialty valves and trim.

4. Sprinklers, escutcheons, and guards. Include sprinkler flow characteristics, mounting, finish, and other pertinent data.
5. Hose connections, including size, type, and finish.
6. Fire department connections, including type; number, size, and arrangement of inlets; caps and chains; size and direction of outlet; escutcheon and marking; and finish.
7. Alarm devices, including electrical data.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Fire-hydrant flow test report.

D. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations, if applicable.

E. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13 and NFPA 14. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."

F. Welding certificates.

G. Field quality-control test reports.

H. Operation and Maintenance Data: For standpipe and sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

    a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

C. NFPA Standards: Fire-suppression-system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13, "Installation of Sprinkler Systems."
2. NFPA 14, "Installation of Standpipe, Private Hydrant, and Hose Systems."
3. NFPA 20, "Installation of Stationary Pumps for Fire Protection."
4. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

1.8 COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.9 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sprinkler Cabinets: Finished, wall-mounting, steel cabinet with hinged cover, 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 on Project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell end and plain end.

1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron gland, rubber gasket, and steel bolts and nuts.

B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell end and plain end.

1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Gaskets: AWWA C111, rubber.

C. Grooved-End, Ductile-Iron Pipe: AWWA C151, with factory- or field-formed, radius-cut-grooved ends according to AWWA C606.

1. Grooved-Joint Piping Systems:

a. Available Manufacturers:

1) Victaulic Co. of America.

b. Grooved-End Fittings: ASTM A 536, ductile-iron casting with OD matching ductile-iron-pipe OD and cement lining.
c. Grooved-End-Pipe Couplings: AWWA C606, gasketed fitting matching ductile-iron-pipe OD. Include ductile-iron housing with keys matching ductile-iron-pipe and fitting grooves, prelubricated rubber gasket with center leg, and steel bolts and nuts.
d. Grooved-End-Pipe Transition Coupling: UL 213 and AWWA C606, gasketed fitting with end matching ductile-iron-pipe OD and end matching steel-pipe OD. Include ductile-iron housing with key matching ductile-iron-pipe groove and key matching steel-pipe groove, prelubricated rubber gasket listed for use with housing, and steel bolts and nuts.

e. Grooved-End Transition Flange: UL 213, gasketed fitting with key for ductile-iron-pipe dimensions. Include flange-type, ductile-iron housing with rubber gasket listed for use with housing and steel bolts and nuts.

2.3 STEEL PIPE AND FITTINGS

A. Threaded-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, hot-dip galvanized where indicated and with factory- or field-formed threaded ends.

1. Cast-Iron Threaded Flanges: ASME B16.1.
2. Malleable-Iron Threaded Fittings: ASME B16.3.
3. Gray-Iron Threaded Fittings: ASME B16.4.
4. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe hot-dip galvanized where indicated. Include ends matching joining method.
5. Steel Threaded Couplings: ASTM A 865 hot-dip galvanized-steel pipe where indicated.

B. Plain-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795 hot-dip galvanized-steel pipe where indicated.

1. Locking-Lug Fittings: UL 213, ductile-iron body with retainer lugs that require one-quarter turn to secure pipe in fitting.

a. Available Manufacturers:

1) Anvil International, Inc.
2) Victaulic Co. of America.
3) Ward Manufacturing.

C. Plain-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795 hot-dip galvanized-steel pipe where indicated.

1. Steel Welding Fittings: ASTM A 234/A 234M, and ASME B16.9 or ASME B16.11.
2. Steel Flanges and Flanged Fittings: ASME B16.5.

D. Grooved-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, hot-dip galvanized where indicated and with factory- or field-formed, square-cut- or roll-grooved ends.

1. Grooved-Joint Piping Systems:

a. Available Manufacturers:

1) Anvil International, Inc.
2) Central Sprinkler Corp.
3) Ductilic, Inc.
4) JDH Pacific, Inc.
5) National Fittings, Inc.
6) Shurjoint Piping Products, Inc.
7) Southwestern Pipe, Inc.
8) Star Pipe Products; Star Fittings Div.
9) Victaulic Co. of America.
10) Ward Manufacturing.

b. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.
c. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves,[prelubricated] rubber gasket listed for use with housing, and steel bolts and nuts.

E. Plain-End, Schedule 10 Steel Pipe: ASTM A 135 or ASTM A 795, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10.

1. Locking-Lug Fittings: UL 213, ductile-iron body with retainer lugs that require one-quarter turn to secure pipe in fitting.

a. Available Manufacturers:

1) Anvil International, Inc.
2) Victaulic Co. of America.
3) Ward Manufacturing.

F. Plain-End, Schedule 10 Steel Pipe: ASTM A 135 or ASTM A 795, Schedule 10 in NPS 5 and smaller; and NFPA 13 specified wall thickness in NPS 6 to NPS 10.

1. Steel Welding Fittings: ASTM A 234/A 234M, and ASME B16.9 or ASME B16.11.
2. Steel Flanges and Flanged Fittings: ASME B16.5.

G. Grooved-End, Schedule 10 Steel Pipe: ASTM A 135 or ASTM A 795, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10 with factory- or field-formed, roll-grooved ends.

1. Grooved-Joint Piping Systems:

a. Available Manufacturers:

1) Anvil International, Inc.
2) Central Sprinkler Corp.
3) Ductilic, Inc.
4) JDH Pacific, Inc.
5) National Fittings, Inc.
6) Shurjoint Piping Products, Inc.
7) Southwestern Pipe, Inc.
8) Star Pipe Products; Star Fittings Div.
9) Victaulic Co. of America.
10) Ward Manufacturing.

b. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.
c. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves,[prelubricated] rubber gasket listed for use with housing, and steel bolts and nuts.

2.4 DIELECTRIC FITTINGS

A. Assembly shall be copper alloy, ferrous, and insulating materials with ends matching piping system.

B. Dielectric Unions: Factory-fabricated assembly, designed for 250-psig minimum working pressure at 180 deg F. Include insulating material that isolates dissimilar materials and ends with inside threads according to ASME B1.20.1.

1. Available Manufacturers:

a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Epco Sales, Inc.
d. Hart Industries International, Inc.
e. Watts Industries, Inc.; Water Products Div.
f. Zurn Industries, Inc.; Wilkins Div.

C. Dielectric Flanges: Factory-fabricated companion-flange assembly, for 175-psig (1200-kPa) minimum working-pressure rating as required for piping system.

1. Available Manufacturers:

a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Epco Sales, Inc.
d. Watts Industries, Inc.; Water Products Div.

D. Dielectric Flange Insulation Kits: Components for field assembly shall include CR or phenolic gasket, PE or phenolic bolt sleeves, phenolic washers, and steel backing washers.

1. Available Manufacturers:

a. Advance Products and Systems, Inc.
b. Calpico, Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.

E. Dielectric Couplings: Galvanized steel with inert and noncorrosive thermoplastic lining and threaded ends and 300-psig working-pressure rating at 225 deg F.

1. Available Manufacturers:

a. Calpico, Inc.
b. Lochinvar Corp.

F. Dielectric Nipples: Electroplated steel with inert and noncorrosive thermoplastic lining, with combination of plain, threaded, or grooved ends and 300-psig working-pressure rating at 225 deg F.

1. Available Manufacturers:

a. Perfection Corporation.
b. Precision Plumbing Products, Inc.
c. Victaulic Co. of America.

2.5 FLEXIBLE CONNECTORS

A. Flexible connectors shall have materials suitable for system fluid. Include 175-psig minimum working-pressure rating and ends according to the following:

1. NPS 2 and Smaller: Threaded.
2. NPS 2-1/2 and Larger: Flanged.
3. Option for NPS 2-1/2 and Larger: Grooved for use with grooved-end-pipe couplings.

B. Available Manufacturers:

1. Anamet Inc.
2. Flex-Hose Co., Inc.
3. Flexicraft Industries.
4. Flex-Pression, Ltd.
5. Flex-Weld, Inc.
6. Hyspan Precision Products, Inc.
7. Mercer Rubber Co.
8. Metraflex, Inc.
9. Proco Products, Inc.
10. Unaflex Inc.

C. Bronze-Hose, Flexible Connectors: Corrugated, bronze, inner tubing covered with bronze wire braid. Include copper-tube ends or bronze flanged ends, braze welded to hose.

D. Stainless-Steel-Hose/Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include steel nipples or flanges, welded to hose.

E. Stainless-Steel-Hose/Stainless-Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include stainless-steel nipples or flanges, welded to hose.

2.6 CORROSION-PROTECTIVE ENCASEMENT FOR PIPING

A. Encasement for Underground Metal Piping: ASTM A 674 or AWWA C105, PE film, 0.008-inch minimum thickness, tube or sheet.

2.7 SPRINKLER SPECIALTY FITTINGS

A. Sprinkler specialty fittings shall be UL listed or FMG approved, with 175-psig minimum working-pressure rating, and made of materials compatible with piping. Sprinkler specialty fittings shall have 250-psig minimum working-pressure rating if fittings are components of high-pressure piping system.

B. Outlet Specialty Fittings:

1. Available Manufacturers:

a. Anvil International, Inc.
b. Central Sprinkler Corp.
c. Ductilic, Inc.
d. JDH Pacific, Inc.
e. National Fittings, Inc.
f. Shurjoint Piping Products, Inc.

g. Southwestern Pipe, Inc.
h. Star Pipe Products; Star Fittings Div.
i. Victaulic Co. of America.
j. Ward Manufacturing.

2. Mechanical-T and -Cross Fittings: UL 213, ductile-iron housing with gaskets, bolts and nuts, and threaded, locking-lug, or grooved outlets.
3. Snap-On and Strapless Outlet Fittings: UL 213, ductile-iron housing or casting with gasket and threaded outlet.

C. Sprinkler Drain and Alarm Test Fittings: Cast- or ductile-iron body; with threaded or locking-lug inlet and outlet, test valve, and orifice and sight glass.

1. Available Manufacturers:

a. Central Sprinkler Corp.
b. Fire-End and Croker Corp.
c. Viking Corp.
d. Victaulic Co. of America.

D. Sprinkler Branch-Line Test Fittings: Brass body with threaded inlet, capped drain outlet, and threaded outlet for sprinkler.

1. Available Manufacturers:

a. Elkhart Brass Mfg. Co., Inc.
b. Fire-End and Croker Corp.
c. Potter-Roemer; Fire-Protection Div.

E. Sprinkler Inspector's Test Fitting: Cast- or ductile-iron housing with threaded inlet and drain outlet and sight glass.

1. Available Manufacturers:

a. AGF Manufacturing Co.
b. Central Sprinkler Corp.
c. G/J Innovations, Inc.
d. Triple R Specialty of Ajax, Inc.

F. Drop-Nipple Fittings: UL 1474, adjustable with threaded inlet and outlet, and seals.

1. Available Manufacturers:

a. CECA, LLC.
b. Merit.

2.8 LISTED FIRE-PROTECTION VALVES

A. Valves shall be UL listed or FMG approved, with 175-psig minimum pressure rating. Valves shall have 250-psig minimum

B. Gate Valves with Wall Indicator Posts:

1. Gate Valves: UL 262, cast-iron body, bronze mounted, with solid disc, nonrising stem, operating nut, and flanged ends.
2. Indicator Posts: UL 789, horizontal-wall type, cast-iron body, with hand wheel, extension rod, locking device, and cast-iron barrel.
3. Available Manufacturers:

    a. Grinnell Fire Protection.
    b. McWane, Inc.; Kennedy Valve Div.
    c. NIBCO.
    d. Stockham.

C. Ball Valves: Comply with UL 1091, except with ball instead of disc.

1. NPS 1-1/2 and Smaller: Bronze body with threaded ends.
2. NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
3. NPS 3: Ductile-iron body with grooved ends.
4. Available Manufacturers:

    a. NIBCO.
    b. Victaulic Co. of America.

D. Butterfly Valves: UL 1091.

1. NPS 2 and Smaller: Bronze body with threaded ends.

    a. Available Manufacturers:

        1) Global Safety Products, Inc.
        2) Milwaukee Valve Company.

        3) NPS 2-1/2 and Larger: Bronze, cast-iron, or ductile-iron body; wafer type or with flanged or grooved ends.

    b. Available Manufacturers:

        1) Central Sprinkler Corp.
        2) Global Safety Products, Inc.
        3) McWane, Inc.; Kennedy Valve Div.
        4) Mueller Company.
        5) NIBCO.
        6) Pratt, Henry Company.
        7) Victaulic Co. of America.

E. Check Valves NPS 2 and Larger: UL 312, swing type, cast-iron body with flanged or grooved ends.

1. Available Manufacturers:

    a. AFAC Inc.
    b. American Cast Iron Pipe Co.; Waterous Co.
    c. Central Sprinkler Corp.
    d. Clow Valve Co.
    e. Crane Co.; Crane Valve Group; Crane Valves.
    f. Crane Co.; Crane Valve Group; Jenkins Valves.
    g. Firematic Sprinkler Devices, Inc.

h. Globe Fire Sprinkler Corporation.
i. Grinnell Fire Protection.
j. Hammond Valve.
k. Matco-Norca, Inc.
l. McWane, Inc.; Kennedy Valve Div.
m. Mueller Company.
n. NIBCO.
o. Potter-Roemer; Fire Protection Div.
p. Reliable Automatic Sprinkler Co., Inc.
q. Star Sprinkler Inc.
r. Stockham.
s. United Brass Works, Inc.
t. Venus Fire Protection, Ltd.
u. Victaulic Co. of America.
v. Watts Industries, Inc.; Water Products Div.

F. Gate Valves: UL 262, OS&Y type.

1. NPS 2 and Smaller: Bronze body with threaded ends.

a. Available Manufacturers:

1) Crane Co.; Crane Valve Group; Crane Valves.
2) Hammond Valve.
3) NIBCO.
4) United Brass Works, Inc.

2. NPS 2-1/2 and Larger: Cast-iron body with flanged ends.

a. Available Manufacturers:

1) Clow Valve Co.
2) Crane Co.; Crane Valve Group; Crane Valves.
3) Crane Co.; Crane Valve Group; Jenkins Valves.
4) Hammond Valve.
5) Milwaukee Valve Company.
6) Mueller Company.
7) NIBCO.
8) Red-White Valve Corp.
9) United Brass Works, Inc.

G. Indicating Valves: UL 1091, with integral indicating device and ends matching connecting piping.

1. Indicator: Electrical, 115-V ac, prewired, single-circuit, supervisory switch
2. NPS 2 and Smaller: Ball or butterfly valve with bronze body and threaded ends.

a. Available Manufacturers:

1) Milwaukee Valve Company.
2) NIBCO.
3) Victaulic Co. of America.

3. NPS 2-1/2 and Larger: Butterfly valve with cast- or ductile-iron body; wafer type or with flanged or grooved ends.

a. Available Manufacturers:

1) Central Sprinkler Corp.
2) Grinnell Fire Protection.
3) McWane, Inc.; Kennedy Valve Div.
4) Milwaukee Valve Company.
5) NIBCO.
6) Victaulic Co. of America.

2.9 UNLISTED GENERAL-DUTY VALVES

A. Ball Valves NPS 2 and Smaller: MSS SP-110, 2-piece copper-alloy body with chrome-plated brass ball, 600-psig minimum CWP rating, blowout-proof stem, and threaded ends.

B. Check Valves NPS 2 and Smaller: MSS SP-80, Type 4, Class 125 minimum, swing type with bronze body, nonmetallic disc, and threaded ends.

C. Gate Valves NPS 2 and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, solid wedge, and threaded ends.

D. Globe Valves NPS 2 and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, nonmetallic disc, and threaded ends.

2.10 SPECIALTY VALVES

A. Sprinkler System Control Valves: UL listed or FMG approved, cast- or ductile-iron body with flanged or grooved ends, and 175-psig minimum pressure rating. Control valves shall have 250-psig minimum pressure rating if valves are components of high-pressure piping system.

B.

1. Available Manufacturers:

a. AFAC Inc.
b. Central Sprinkler Corp.
c. Firematic Sprinkler Devices, Inc.
d. Globe Fire Sprinkler Corporation.
e. Grinnell Fire Protection.
f. Reliable Automatic Sprinkler Co., Inc.
g. Star Sprinkler Inc.
h. Venus Fire Protection, Ltd.
i. Victaulic Co. of America.
j. Viking Corp.

2. Alarm Check Valves: UL 193, designed for horizontal or vertical installation, with bronze grooved seat with O-ring seals, single-hinge pin, and latch design. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer.

a. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
b. Drip Cup Assembly: Pipe drain with check valve to main drain piping.

2.11 MANUAL CONTROL STATIONS

A. Manual Control Stations: UL listed or FMG approved, hydraulic operation, with union, NPS ½ pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.12 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. Panels contain power supply; battery charger; standby batteries; field-wiring terminal strip; electrically supervised solenoid valves and polarized fire alarm bell; lamp test facility; single-pole, double-throw auxiliary alarm contacts; and rectifier.

1. Panels: UL listed and FMG approved when used with thermal detectors and Class A detector circuit wiring. Electrical characteristics are 120-V ac, 60 Hz, with 24-V dc rechargeable batteries.
2. Manual Control Stations: Electric operation, metal enclosure, labeled "MANUAL CONTROL STATION" with operating instructions and a cover held closed by breakable strut.
3. Manual Control Stations: Hydraulic operation, with union, NPS 1/2 pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut.

2.13 SPRINKLERS

A. Sprinklers shall be UL listed, with 175-psig minimum pressure rating. Sprinklers shall have 250-psig minimum pressure rating if sprinklers are components of high-pressure piping system.

B. Available Manufacturers:

1. AFAC Inc.
2. Central Sprinkler Corp.
3. Firematic Sprinkler Devices, Inc.
4. Globe Fire Sprinkler Corporation.
5. Grinnell Fire Protection.
6. Reliable Automatic Sprinkler Co., Inc.
7. Star Sprinkler Inc.
8. Venus Fire Protection, Ltd.
9. Victaulic Co. of America.
10. Viking Corp.

C. Automatic Sprinklers: With heat-responsive element complying with the following:

1. UL 199, for nonresidential applications.
2. UL 1626, for residential applications.
3. UL 1767, for early-suppression, fast-response applications.

D. Sprinkler Types and Categories: Nominal 1/2-inch orifice for "Ordinary" temperature classification rating, unless otherwise indicated or required by application.

1. Open Sprinklers: UL 199, without heat-responsive element.

a. Orifice: 1/2 inch, with discharge coefficient K between 5.3 and 5.8.

b. Orifice: 17/32 inch, with discharge coefficient K between 7.4 and 8.2.

E. Sprinkler types, features, and options as follows:

1. Concealed ceiling sprinklers, including cover plate.
2. Extended-coverage sprinklers.
3. Flow-control sprinklers, with automatic open and shutoff feature.
4. Flush ceiling sprinklers, including escutcheon.
5. High-pressure sprinklers.
6. Institution sprinklers, made with a small, breakaway projection.
7. Open sprinklers.
8. Pendent sprinklers.
9. Quick-response sprinklers.
10. Recessed sprinklers, including escutcheon.
11. Sidewall sprinklers.
12. Upright sprinklers.

F. Sprinkler Finishes: Chrome plated, bronze, and painted.

G. Special Coatings: Wax, lead, and corrosion-resistant paint.

H. 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: Refer to architectural for finish. One piece, flat.
2. Sidewall Mounting: Refer to architectural for finish. One piece, flat.

I. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler.

2.14 HOSE CONNECTIONS

A. Available Manufacturers:

1. AFAC Inc.
2. Central Sprinkler Corp.
3. Elkhart Brass Mfg. Co., Inc.
4. Fire-End and Croker Corp.
5. Fire Protection Products, Inc.
6. GMR International Equipment Corporation.
7. Grinnell Fire Protection.
8. Guardian Fire Equipment Incorporated.
9. McWane, Inc.; Kennedy Valve Div.
10. Mueller Company.
11. Potter-Roemer; Fire-Protection Div.
12. United Brass Works, Inc.

B. Description: UL 668, brass or bronze, 300-psig minimum pressure rating, hose valve for connecting fire hose. Include angle or gate pattern design; female NPS inlet and male hose outlet; and lugged cap, gasket, and chain. Include NPS 2-1/2 as indicated, and hose valve threads according to NFPA 1963 and matching local fire department threads.

1. Valve Operation: Nonadjustable type.
2. Finish: Rough chrome-plated.

2.15 FIRE DEPARTMENT CONNECTIONS

A. Available Manufacturers:

1. AFAC Inc.
2. Central Sprinkler Corp.
3. Elkhart Brass Mfg. Co., Inc.
4. Fire-End and Croker Corp.
5. Fire Protection Products, Inc.
6. GMR International Equipment Corporation.
7. Guardian Fire Equipment Incorporated.
8. Potter-Roemer; Fire-Protection Div.
9. Reliable Automatic Sprinkler Co., Inc.
10. United Brass Works, Inc.

B. Exposed, Freestanding-Type, Fire Department Connection: UL 405, 175-psig (1200-kPa) minimum pressure rating; with corrosion-resistant-metal body, brass inlets with threads according to NFPA 1963 and matching local fire department sizes and threads, and bottom outlet with pipe threads. Include brass lugged caps, gaskets, and brass chains; brass lugged swivel connection and drop clapper for each hose-connection inlet; 18-inch- (460-mm-) high, brass sleeve; and round, floor, brass escutcheon plate with marking "AUTO SPKR & STANDPIPE."

1. Finish Including Sleeve: Polished chrome-plated.

2.16 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Water-Motor-Operated Alarm: UL 753, mechanical-operation type with pelton-wheel operator with shaft length, bearings, and sleeve to suit wall construction and 10-inch- (250-mm-) diameter, cast-aluminum alarm gong with red-enamel factory finish. Include NPS 3/4 (DN 20) inlet and NPS 1 drain connections.

1. Available Manufacturers:

a. AFAC Inc.
b. Central Sprinkler Corp.
c. Firematic Sprinkler Devices, Inc.
d. Globe Fire Sprinkler Corporation.
e. Grinnell Fire Protection.
f. Reliable Automatic Sprinkler Co., Inc.
g. Star Sprinkler Inc.
h. Viking Corp.

C. Electrically Operated Alarm: UL 464, with 8-inch-minimum-diameter, vibrating-type, metal alarm bell with red-enamel factory finish and suitable for outdoor use.

1. Available Manufacturers:

a. Potter Electric Signal Company.
b. System Sensor.

D. Water-Flow Indicator: UL 346, electrical-supervision, paddle-operated-type, water-flow detector with 250-psig pressure rating and designed for horizontal or vertical installation. Include 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.

1. Available Manufacturers:

    a. ADT Security Services, Inc.
    b. Grinnell Fire Protection.
    c. ITT McDonnell & Miller.
    d. Potter Electric Signal Company.
    e. System Sensor.
    f. Viking Corp.
    g. Watts Industries, Inc.; Water Products Div.

E. Pressure Switch: UL 753, electrical-supervision-type, water-flow switch with retard feature. Include single-pole, double-throw, normally closed contacts and design that operates on rising pressure and signals water flow.

1. Available Manufacturers:

    a. Grinnell Fire Protection.
    b. Potter Electric Signal Company.
    c. System Sensor.
    d. Viking Corp.

F. 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.

1. Available Manufacturers:

    a. McWane, Inc.; Kennedy Valve Div.
    b. Potter Electric Signal Company.
    c. System Sensor.

G. Indicator-Post Supervisory Switch: UL 753, electrical, single-pole, double-throw switch with normally closed contacts. Include design that signals controlled indicator-post valve is in other than fully open position.

1. Available Manufacturers:

    a. Potter Electric Signal Company.
    b. System Sensor.

2.17 PRESSURE GAGES

A. Available Manufacturers:

1. AGF Manufacturing Co.
2. AMETEK, Inc.; U.S. Gauge.
3. Brecco Corporation.
4. Dresser Equipment Group; Instrument Div.
5. Marsh Bellofram.
6. WIKA Instrument Corporation.

B. Description: UL 393, 3-1/2- to 4-1/2-inch-diameter, dial pressure gage with range of 0 to 250 psig minimum

1. Water System Piping: Include caption "WATER" on dial face.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13, NFPA 14, and NFPA 291. Use results for system design calculations required in Part 1 "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 EARTHWORK

A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.3 EXAMINATION

A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.

B. Examine walls and partitions for suitable thicknesses, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.4 PIPING APPLICATIONS, GENERAL

A. Shop weld pipe joints where welded piping is indicated.

B. Do not use welded joints for galvanized-steel pipe.

C. Flanges, flanged fittings, unions, nipples, and transition and special fittings with finish and pressure ratings same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.

D. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

E. Underground Service-Entrance Piping: Ductile-iron, mechanical-joint pipe and fittings and restrained joints. Include corrosion-protective encasement.

3.5 STANDPIPE SYSTEM PIPING APPLICATIONS

A. Standard-Pressure and high pressure, Wet-and Dry Type Standpipe System, 175 to 250-psig Maximum Working Pressure:
   1. NPS 4 and Smaller: Plain-end, black, standard-weight steel pipe; steel welding fittings; and welded joints.
   2. NPS 4 and Smaller: Grooved-end, galvanized, standard-weight steel pipe with roll-grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
   3. NPS 4 and Smaller: Plain-end, Schedule 10 steel pipe; steel welding fittings; and welded joints.

4. NPS 4 and Smaller: Grooved-end, Schedule 10 steel pipe; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
5. NPS 6 and up: Plain-end, black, standard-weight steel pipe; steel welding fittings; and welded joints.
6. NPS 6 and up: Grooved-end, galvanized, standard-weight steel pipe with roll-grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
7. NPS 6 and up: Plain-end, Schedule 10 steel pipe; steel welding fittings; and welded joints.
8. NPS 6 and up: Grooved-end, Schedule 10 steel pipe; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

3.6 SPRINKLER SYSTEM PIPING APPLICATIONS

A. Standard and High Pressure, Wet-Pipe Sprinkler System, 175-psig to 250 psig Maximum Working Pressure:

1. Sprinkler-Piping Fitting Option: Specialty sprinkler fittings, NPS 2 and smaller, including mechanical-T and -cross fittings, may be used downstream from sprinkler zone valves.
2. Copper-Tube Fitting Option: Copper, mechanically formed tee branches NPS 2 and smaller, with brazed joints, may be used downstream from sprinkler zone valves. Comply with schedule tube and branch sizes listed in UL's "Fire Protection Equipment Directory."
3. NPS 1-1/2 and Smaller: Threaded-end, black or galvanized, standard-weight steel pipe; cast- or malleable-iron threaded fittings; and threaded joints.
4. NPS 1-1/2 and Smaller: Plain-end, black, standard-weight steel pipe; steel welding fittings; and welded joints.
5. NPS 1-1/2 and Smaller: Plain-end, Schedule 10 steel pipe; steel welding fittings; and welded joints.
6. NPS 2 and up: Threaded-end, black or galvanized, standard-weight steel pipe; cast- or malleable-iron threaded fittings; and threaded joints.
7. NPS 2 and up: Plain-end, black, standard-weight steel pipe; steel welding fittings; and welded joints.
8. NPS 2 and up: Grooved-end, black or galvanized, standard-weight steel pipe; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
9. NPS 2 and up: Plain-end, Schedule 10 steel pipe; steel welding fittings; and welded joints.
10. NPS 2 and up: Grooved-end, Schedule 10 steel pipe; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
11. grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

3.7 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Listed Fire-Protection Valves: UL listed and FMG approved for applications where required by NFPA 13 and NFPA 14.

    a. Shutoff Duty: Use ball, butterfly, or gate valves.

2. Unlisted General-Duty Valves: For applications where UL-listed and FMG-approved valves are not required by NFPA 13 and NFPA 14.

    a. Shutoff Duty: Use ball, butterfly, or gate valves.
    b. Throttling Duty: Use ball or globe valves.

3.8 JOINT CONSTRUCTION

A. Refer to Division 21 Section "Common Work Results for Fire Suppression" for basic piping joint construction.

B. Threaded Joints: Comply with NFPA 13 for pipe thickness and threads. Do not thread pipe smaller than NPS 8 with wall thickness less than Schedule 40 unless approved by authorities having jurisdiction and threads are checked by a ring gage and comply with ASME B1.20.1.

C. Pressure-Sealed Joints: Use UL-listed tool and procedure. Include use of specific equipment, pressure-sealing tool, and accessories.

D. Mechanically Formed, Copper-Tube-Outlet Joints: Use UL-listed tool and procedure. Drill pilot hole in copper tube, form branch for collar, dimple tube to form seating stop, and braze branch tube into formed-collar outlet.

E. Grooved Joints: Assemble joints with listed coupling and gasket, lubricant, and bolts.

1. Ductile-Iron Pipe: Radius-cut-groove ends of piping. Use grooved-end fittings and grooved-end-pipe couplings.
2. Steel Pipe: Square-cut or roll-groove piping as indicated. Use grooved-end fittings and rigid, grooved-end-pipe couplings, unless otherwise indicated.
3. Copper Tube: Roll-groove tubing. Use grooved-end fittings and grooved-end-tube couplings.

F. Dissimilar-Metal Piping Joints: Construct joints using dielectric fittings compatible with both piping materials.

1. NPS 2 and Smaller: Use dielectric unions, couplings, or nipples.
2. NPS 2-1/2 to NPS 4: Use dielectric flanges.
3. NPS 5 and Larger: Use dielectric flange insulation kits.

3.9 SERVICE-ENTRANCE PIPING

A. Connect fire-suppression piping to water-service piping of size and in location indicated for service entrance to building. Refer to Division 22 Section "Facility Water Distribution 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.

3.10 WATER-SUPPLY CONNECTION

A. Connect fire-suppression piping to building's interior water distribution piping. Refer to Division 22 Section "Domestic Water Piping" for interior piping.

B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water distribution piping. Refer to Division 22 Section "Domestic Water Piping Specialties" for backflow preventers.

C. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

3.11 PIPING INSTALLATION

A. Refer to Division 21 Section "Common Work Results for Fire Suppression" for basic piping installation.

B. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

C. Install underground ductile-iron service-entrance piping according to NFPA 24 and with restrained joints.

D. Install underground copper service-entrance piping according to NFPA 24.

E. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

F. Install unions adjacent to each valve in pipes NPS 2 and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.

G. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 and larger connections.

H. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, sized and located according to NFPA 13.

I. Install sprinkler piping with drains for complete system drainage.

J. Install sprinkler zone control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

K. Install drain valves on standpipes.

L. Install ball drip valves to drain piping between fire department connections and check valves. Drain to floor drain or outside building.

M. Install alarm devices in piping systems.

N. Hangers and Supports: Comply with NFPA 13 for hanger materials.

1. Install standpipe system piping according to NFPA 14.
2. Install sprinkler system piping according to NFPA 13.

O. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

P. Fill wet-standpipe system piping with water.

Q. Fill wet-pipe sprinkler system piping with water.

R. Install flexible connectors on fire-pump and pressure-maintenance-pump supply and discharge connections and in fire-suppression piping where indicated.

3.12 VALVE INSTALLATION

A. Install listed fire-protection valves, unlisted general-duty valves, specialty valves and trim, controls, and specialties according to NFPA 13 and NFPA 14 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. Valves for Wall-Type Fire Hydrants: Install nonrising-stem gate valve in water-supply pipe.

D. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water supply sources.

E. Specialty Valves:

1. Alarm Check Valves: Install in vertical position for proper direction of flow, including bypass check valve and retarding chamber drain-line connection.

3.13 SPRINKLER APPLICATIONS

A. To be laid out by the sprinkler Contractor and approved by the Architect prior to purchasing or installation.

3.14 SPRINKLER INSTALLATION

A. Coordinate sprinkler locations and type closely with architect and engineer.

3.15 HOSE-CONNECTION INSTALLATION

A. Install hose connections adjacent to standpipes, unless otherwise indicated.

B. Install freestanding hose connections for access and minimum passage restriction.

C. Install NPS 2-1/2 hose connections with quick-disconnect NPS 2-1/2 by NPS 1-1/2 reducer adapter and flow-restricting device, unless otherwise indicated.

D. Install wall-mounting-type hose connections in cabinets. Include pipe escutcheons, with finish matching valves, inside cabinet where water-supply piping penetrates cabinet. Install valves at angle required for connection of fire hose. Refer to Division 10 Section "Fire Extinguisher Cabinets" for cabinets.

3.16 FIRE DEPARTMENT CONNECTION INSTALLATION

A. Install freestanding-type, fire department connections in level surface.

1. Install protective pipe bollards on two sides of each fire department connection. Refer to Division 05 Section "Metal Fabrications" for pipe bollards.

B. Install ball drip valve at each check valve for fire department connection.

3.17 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Connect water-supply piping to fire-suppression piping. Include backflow preventer between potable-water piping and fire-suppression piping. Refer to Division 22 Section "Domestic Water Piping Specialties" for backflow preventers.

D. Install ball drip valves at each check valve for fire department connection. Drain to floor drain or outside building.

E. Connect piping to specialty valves, hose valves, specialties, fire department connections, and accessories.

F. Connect excess-pressure pumps to the following piping and wiring:

1. Sprinkler system, hydraulically.
2. Pressure gages and controls, hydraulically.
3. Electrical power system.
4. Alarm device accessories for pump.
5. Fire alarm.

G. Electrical Connections: Power wiring is specified in Division 26.

H. Connect alarm devices to fire alarm.

I. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

J. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

K. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.18 LABELING AND IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and NFPA 14.

3.19 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Energize circuits to electrical equipment and devices.
4. Start and run excess-pressure pumps.
5. Start and run air compressors.
6. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
7. Flush, test, and inspect standpipe systems according to NFPA 14, "System Acceptance" Chapter.
8. Coordinate with fire alarm tests. Operate as required.
9. Coordinate with fire-pump tests. Operate as required.
10. Verify that equipment hose threads are same as local fire department equipment.

B. Report test results promptly and in writing to Architect and authorities having jurisdiction.

3.20 CLEANING AND PROTECTION

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

C. Protect sprinklers from damage until Substantial Completion.

3.21 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves. Refer to Division 01 Section "Demonstration and Training."

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SECTION 21 31 13

ELECTRIC-DRIVE, CENTRIFUGAL FIRE 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. This Section includes electric-drive, split-case centrifugal fire pumps and the following:

1. Full-service fire-pump controllers and automatic transfer switches.
2. Fire-pump accessories and specialties.
3. Pressure-maintenance pumps, controllers, accessories, and specialties.
4. Alarm panels.
5. Flowmeter systems.

1.3 PERFORMANCE REQUIREMENTS

A. Pump, Equipment, Accessory, Specialty, and Piping Pressure Rating: 175-psig minimum working-pressure rating, unless otherwise indicated.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, certified pump performance curves with each selection point indicated, operating characteristics, and furnished accessories and specialties for each fire pump and pressure-maintenance pump.

B. Shop Drawings: For fire pumps and drivers, fire-pump controllers, fire-pump accessories and specialties, pressure-maintenance pumps, pressure-maintenance-pump controllers, and pressure-maintenance-pump accessories and specialties. Include plans, elevations, sections, details, and attachments to other work.

1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
2. Wiring Diagrams: Power, signal, and control wiring.

C. Product Certificates: For each type of fire pump and fire-pump controller, signed by product manufacturer.

D. Source quality-control test reports.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For fire pumps and drivers, pressure-maintenance pumps, controllers, accessories and specialties, alarm panels, and flowmeter systems to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain fire pumps, pressure-maintenance pumps, and controllers through one source from a single manufacturer for each type of equipment.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of fire pumps, pressure-maintenance pumps, and controllers and are based on specific systems indicated. Refer to Division 01 Section "Product Requirements."

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with standards of authorities having jurisdiction pertaining to materials, hose threads, and installation.

E. Comply with NFPA 20, "Stationary Pumps for Fire Protection," for fire pumps, drivers, controllers, accessories, and their installation.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 CENTRIFUGAL FIRE PUMPS

A. Description, General: UL 448, factory-assembled and -tested, electric-drive, centrifugal fire pumps capable of furnishing not less than 150 percent of rated capacity at not less than 65 percent of total rated head and with shutoff head limited to 140 percent of total rated head.

1. Finish: Manufacturer's standard red paint applied to factory-assembled and -tested unit before shipping.
2. Nameplate: Complete with capacities, characteristics, and other pertinent data.

B. Fabricate base and attachment to fire pumps, pressure-maintenance pumps, and controllers with reinforcement to resist movement of pumps and controllers during a seismic event when their bases are anchored to building structure.

C. Single-Stage, Horizontally Mounted, Split-Case Fire Pumps: Single-suction type with pump and driver mounted on same base and connected with coupling.

1. Available Manufacturers:

a. A-C Pump; ITT Industries.
b. Armstrong Darling, Inc.
c. Aurora Pump; Pentair Pump Group.
d. Fairbanks Morse; Pentair Pump Group.
e. Paco Pumps, Inc.
f. Patterson Pump Company.
g. Reddy-Buffaloes Pump Co.
h. Sterling Peerless Pump; Sterling Fluid Systems Group.

2. Pump: Axially split cast-iron casing with suction and discharge flanges machined to ASME B16.1, Class 125 dimensions, unless otherwise indicated.

a. Impeller: Cast bronze of construction to match fire pump, statically and dynamically balanced, and keyed to shaft.
b. Wear Rings: Replaceable, bronze.
c. Shaft and Sleeve: Steel shaft with bronze sleeve.

1) Shaft Bearings: Grease-lubricated ball bearings in cast-iron housing.
2) Seals: Stuffing box with minimum of four rings of graphite-impregnated braided yarn and bronze packing gland.

3. Coupling: Flexible and capable of absorbing torsional vibration and shaft misalignment. Include metal coupling guard.
4. Driver: UL-listed, NEMA MG 1, open-dripproof, squirrel-cage, induction motor complying with NFPA 20 and NFPA 70. Include wiring compatible with controller used.

a. Available Manufacturers:

1) Emerson; U.S. Electrical Motors.
2) Lincoln Electric Company (The).
3) Marathon Electric, Inc.

D. Fire-Pump Characteristics and Specialty Data: To be sized by fire sprinkler contractor.

2.3 FIRE-PUMP CONTROLLERS

A. Fire-Pump Controllers, General: UL 218 and NFPA 20; listed for electric-drive, fire-pump service and service entrance; combined automatic and manual operation; factory assembled and wired; and factory tested for capacities and electrical characteristics.

1. Available Manufacturers:

a. Cutler-Hammer.
b. Firetrol, Inc.
c. Hubbell Industrial Controls, Inc.
d. Joslyn Clark.
e. Master Control Systems, Inc.

f. Metron, Inc.

2. Rate controllers for scheduled fire-pump horsepower and short-circuit withstand rating at least equal to short-circuit current available at controller location. Take into account cable size and distance from substation or supply transformers.
3. Enclosure: UL 50, Type 2, dripproof, indoor, unless special-purpose enclosure is indicated. Include manufacturer's standard red paint applied to factory-assembled and -tested unit before shipping.
4. Controls, devices, alarms, functions, and operations listed in NFPA 20 as required for drivers and controller types used, and specific items listed.

    a. Isolating means and circuit breaker.
    b. "Power on" pilot lamp.
    c. Fire-alarm system connections for indicating motor running condition, loss-of-line power, and line-power phase reversal.
    d. Automatic and manual operation, and minimum run-time relay to prevent short cycling.
    e. Water-pressure-actuated switch with independent high and low calibrated adjustments responsive to water pressure in fire-suppression piping.
    f. Automatic and manual shutdown.
    g. System pressure recorder, electric ac driven with spring backup.

5. Nameplate: Complete with capacity, characteristics, approvals and listings, and other pertinent data.
6. Controller Sensing Pipes: Fabricate pipe and fittings according to NFPA 20 with nonferrous-metal sensing piping, NPS 1/2, with globe valves for testing controller mechanism from system to pump controller as indicated. Include bronze check valve with 3/32-inch orifice in clapper or ground-face union with noncorrosive diaphragm having 3/32-inch orifice.

B. Full-Service Fire-Pump Controllers:

1. Type Starting: Wye delta, closed transition.
2. Mounting: Floor-stand type for field electrical connections.
3. Automatic Transfer Switches: UL 218 and UL 1008 and requirements for and attached to fire-pump controllers. Include enclosure complying with UL 50, Type 2, with automatic transfer switch with rating at least equal to fire-pump driver-motor horsepower. Include ampere rating not less than 115 percent of motor full-load current and suitable for switching motor-locked rotor current.

C. Limited-Service Fire-Pump Controllers:

1. Type Starting: Across the line.
2. Mounting: Wall type.

2.4 FIRE-PUMP ACCESSORIES AND SPECIALTIES

A. Match fire-pump suction and discharge ratings as required for fire-pump capacity rating. Include the following:

1. Automatic air-release valve.
2. Circulation relief valve.
3. Suction and discharge pressure gages.
4. Eccentric-tapered reducer at suction inlet.
5. Concentric-tapered reducer at discharge outlet.
6. Test-Header Manifold: Ductile-iron or brass body for hose valves. Include nozzle outlets arranged in single line; horizontal, flush-wall mounting attachment; and rectangular, polished chrome-plated brass finish escutcheon plate with lettering equivalent to "PUMP TEST CONNECTION."

7. Test-Header Manifold: Ferrous body for hose valves. Manufacturer's standard finish. Include bronze or cast-iron, exposed-type valve header with nozzle outlets; and round, brass escutcheon plate with lettering equivalent to "PUMP TEST CONNECTION."
8. Hose Valves: UL 668, straightway pattern, and bronze with cap and chain. Include NFPA 1963 hose thread that complies with local fire department standards and finish same as for test-header-manifold escutcheon plate.
9. Ball Drip Valve: UL 1726.
10. Main Relief Valve: UL 1478, spring loaded.
11. Discharge Cone: Open type.
12. Finish: Manufacturer's standard factory-applied red paint unless brass or other finish is specified.

2.5 PRESSURE-MAINTENANCE PUMPS

A. Pressure-Maintenance Pumps, General: Factory-assembled and -tested pumps with electric-motor driver, controller, and accessories and specialties. Include cast-iron or stainless-steel casing and bronze or stainless-steel impellers, mechanical seals, and suction and discharge flanges machined to ASME B16.1, Class 125 dimensions unless Class 250 flanges are indicated and except that connections may be threaded in sizes where flanges are not available.

1. Finish: Manufacturer's standard color paint applied to factory-assembled and -tested unit before shipping.
2. Nameplate: Complete with capacity, characteristics, and other pertinent data.

B. Multistage, Pressure-Maintenance Pumps: Multiple-impeller type complying with HI 1.1-1.2 and HI 1.3 requirements for multistage centrifugal pumps. Include base.

1. Available Manufacturers:

    a. A-C Pump; ITT Industries.
    b. Grundfos Pumps Corp.
    c. Jacuzzi Brothers.
    d. Paco Pumps, Inc.
    e. Sterling Peerless Pump; Sterling Fluid Systems Group.
    f. Taco, Inc.

2. Driver: NEMA MG 1, open-dripproof, squirrel-cage, induction motor complying with NFPA 20 and NFPA 70. Include wiring compatible with controller used.

C. Regenerative-Turbine, Pressure-Maintenance Pumps: Close-coupled type complying with HI 1.1-1.2 and HI 1.3 requirements for regenerative-turbine centrifugal pumps. Include base.

1. Available Manufacturers:

    a. Aurora Pump; Pentair Pump Group.
    b. Crane Pumps & Systems, Inc.
    c. Fairbanks Morse; Pentair Pump Group.
    d. MTH Tool Co., Inc.
    e. Paco Pumps, Inc.

2. Driver: NEMA MG 1, open-dripproof, squirrel-cage, induction motor complying with NFPA 20 and NFPA 70. Include wiring compatible with controller used.

D. Controllers: UL 508; factory-assembled, -wired, and -tested, across-the-line type for combined automatic and manual operation.

1. Available Manufacturers:

a. Cutler-Hammer.
b. Firetrol, Inc.
c. Hubbell Industrial Controls, Inc.
d. Joslyn Clark.
e. Master Control Systems, Inc.
f. Metron, Inc.

2. Enclosure: UL 508 and NEMA 250, Type 2, wall-mounting type for field electrical wiring.

a. Finish: Manufacturer's standard color paint applied to factory-assembled and -tested unit before shipping.

3. Rate controller for scheduled horsepower and include the following:

a. Fusible disconnect switch.
b. Pressure switch.
c. Hand-off-auto selector switch.
d. Pilot light.
e. Running period timer.

E. Accessories and Specialties: Match pressure-maintenance-pump suction and discharge ratings as required for pump capacity rating. Include the following:

1. Circulation relief valve.
2. Suction and discharge pressure gages.

F. Pressure-Maintenance-Pump Characteristics and Specialty Data: To be sized by fire sprinkler contractor.

2.6 ALARM PANELS

A. Description: Factory-assembled and -wired remote panel complying with UL 508 and requirements in NFPA 20. Include audible and visible alarms matching controller type.

1. Available Manufacturers:

a. Cutler-Hammer.
b. Firetrol, Inc.
c. Hubbell Industrial Controls, Inc.
d. Joslyn Clark.
e. Master Control Systems, Inc.
f. Metron, Inc.

2. Enclosure: NEMA 250, Type 2, remote wall-mounting type.

a. Finish: Manufacturer's standard red paint applied to factory-assembled and -tested unit before shipping.

3. Features: Include manufacturer's standard features and the following:

    a. Motor-operating condition.
    b. Loss-of-line power.
    c. Phase reversal.
    d. Low-water alarm.

2.7 FLOWMETER SYSTEMS

A. Description: Fire-pump flowmeter system that indicates flow to not less than 175 percent of fire-pump rated capacity. Include sensor of size to match pipe, tubing, flowmeter, and fittings.

1. Available UL-Listed Manufacturers:

    a. Fire Research Corp.
    b. Reddy-Buffaloes Pump Co.

2. Pressure Rating: 175-psig minimum.
3. Sensor: Venturi, annubar probe, or orifice plate, unless otherwise indicated.
4. Flowmeter: Compatible with flow sensor with dial not less than 4-1/2 inches in diameter or manufacturer's equivalent size.
5. Permanently Mounted Flowmeter: Suitable for wall mounting with copper tubing to connect to flow sensor.
6. Portable Flowmeter: With two 12-foot hoses, in carrying case.

2.8 PRESSURE GAGES

A. Description: UL 393, 3-1/2- to 4-1/2-inch diameter dial with range of 0- to 300-psig minimum. Include caption "WATER" on dial face.

1. Available Manufacturers:

    a. AGF Manufacturing Co.
    b. AMETEK, Inc.; U.S. Gauge.
    c. Brecco Corporation.
    d. Dresser Equipment Group; Instruments Div.
    e. Marsh Bellofram.
    f. WIKA Instrument Corporation.

2.9 GROUT

A. Description: 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.

2.10 SOURCE QUALITY CONTROL

A. Test and inspect fire pumps with their controllers according to NFPA 20 for certified shop tests.

B. Verification of Performance: Rate fire pumps according to requirements indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, concrete bases, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of fire pumps. Coordinate location of concrete base and fire pump system with all other disciplines.

B. Examine roughing-in for fire-suppression piping to verify actual locations of piping connections before fire-pump installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CONCRETE BASES: Must be approved in writing by registered structural engineer.

A. Install concrete bases of dimensions indicated for fire pumps, pressure-maintenance pumps, and controllers. Refer to Division 21 Section "Common Work Results for Fire Suppression."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of base.
2. For supported equipment, 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.

B. Cast-in-place concrete materials and placement requirements are specified in Division 03.

3.3 INSTALLATION

A. Install and align fire pump, pressure-maintenance pump, and controller according to NFPA 20.

B. Install pumps and controllers to provide access for periodic maintenance including removal of motors, impellers, couplings, and accessories.

C. Set base-mounting-type pumps on concrete bases. Disconnect coupling halves before setting. Do not reconnect couplings until alignment operations have been completed.

1. Support pump baseplate on rectangular metal blocks and shims or on metal wedges having small taper, at points near anchor bolts, to provide 3/4- to 1-1/2-inch gap between pump base and concrete base for grouting.
2. Adjust metal supports or wedges until pump and driver shafts are level. Verify that coupling faces and pump suction and discharge flanges are level and plumb.

D. Install suction and discharge piping equal to or greater than diameter of fire-pump nozzles.

E. Install valves that are same size as piping connecting fire pumps, bypasses, test headers, and other piping systems.

F. Install pressure gages on fire-pump suction and discharge at pressure-gage tappings.

G. Support pumps and piping separately so weight of piping does not rest on pumps.

H. Install piping accessories, hangers and supports, anchors, valves, meters and gages, and equipment supports.

I. Install flowmeters and sensors where indicated. Install flowmeter-system components and make connections according to manufacturer's written instructions.

J. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted. Furnish copies of manufacturers' wiring diagram submittals to electrical Installer.

3.4 CONNECTIONS

A. Piping installation requirements are specified in Division 21 Section "Water-Based Fire-Suppression Systems." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to pumps and equipment to allow service and maintenance.

C. Connect water supply and discharge piping to fire pumps with flexible connectors. Connect water supply and discharge piping to pressure-maintenance pumps with flexible connectors. Refer to Division 21 Section "Water-Based Fire-Suppression Systems" for flexible connectors.

D. Connect relief-valve discharge to point of disposal.

E. Connect flowmeter-system sensors and meters according to manufacturer's written instructions.

F. Connect controllers to pumps.

G. Connect fire-pump controllers to building fire-alarm system. Refer to Division 28 Section "Fire Detection and Alarm."

H. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

I. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.5 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 field tests for each fire pump when installation is complete. Comply with operating instructions and procedures in NFPA 20 to demonstrate compliance with requirements. Where possible, field correct malfunctioning equipment, then retest to demonstrate compliance. Replace equipment that cannot be

satisfactorily corrected or that does not perform as indicated, then retest to demonstrate compliance. Verify that each fire pump performs as indicated.

C. Perform the following field tests and inspections and prepare test reports:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Final Checks before Startup: Perform the following preventive-maintenance operations and checks:

    a. Lubricate oil-lubrication-type bearings.
    b. Remove grease-lubrication-type bearing covers, flush bearings with kerosene, and clean thoroughly. Fill with new lubricant according to manufacturer's written instructions.
    c. Disconnect coupling and check electric motor for proper rotation. Rotation shall match direction of rotation marked on pump casing.
    d. Verify that pump is free to rotate by hand. If pump is bound or if it drags even slightly, do not operate until cause of trouble is determined and corrected.

3. Starting procedure for pumps is as follows:

    a. Prime pump by opening suction valve and closing drains, and prepare pump for operation.
    b. Open sealing-liquid supply valves if pump is so fitted.
    c. Start motor.
    d. Open discharge valve slowly.
    e. Observe leakage from stuffing boxes and adjust sealing-liquid valve for proper flow to ensure lubrication of packing. Do not tighten gland immediately, but let packing run in before reducing leakage through stuffing boxes.
    f. Check general mechanical operation of pump and motor.

4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
5. Furnish fire hoses in number, size, and length required to reach storm drain or other acceptable location to dispose of fire-pump test water. Fire hoses are for field-acceptance tests only and are not property of Owner.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire pumps, drivers, controllers, and pressure-maintenance pumps. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 21 3113

SECTION 22 0500

COMMON WORK RESULTS FOR PLUMBING

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. Piping materials and installation instructions common to most piping systems.
2. Transition fittings.
3. Dielectric fittings.
4. Mechanical sleeve seals.
5. Sleeves.
6. Escutcheons.
7. Grout.
8. Plumbing demolition.
9. Equipment installation requirements common to equipment sections.
10. Painting and finishing.
11. Concrete bases.
12. Supports and anchorages.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.

2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PE: Polyethylene plastic.
4. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes 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. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

1.8 AS-BUILT DRAWINGS

A. DEFINITIONS

1. Contractor Markups – Drawings that are marked and annotated to show the project As-Built and constructed by the contractor. They are part of the working as-built set.
2. As-Built Drawings – The amended “As-designed” drawing revised to show the project as the contractor built and constructed it. The revisions from Contractor Markups and field inspection notes are transferred to the Final as-built set of drawings. The final as-built drawings include modifications during construction, field requested changes, shop drawing modifications, and contractor designs,

B. DESCRIPTION OF WORK

Section includes: Administrative and procedural requirements for as-built process for contractor to follow.

C. RECORD DOCUMENT SUBMITTALS

Record As-Built Drawings: General Contractor shall maintain on-site 2 sets of as-built Contract Drawings, in Contractor Field Office. Working as-built drawings shall be kept current on a weekly basis and at least one paper set of as-built drawings shall be available on the jobsite at all times. Note that MEPCE will not provide plumbing CAD files to the Contractor.

a. Changes to Drawings, including those that involve only narrative, shall be clearly and neatly marked in red pen or pencil, and shall be noted on appropriate drawings. Changes to the Contract Drawings include:

1. Changes to material or equipment for substitutions approved through the Architect/Engineer’s submittal process.
2. Where contract drawings or specifications show options or alternates, only the option selected for construction shall be shown on the final as-built prints. Cross out such words and phrases as “approved equal” and list specifically the material provided. This shall include actual make and model number of equipment installed, as well as voltage and MCA.
3. Shop drawing information.
4. RFIs and Change Order information.
5. Changes made by the Inspector to accommodate field conditions.
6. Actual location, kinds and sizes of all existing and new utility lines, especially underground lines within the construction area. Measurements shall be shown for all change of direction points and all surface or underground components such as valves, manholes, drop inlets, clean outs, meters, etc.
7. Changes in location of equipment and architectural features.
8. Systems designed or enhanced by the Contractor, such as HVAC controls, fire alarm, fire sprinkler and irrigation systems.
9. All construction changes that result from the final inspection.

b. General Contractor shall note each entry with a notation referencing source of information (Example: RFI #94, CO #3, or field notes of same).
   1. As-built record drawings shall be updated no less frequently than once per week.
   2. Verification of current as-built record drawing status is included in the monthly payment approval process that shall be noted in the inspector's log notes.
   3. Individual(s) responsible for the verification of the as-built process shall be identified to the Architect/Engineer.

c. When completed, scanned pdf copies of the as-built drawings shall be sent to the Owner and Architect/Engineer for final approval. Compliance and delivery of the final as-built drawings will be enforced through the approval of progress payments. The quality of the final as-built drawings will be reflected in the construction contractor's performance evaluation.

D. MARK-UP GUIDELINE

The following information is provided to improve the quality of the marked-up prints and thereby facilitate preparation of final as-built drawings. The most important guideline is that the marked-up changes on the prints shall be complete and understandable.

1. Frequently use written explanation on As-Built drawings to describe changes. Do not rely totally on graphic means to convey the revision.
2. Legibility of lettering and digit values shall be clean and clear and readable from a scanned copy.
3. Whenever a revision is made, make changes to affect related section views, details, legend, plans and elevation view, schedules, notes and call-out designations, and mark accordingly to avoid conflicting data on all other sheets.
4. When changes are required on small-scale drawings or on drawings with limited area available, large-scale inserts shall be drawn or sketched, with leaders to the location where applicable.
5. When attached prints (or sketches) are provided with marked-up print, indicate whether:
   a. Entire drawing shall be added to contract drawings or
   b. Whether the contract drawings shall be changed to agree, or
   c. For reference only to further details not required for initial design.
6. Make the comments on the drawing complete without reference to letters, memo's or materials that are not also a part of the As-Built. For instance, do not just say, "As per Change Order #12", when the actual change order states, "Changed water pipe from 2-1/2" to 3". This also applies for changes as per the Architect/Engineer, Owner or Inspector.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for 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, the manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. Solvent Cements for Joining Plastic Piping:

1. ABS Piping: ASTM D 2235.
2. CPVC Piping: ASTM F 493.
3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
4. PVC to ABS Piping Transition: ASTM D 3138.

I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.4 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

1. Available Manufacturers:

a. Cascade Waterworks Mfg. Co.
b. Dresser Industries, Inc.; DMD Div.
c. Ford Meter Box Company, Incorporated; Pipe Products Div.
d. JCM Industries.
e. Smith-Blair, Inc.

f. Viking Johnson.
g. Or approved equal.

2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
3. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
4. Aboveground Pressure Piping: Pipe fitting.

B. Plastic-to-Metal Transition Fittings: CPVC and/or PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

1. Available Manufacturers:

a. Eslon Thermoplastics.
b. Or approved equal.

C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

1. Available Manufacturers:

a. Thompson Plastics, Inc.
b. Or approved equal.

D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and/or PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.

1. Available Manufacturers:

a. NIBCO INC.
b. NIBCO, Inc.; Chemtrol Div.
c. Or approved equal.

E. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

1. Available Manufacturers:

a. Cascade Waterworks Mfg. Co.
b. Fernco, Inc.
c. Mission Rubber Company.
d. Plastic Oddities, Inc.
e. Or approved equal.

2.5 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

1. Available Manufacturers:

a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Eclipse, Inc.
d. Epco Sales, Inc.
e. Hart Industries, International, Inc.
f. Watts Industries, Inc.; Water Products Div.
g. Zurn Industries, Inc.; Wilkins Div.
h. Or approved equal

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

1. Available Manufacturers:

a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Epco Sales, Inc.
d. Watts Industries, Inc.; Water Products Div.
e. Or approved equal.

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Available Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.
e. Or approved equal.

2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

1. Available Manufacturers:

a. Calpico, Inc.
b. Lochinvar Corp.
c. Or approved equal.

G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F.

1. Available Manufacturers:

a. Perfection Corp.
b. Precision Plumbing Products, Inc.
c. Sioux Chief Manufacturing Co., Inc.
d. Victaulic Co. of America.
e. Or approved equal.

2.6 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Available Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.
e. Or approved equal.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Carbon or Stainless steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating or Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.

F. PVC Pipe: ASTM D 1785, Schedule 40.

G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.8 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.

1. Finish: Polished chrome-plated.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

1. Finish: Polished chrome-plated and rough brass.

E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.

F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.

G. One-Piece, Floor-Plate Type: Cast-iron floor plate.

H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.9 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.

B. 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 Coordination Drawings.

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 to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:

    a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
    c. Insulated Piping: One-piece, stamped-steel type with spring clips.
    d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
    f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
    g. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.
    h. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
    i. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

M. Sleeves are not required for core-drilled holes.

N. Permanent sleeves are not required for holes formed by removable PE sleeves.

O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

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. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

    a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
    b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
    c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.

        1) Seal space outside of sleeve fittings with grout.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using 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.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.

2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

T. Verify final equipment locations for roughing-in.

U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. 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 unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic 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. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
5. PVC Nonpressure Piping: Join according to ASTM D 2855.
6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.3 PIPING CONNECTIONS

A. 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. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.5 PAINTING

A. Painting of plumbing systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
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 the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's 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 anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete or Miscellaneous Cast-in-Place Concrete."

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.8 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.9 GROUTING

A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 22 0500

SECTION 22 0519

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. Thermometers.
2. Gages.
3. Test plugs.

B. Related Sections:
1. Division 22 Section "Domestic Water Piping" for domestic and fire-protection water service meters inside the building.
2. Division 23 Section "Facility Natural-Gas Piping" for gas meters.

1.3 DEFINITIONS

A. CR: Chlorosulfonated polyethylene synthetic rubber.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated; include performance curves.

B. Shop Drawings: Schedule for thermometers and gages indicating manufacturer's number, scale range, and location for each.

C. Product Certificates: For each type of thermometer and gage, signed by product manufacturer.

PART 2 - PRODUCTS

2.1 DIRECT-MOUNTING, VAPOR-ACTUATED DIAL THERMOMETERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:

1. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
2. Trerice, H. O. Co.
3. Weiss Instruments, Inc.
4. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
5. Or approved equal.

B. Case: Dry type, drawn steel or cast aluminum, 4-1/2-inch diameter.

C. Element: Bourdon tube or other type of pressure element.

D. Movement: Mechanical, connecting element and pointer.

E. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.

F. Pointer: Red metal.

G. Window: Glass or plastic.

H. Ring: Metal or plastic.

I. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.

J. Thermal System: Liquid- or mercury-filled bulb in copper-plated steel, aluminum, or brass stem for thermowell installation and of length to suit installation.

K. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.2 REMOTE-MOUNTING, VAPOR-ACTUATED DIAL THERMOMETERS

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 comparable product by one of the following:

1. AMETEK, Inc.; U.S. Gauge Div.
2. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
3. Marsh Bellofram.
4. Miljoco Corp.
5. Palmer - Wahl Instruments Inc.
6. REO TEMP Instrument Corporation.
7. Tel-Tru Manufacturing Company.
8. Trerice, H. O. Co.
9. Weiss Instruments, Inc.
10. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
11. Winters Instruments.
12. Or approved equal.

C. Case: Dry type, drawn steel or cast aluminum, 4-1/2-inch diameter with holes for panel mounting.

D. Element: Bourdon tube or other type of pressure element.

E. Movement: Mechanical, connecting element and pointer.

F. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.

G. Pointer: Red metal.

H. Window: Glass or plastic.

I. Ring: Brass.

J. Connector: Bottom or Back union type.

K. Thermal System: Liquid- or mercury-filled bulb in copper-plated steel, aluminum, or brass stem for thermowell installation and of length to suit installation.

L. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.3 BIMETALLIC-ACTUATED DIAL THERMOMETERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:

1. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
2. Ernst Gage Co.
3. Eugene Ernst Products Co.
4. Marsh Bellofram.
5. Miljoco Corp.
6. NANMAC Corporation.
7. Noshok, Inc.
8. Palmer - Wahl Instruments Inc.
9. REO TEMP Instrument Corporation.
10. Tel-Tru Manufacturing Company.
11. Trerice, H. O. Co.
12. Weiss Instruments, Inc.
13. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
14. WIKA Instrument Corporation.
15. Winters Instruments.
16. Or approved equal.

B. Description: Direct-mounting, bimetallic-actuated dial thermometers complying with ASME B40.3.

C. Case: Dry type, stainless steel with 5-inch diameter.

D. Element: Bimetal coil.

E. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.

F. Pointer: Red metal.

G. Window: Glass or plastic.

H. Ring: Stainless steel.

I. Connector: Adjustable angle type.

J. Stem: Metal, for thermowell installation and of length to suit installation.

K. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.4 THERMOWELLS

A. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:

1. AMETEK, Inc.; U.S. Gauge Div.
2. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
3. Ernst Gage Co.
4. Marsh Bellofram.
5. Miljoco Corp.
6. NANMAC Corporation.
7. Noshok, Inc.
8. Palmer - Wahl Instruments Inc.
9. REO TEMP Instrument Corporation.
10. Tel-Tru Manufacturing Company.
11. Trerice, H. O. Co.
12. Weiss Instruments, Inc.
13. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
14. WIKA Instrument Corporation.
15. Winters Instruments.
16. Or approved equal.

B. Manufacturers: Same as manufacturer of thermometer being used.

C. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer.

2.5 PRESSURE GAGES

A. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:

1. AMETEK, Inc.; U.S. Gauge Div.
2. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
3. Ernst Gage Co.
4. Eugene Ernst Products Co.
5. KOBOLD Instruments, Inc.
6. Marsh Bellofram.
7. Miljoco Corp.
8. Noshok, Inc.
9. Palmer - Wahl Instruments Inc.
10. REO TEMP Instrument Corporation.
11. Trerice, H. O. Co.
12. Weiss Instruments, Inc.
13. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
14. WIKA Instrument Corporation.

15. Winters Instruments.
16. Or approved equal.

B. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.

1. Case: Dry type, drawn steel or cast aluminum, 4-1/2-inch diameter.
2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
6. Pointer: Red metal.
7. Window: Glass or plastic.
8. Ring: Brass.
9. Accuracy: Grade A, plus or minus 1 percent of middle half scale.
10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
11. Range for Fluids under Pressure: Two times operating pressure.

C. Remote-Mounting, Dial-Type Pressure Gages: ASME B40.100, indicating-dial type.

1. Case: Dry type, drawn steel or cast aluminum, 4-1/2-inch diameter with holes for panel mounting.
2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
6. Pointer: Red metal.
7. Window: Glass or plastic.
8. Ring: Brass.
9. Accuracy: Grade A, plus or minus 1 percent of middle half scale.
10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
11. Range for Fluids under Pressure: Two times operating pressure.

D. Pressure-Gage Fittings:

1. Valves: NPS 1/4 brass or stainless-steel needle type.
2. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

2.6 TEST PLUGS

A. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:

1. Flow Design, Inc.
2. MG Piping Products Co.
3. National Meter, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Co.
6. Trerice, H. O. Co.
7. Watts Industries, Inc.; Water Products Div.
8. Or approved equal.

B. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.

C. Minimum Pressure and Temperature Rating: 150 psig at 200 deg F.

D. Core Inserts: One or two self-sealing rubber valves.

1. Insert material for water service at 20 to 200 deg F shall be CR.
2. Insert material for water service at minus 30 to plus 275 deg F shall be EPDM.

PART 3 - EXECUTION

3.1 THERMOMETER AND GAGE APPLICATIONS

A. Install thermometers in the outlet of each domestic, hot-water storage tank.

B. Install thermometers at suction and discharge of each pump.

C. Provide the following temperature ranges for thermometers:

1. Domestic Hot Water: 30 to 180 deg F, with 2-degree scale divisions.
2. Domestic Cold Water: 30 to 130 deg F, with 2-degree scale divisions.

D. Install dry-case-type pressure gages for discharge of each pressure-reducing valve.

E. Install pressure gages at suction and discharge of each pump.

3.2 INSTALLATIONS

A. Install direct-mounting thermometers and adjust vertical and tilted positions.

B. Install remote-mounting dial thermometers on panel, with tubing connecting panel and thermometer bulb supported to prevent kinks. Use minimum tubing length.

C. Install thermowells with socket extending to center of pipe and in vertical position in piping tees where thermometers are indicated.

D. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.

E. Install remote-mounting pressure gages on panel.

F. Install needle-valve and snubber fitting in piping for each pressure gage.

G. Install test plugs in tees in piping.

H. Install permanent indicators on walls or brackets in accessible and readable positions.

I. Install connection fittings for attachment to portable indicators in accessible locations.

J. Install thermometers and gages adjacent to machines and equipment to allow service and maintenance for thermometers, gages, machines, and equipment.

K. Adjust faces of thermometers and gages to proper angle for best visibility.

END OF SECTION 22 0519

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SECTION 22 0523

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. This Section includes the following general-duty valves:

1. Bronze angle valves.
2. Copper-alloy ball valves.
3. Bronze check valves.

B. Related Sections include the following:

1. Division 21 Fire-suppression piping and Fire pump Sections for fire-protection valves.
2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and charts.
3. Division 22 piping Sections for specialty valves applicable to those Sections only.

1.3 DEFINITIONS

A. The following are standard abbreviations for valves:

1. CWP: Cold working pressure.
2. EPDM: Ethylene-propylene-diene terpolymer rubber.
3. NBR: Acrylonitrile-butadiene rubber.
4. PTFE: Polytetrafluoroethylene plastic.
5. TFE: Tetrafluoroethylene plastic.

1.4 SUBMITTALS

A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

1.5 QUALITY ASSURANCE

A. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.

B. 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. Set butterfly valves closed or slightly open.
6. 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 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for 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, the manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 VALVES, GENERAL

A. Refer to Part 3 "Valve Applications" Article for applications of valves.

B. Bronze Valves: NPS 2 and smaller with threaded ends, unless otherwise indicated.

C. Ferrous Valves: NPS 2-1/2 and larger with flanged ends, unless otherwise indicated.

D. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

E. Valve Sizes: Same as upstream pipe, unless otherwise indicated.

F. Valve Actuators:

1. Chainwheel: For attachment to valves, of size and mounting height, as indicated in the "Valve Installation" Article in Part 3.
2. Gear Drive: For quarter-turn valves NPS 8 and larger.
3. Handwheel: For valves other than quarter-turn types.

4. Lever Handle: For quarter-turn valves NPS 6 and smaller, except plug valves.
5. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug head.

G. Extended Valve Stems: On insulated valves.

H. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.

I. Valve Grooved Ends: AWWA C606.

1. Solder Joint: With sockets according to ASME B16.18.

a. Caution: Use solder with melting point below 840 deg F for angle, check, gate, and globe valves; below 421 deg F for ball valves.

2. Threaded: With threads according to ASME B1.20.1.

J. Valve Bypass and Drain Connections: MSS SP-45.

2.3 BRONZE ANGLE VALVES

A. Available Manufacturers:

B. Manufacturers:

1. Type 2, Bronze Angle Valves with Nonmetallic Disc:

a. American Valve, Inc.
b. Cincinnati Valve Co.
c. Crane Co.; Crane Valve Group; Crane Valves.
d. Crane Co.; Crane Valve Group; Jenkins Valves.
e. Crane Co.; Crane Valve Group; Stockham Div.
f. Grinnell Corporation.
g. Hammond Valve.
h. NIBCO INC.
i. Powell, Wm. Co.
j. Or approved equal.

C. Bronze Angle Valves, General: MSS SP-80, with ferrous-alloy handwheel.

D. Type 2, Class 125, Bronze Angle Valves: Bronze body with PTFE disc and union-ring bonnet.

2.4 COPPER-ALLOY BALL VALVES

A. Available Manufacturers:

B. Manufacturers:

1. Two-Piece, Copper-Alloy Ball Valves:

a. Conbraco Industries, Inc.; Apollo Div.
b. Crane Co.; Crane Valve Group; Crane Valves.

c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Div.
e. DynaQuip Controls.
f. Flow-Tek, Inc.
g. Grinnell Corporation.
h. Hammond Valve.
i. Honeywell Braukmann.
j. Jamesbury, Inc.
k. Jomar International, LTD.
l. Kitz Corporation of America.
m. Legend Valve & Fitting, Inc.
n. Milwaukee Valve Company.
o. Nexus Valve Specialties.
p. NIBCO INC.
q. R & M Energy Systems (Borger, TX).
r. Red-White Valve Corp.
s. Richards Industries; Marwin Ball Valves.
t. Watts Industries, Inc.; Water Products Div.
u. Or approved equal.

C. Copper-Alloy Ball Valves, General: MSS SP-110.

D. Two-Piece, Copper-Alloy Ball Valves: Brass or bronze body with full-port, chrome-plated bronze ball; PTFE seats; and 600-psig minimum CWP rating and blowout-proof stem.

2.5 BRONZE CHECK VALVES

A. Available Manufacturers:

B. Manufacturers:

1. Type 2, Bronze, Horizontal Lift Check Valves with Nonmetallic Disc:

a. Cincinnati Valve Co.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Div.
e. Walworth Co.

2. Type 1, Bronze, Vertical Lift Check Valves with Metal Disc:

a. Cincinnati Valve Co.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Red-White Valve Corp.

3. Type 2, Bronze, Vertical Lift Check Valves with Nonmetallic Disc:

a. Grinnell Corporation.
b. Kitz Corporation of America.
c. Milwaukee Valve Company.

4. Type 3, Bronze, Swing Check Valves with Metal Disc:

a. American Valve, Inc.
b. Cincinnati Valve Co.
c. Crane Co.; Crane Valve Group; Crane Valves.
d. Crane Co.; Crane Valve Group; Jenkins Valves.
e. Crane Co.; Crane Valve Group; Stockham Div.
f. Grinnell Corporation.
g. Hammond Valve.
h. Kitz Corporation of America.
i. Legend Valve & Fitting, Inc.
j. Milwaukee Valve Company.
k. NIBCO INC.
l. Powell, Wm. Co.
m. Red-White Valve Corp.
n. Walworth Co.
o. Watts Industries, Inc.; Water Products Div.

5. Type 4, Bronze, Swing Check Valves with Nonmetallic Disc:

a. Cincinnati Valve Co.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Div.
e. Grinnell Corporation.
f. Hammond Valve.
g. McWane, Inc.; Kennedy Valve Div.
h. Milwaukee Valve Company.
i. NIBCO INC.
j. Red-White Valve Corp.
k. Walworth Co.
l. Watts Industries, Inc.; Water Products Div.

C. Bronze Check Valves, General: MSS SP-80.

D. Type 2, Class 150, Bronze, Horizontal Lift Check Valves: Bronze body with nonmetallic disc and bronze seat.

E. Type 2, Class 150, Bronze, Vertical Lift Check Valves: Bronze body with nonmetallic disc and bronze seat.

F. Type 3, Class 150, Bronze, Swing Check Valves: Bronze body with bronze disc and seat.

G. Type 4, Class 150, Bronze, Swing Check Valves: Bronze body with nonmetallic disc and bronze seat.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

B. 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.

C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

D. Examine threads on valve and mating pipe for form and cleanliness.

E. 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.

F. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE APPLICATIONS

A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball valves.
2. Throttling Service: Angle, ball valves.
3. Pump Discharge: Spring-loaded, lift-disc check valves.

B. If valves with specified CWP ratings are not available, the same types of valves with higher CWP ratings may be substituted.

C. Domestic Water Piping: Use the following types of valves:

1. Angle Valves, NPS 2 (DN 50) and Smaller: Type 2, Class 125, bronze.
2. Ball Valves, NPS 2 (DN 50) and Smaller: Two-piece, 400-psig (2760-kPa) CWP rating, copper alloy.
3. Lift Check Valves, NPS 2 (DN 50) and Smaller: Type 2, Class 150, horizontal or vertical, bronze.
4. Swing Check Valves, NPS 2 (DN 50) and Smaller: Type 4, Class 150, bronze.
5. Spring-Loaded, Lift-Disc Check Valves, NPS 2 (DN 50) and Smaller: Type IV, Class 150.

D. Select valves, except wafer and flangeless types, with the following end connections:

1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Solder-joint, pressed, or threaded ends.

3.3 VALVE INSTALLATION

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

C. Locate valves for easy access and provide separate support where necessary.

D. Install valves in horizontal piping with stem at or above center of pipe.

E. Install valves in position to allow full stem movement.

F. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Dual-Plate Check Valves: In horizontal or vertical position, between flanges.

3. Lift Check Valves: With stem upright and plumb.

3.4 JOINT CONSTRUCTION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for basic piping joint construction.

B. Grooved Joints: Assemble joints with keyed coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

C. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.5 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

END OF SECTION 22 0523

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SECTION 22 0529

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. This Section includes the following hangers and supports for plumbing system piping and equipment:

1. Steel pipe hangers and supports.
2. Trapeze pipe hangers.
3. Fiberglass pipe hangers.
4. Metal framing systems.
5. Fiberglass strut systems.
6. Thermal-hanger shield inserts.
7. Fastener systems.
8. Pipe stands.
9. Pipe positioning systems.
10. Equipment supports.

B. Related Sections include the following:

1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Division 21 Section "Water-Based Fire-Suppression Systems" for pipe hangers for fire-suppression piping.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Steel pipe hangers and supports.
2. Fiberglass pipe hangers.
3. Thermal-hanger shield inserts.
4. Powder-actuated fastener systems.
5. Pipe positioning systems.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers. Include Product Data for components.
2. Metal framing systems. Include Product Data for components.
3. Fiberglass strut systems. Include Product Data for components.
4. Pipe stands. Include Product Data for components.
5. Equipment supports.

C. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel." AWS D1.4, "Structural Welding Code--Reinforcing Steel." ASME Boiler and Pressure Vessel Code: Section IX.

B. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."
2. AWS D1.2, "Structural Welding Code--Aluminum."
3. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
4. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Available Manufacturers:

1. AAA Technology & Specialties Co., Inc.
2. Bergen-Power Pipe Supports.
3. B-Line Systems, Inc.; a division of Cooper Industries.
4. Carpenter & Paterson, Inc.
5. Empire Industries, Inc.
6. ERICO/Michigan Hanger Co.
7. Globe Pipe Hanger Products, Inc.
8. Grinnell Corp.
9. GS Metals Corp.
10. National Pipe Hanger Corporation.
11. PHD Manufacturing, Inc.
12. PHS Industries, Inc.
13. Piping Technology & Products, Inc.
14. Tolco Inc.

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 FIBERGLASS PIPE HANGERS

A. Clevis-Type, Fiberglass Pipe Hangers: Similar to MSS Type 1, steel pipe hanger except hanger is made of fiberglass and continuous-thread rod and nuts are made of polyurethane or stainless steel.

1. Available Manufacturers:

a. B-Line Systems, Inc.; a division of Cooper Industries.
b. Champion Fiberglass, Inc.
c. Cope, T. J., Inc.; Tyco International, Ltd.
d. Seasafe, Inc.
e. Unistrut Corp.; Tyco International, Ltd.
f. Wesanco, Inc.

B. Strap-Type, Fiberglass Pipe Hangers: Made of fiberglass loop with stainless-steel continuous-thread rod, nuts, and support hook.

1. Available Manufacturers:

a. Plasti-Fab, Inc.

2.5 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Available Manufacturers:

1. B-Line Systems, Inc.; a division of Cooper Industries.
2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
3. GS Metals Corp.
4. Power-Strut Div.; Tyco International, Ltd.
5. Thomas & Betts Corporation.
6. Tolco Inc.
7. Unistrut Corp.; Tyco International, Ltd.

C. Coatings: Manufacturer's standard finish unless bare metal surfaces are indicated.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.6 FIBERGLASS STRUT SYSTEMS

A. Description: Shop- or field-fabricated pipe-support assembly, similar to MFMA-3, made of fiberglass channels and other components.

B. Available Manufacturers:

1. B-Line Systems, Inc.; a division of Cooper Industries.
2. Champion Fiberglass, Inc.
3. Cope, T. J., Inc.; Tyco International Ltd.
4. Seasafe, Inc.

2.7 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Available Manufacturers:

1. Carpenter & Paterson, Inc.
2. ERICO/Michigan Hanger Co.
3. PHS Industries, Inc.
4. Pipe Shields, Inc.
5. Rilco Manufacturing Company, Inc.
6. Value Engineered Products, Inc.

C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate, Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass, ASTM C 552, Type II cellular glass with vapor barrier.

D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate, Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass, ASTM C 552, Type II cellular glass.

E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.8 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Available Manufacturers:

a. Hilti, Inc.
b. ITW Ramset/Red Head.
c. Masterset Fastening Systems, Inc.
d. MKT Fastening, LLC.
e. Powers Fasteners.

B. Mechanical-Expansion Anchors: Insert-wedge-type stainless steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Available Manufacturers:

a. B-Line Systems, Inc.; a division of Cooper Industries.
b. Empire Industries, Inc.
c. Hilti, Inc.
d. ITW Ramset/Red Head.
e. MKT Fastening, LLC.
f. Powers Fasteners.

2.9 PIPE STAND FABRICATION

A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod-roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

1. Available Manufacturers:

a. ERICO/Michigan Hanger Co.
b. MIRO Industries.

C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

1. Available Manufacturers:

    a. MIRO Industries.

D. High-Type, Single-Pipe Stand: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.

1. Available Manufacturers:

    a. ERICO/Michigan Hanger Co.
    b. MIRO Industries.
    c. Portable Pipe Hangers.

2. Base: Stainless steel.
3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.

1. Available Manufacturers:

    a. Portable Pipe Hangers.

2. Bases: One or more plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe support made from structural-steel shape, continuous-thread rods, and rollers for mounting on permanent stationary roof curb.

2.10 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, system of metal brackets, clips, and straps for positioning piping in pipe spaces for plumbing fixtures for commercial applications.

B. Available Manufacturers:

1. C & S Mfg. Corp.
2. HOLDRITE Corp.; Hubbard Enterprises.
3. Samco Stamping, Inc.

2.11 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.12 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use padded hangers for piping that is subject to scratching.

F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
4. 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 2.
10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
11. Extension Hinged or 2-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.

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 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 2 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 20, 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.

G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.

H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
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.

I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. 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.

J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. 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 absorb 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 absorb 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 absorb 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.

L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

N. Use powder-actuated fasteners or mechanical-expansion anchors (with permission) instead of building attachments where required in concrete construction.

O. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

3.2 HANGER AND SUPPORT INSTALLATION

A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

C. 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. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

G. 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.

H. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. Refer to Division 07 Section "Roof Accessories" for curbs.

I. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 22 Section "Plumbing Fixtures" for plumbing fixtures.

J. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

K. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

L. 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.

M. Install lateral bracing with pipe hangers and supports to prevent swaying.

N. 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.

O. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

P. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.

Q. Insulated Piping: Comply with the following:

1. Attach clamps and spacers to piping.

    a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    c. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

    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 (DN 100) 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 inserts.
6. Insert Material: Length at least as long as protective shield.
7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 22 0529

SECTION 22 0553

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 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 Stainless steel, 0.025-inch- or Aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.

B. 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. In addition, provide equipment make, model and serial number, voltage, mca, cfm or gpm (as applicable), manufacture date. NOTE THAT MANUFACTURER'S STAMPED NAMEPLATE WILL NOT BE SUFFICIENT.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Red.

C. Background Color: White.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. 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, size and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. 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 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; 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.

2.5 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, 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. Fasteners: Brass wire-link or wire link chain or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) 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.

2.6 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 Approximately 4 by 7 inches.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "Interior Painting or “High-Performance Coatings."

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. Domestic Water Piping:

    a. Background Color: Green.
    b. Letter Color: White.

2. Sanitary Waste Vent:

    a. Background Color: Green.
    b. Letter Color: White.

3. Natural Gas Piping:

a. Background Color: Yellow.
b. Letter Color: Black

4. Condensate, gravity or pumped Piping: Note: designate whether gravity or pumped.

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: Green.
b. Hot Water: Green.

3. Letter Color:

a. Cold Water: White.
b. Hot Water: White.

3.5 WARNING-TAG INSTALLATION

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

END OF SECTION 22 0553

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SECTION 22 0700

PLUMBING 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:

1. Insulation Materials:
   a. Flexible elastomeric.
   b. Mineral fiber.
   c. Polyisocyanurate.
   d. Polyolefin.
   e. Polystyrene.
2. Insulating cements.
3. Adhesives.
4. Mastics.
5. Lagging adhesives.
6. Sealants.
7. Factory-applied jackets.
8. Field-applied fabric-reinforcing mesh.
9. Field-applied cloths.
10. Field-applied jackets.
11. Tapes.
12. Securements.
13. Corner angles.

B. Related Sections include the following:

1. Division 23 Section "HVAC Insulation."

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

B. Shop Drawings:

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.

2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.
8. Detail field application for each equipment type.

C. Qualification Data: For qualified Installer.

D. 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.

E. Field quality-control reports.

1.4 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. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment 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.

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 Part 3 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. Flexible Elastomeric: 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. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

G. 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.; Duct Wrap.
b. Johns Manville; Microlite.
c. Knauf Insulation; Duct Wrap.
d. Manson Insulation Inc.; Alley Wrap.
e. Owens Corning; All-Service Duct Wrap.

H. 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 with factory-applied ASJ or with factory-applied FSK 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.; 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.

I. High-Temperature, Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type III, without factory-applied jacket.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Fibrex Insulations Inc.; FBX.
b. Johns Manville; 1000 Series Spin-Glas.
c. Owens Corning; High Temperature Industrial Board Insulations.
d. Rock Wool Manufacturing Company; Delta Board.
e. Roxul Inc.; Roxul RW.
f. Thermafiber; Thermafiber Industrial Felt.

J. 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(Pipe Insulation.
d. Manson Insulation Inc.; Alley-K.

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 with factory-applied ASJ or with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

K. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ jacket complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. 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.; CrimpWrap.
b. Johns Manville; MicroFlex.
c. Knauf Insulation; Pipe and Tank Insulation.
d. Manson Insulation Inc.; AK Flex.
e. Owens Corning; Fiberglas Pipe and Tank Insulation.

L. Polyisocyanurate: Unfaced, preformed, rigid cellular polyisocyanurate material intended for use as thermal insulation.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Apache Products Company; ISO-25.
b. Dow Chemical Company (The); Trymer.
c. Duna USA Inc.; Corafoam.
d. Elliott Company; Elfoam.

2. Comply with ASTM C 591, Type I or Type IV, except thermal conductivity (k-value) shall not exceed 0.19 Btu x in./h x sq. ft. x deg F at 75 deg F after 180 days of aging.
3. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less for thickness up to 1-1/2 inches as tested by ASTM E 84.
4. Fabricate shapes according to ASTM C 450 and ASTM C 585.
5. Factory-Applied Jacket: Requirements are specified in "Factory-Applied Jackets" Article.

    a. Pipe Applications: PVDC-SSL.
    b. Equipment Applications: PVDC-SSL.

M. 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 Inc.; IMCOLOCK, IMCOSHEET, NOMALOCK, and NOMAPLY.
    c. RBX Corporation; Therma-cell.

N. Polystyrene: Rigid, extruded cellular polystyrene intended for use as thermal insulation. Comply with ASTM C 578, Type IV or Type XIII, except thermal conductivity (k-value) shall not exceed 0.26 Btu x in./h x sq. ft. x deg F after 180 days of aging. Fabricate shapes according to ASTM C 450 and ASTM C 585.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Dow Chemical Company (The); Styrofoam.
    b. Knauf Insulation; Knauf Polystyrene.

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. 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 Products, Division of ITW; CP-97.
    b. Foster Products Corporation, H. B. Fuller Company; 81-27/81-93.
    c. Marathon Industries, Inc.; 290.
    d. Mon-Eco Industries, Inc.; 22-30.
    e. Vimasco Corporation; 760.

C. Cellular-Glass, Phenolic, Polyisocyanurate, and Polystyrene 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 Products, Division of ITW; CP-96.
    b. Foster Products Corporation, H. B. Fuller Company; 81-33.

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 LCC; 520 Adhesive.
    c. Foster Products Corporation, H. B. Fuller Company; 85-75.
    d. RBX Corporation; Rubatex Contact Adhesive.

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 Products, Division of ITW; CP-82.
    b. Foster Products Corporation, H. B. Fuller Company; 85-20.
    c. ITW TACC, Division of Illinois Tool Works; S-90/80.
    d. Marathon Industries, Inc.; 225.
    e. Mon-Eco Industries, Inc.; 22-25.

F. Polystyrene Adhesive: Solvent- or water-based, synthetic resin adhesive with a service temperature range of minus 20 to plus 140 deg F.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Childers Products, Division of ITW; CP-96.
    b. Foster Products Corporation, H. B. Fuller Company; 97-13.

G. 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 Products, Division of ITW; CP-82.
    b. Foster Products Corporation, H. B. Fuller Company; 85-20.
    c. ITW TACC, Division of Illinois Tool Works; S-90/80.
    d. Marathon Industries, Inc.; 225.
    e. Mon-Eco Industries, Inc.; 22-25.

H. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Dow Chemical Company (The); 739, Dow Silicone.
    b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
    c. P.I.C. Plastics, Inc.; Welding Adhesive.
    d. Red Devil, Inc.; Celulon Ultra Clear.
    e. Speedline Corporation; Speedline Vinyl Adhesive.

2.3 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-35.
b. Foster Products Corporation, H. B. Fuller Company; 30-90.
c. ITW TACC, Division of Illinois Tool Works; CB-50.
d. Marathon Industries, Inc.; 590.
e. Mon-Eco Industries, Inc.; 55-40.
f. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96, 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, 59 percent by volume and 71 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 Products, Division of ITW; CP-30.
b. Foster Products Corporation, H. B. Fuller Company; 30-35.
c. ITW TACC, Division of Illinois Tool Works; CB-25.
d. Marathon Industries, Inc.; 501.
e. 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 Products, Division of ITW; Encacel.
b. Foster Products Corporation, H. B. Fuller Company; 60-95/60-96.
c. Marathon Industries, Inc.; 570.
d. Mon-Eco Industries, Inc.; 55-70.

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 Products, Division of ITW; CP-10.
b. Foster Products Corporation, H. B. Fuller Company; 35-00.
c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
d. Marathon Industries, Inc.; 550.
e. Mon-Eco Industries, Inc.; 55-50.
f. Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 200 deg F.
4. Solids Content: 63 percent by volume and 73 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. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-52.
b. Foster Products Corporation, H. B. Fuller Company; 81-42.
c. Marathon Industries, Inc.; 130.
d. Mon-Eco Industries, Inc.; 11-30.
e. Vimasco Corporation; 136.

2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over equipment and pipe insulation.
3. Service Temperature Range: Minus 50 to plus 180 deg F.
4. Color: White.

2.5 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass, Phenolic, and Polyisocyanurate Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-76.
b. Foster Products Corporation, H. B. Fuller Company; 30-45.
c. Marathon Industries, Inc.; 405.
d. Mon-Eco Industries, Inc.; 44-05.
e. Pittsburgh Corning Corporation; Pittseal 444.
f. Vimasco Corporation; 750.

2. Joint Sealants for Polystyrene Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-70.
b. Foster Products Corporation, H. B. Fuller Company; 30-45/30-46.
c. Marathon Industries, Inc.; 405.
d. Mon-Eco Industries, Inc.; 44-05.
e. Vimasco Corporation; 750.

3. Materials shall be compatible with insulation materials, jackets, and substrates.
4. Permanently flexible, elastomeric sealant.
5. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
6. Color: White or gray.

B. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Childers Products, Division of ITW; CP-76-8.
    b. Foster Products Corporation, H. B. Fuller Company; 95-44.
    c. Marathon Industries, Inc.; 405.
    d. Mon-Eco Industries, Inc.; 44-05.
    e. Vimasco Corporation; 750.

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.

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 Products, Division of ITW; 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.

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. PVDC Jacket for Indoor Applications: 4-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96 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 one of 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 perms when tested according to ASTM E 96 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 one of 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 one of the following:

        1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

2.7 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 PVC 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.

5. 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 Products, Division of ITW; Metal Jacketing Systems.
    b. PABCO Metals Corporation; Surefit.
    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 or factory cut and rolled to size.

b. Finish and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and Kraft paper.
d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper 2.5-mil-thick Polysurlyn.
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. Factory cut and rolled to size.
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 2.5-mil-thick Polysurlyn.
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.

2.8 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. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
b. Compac Corp.; 104 and 105.
c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
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. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
    b. Compac Corp.; 110 and 111.
    c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
    d. Venture Tape; 1525 CW, 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 lb f/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. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
    b. Compac Corp.; 130.
    c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
    d. 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. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
    b. Compac Corp.; 120.
    c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
    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 one of the following:

    a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.

2. Width: 3 inches.
3. Film Thickness: 6 mils.
4. Adhesive Thickness: 1.5 mils.
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/inch in width.

2.9 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Childers Products; Bands.
    b. PABCO Metals Corporation; Bands.
    c. RPR Products, Inc.; Bands.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 3/4 inch wide with wing or closed seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing or closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch-diameter shank, length to suit depth of insulation indicated.

    a. Products: Subject to compliance with requirements, provide one of the following:

        1) AGM Industries, Inc.; CWP-1.
        2) GEMCO; CD.
        3) Midwest Fasteners, Inc.; CD.
        4) Nelson Stud Welding; TPA, TPC, and TPS.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

    a. Products: Subject to compliance with requirements, provide one of the following:

        1) AGM Industries, Inc.; CWP-1.
        2) GEMCO; Cupped Head Weld Pin.
        3) Midwest Fasteners, Inc.; Cupped Head.
        4) Nelson Stud Welding; CHP.

3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

    a. Products: Subject to compliance with requirements, provide one of the following:

        1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.

2) GEMCO; Perforated Base.
3) Midwest Fasteners, Inc.; Spindle.

b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
c. Spindle: Copper- or zinc-coated, low carbon steel, aluminum or stainless steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

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, 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. Comply with the following requirements:

a. Products: Subject to compliance with requirements, provide one of the following:

1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
2) GEMCO; Press and Peel.
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, aluminum or stainless 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, aluminum, or 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. Products: Subject to compliance with requirements, provide 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.
b. Childers Products.
c. PABCO Metals Corporation.
d. RPR Products, Inc.

2.10 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 316.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation 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.
3. 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 and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and 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 as recommended by insulation material manufacturer 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. Manholes.
5. Handholes.
6. 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 Division 07 Section "Penetration Firestopping"irestopping 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 Division 07 Section "Penetration Firestopping."

3.5 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

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 100 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 over compress 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 100 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 galvanized 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.
4. As an alternate (hot fluid only) provide removable blanket with Velcro or snap fasteners for pump insulation.

3.6 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, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as 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 (50 mm) 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.

3.7 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

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 MINERAL-FIBER INSULATION INSTALLATION

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 but 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 (25 mm), 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 POLYISOCYANURATE INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with tape or bands and tighten without deforming insulation materials. Orient longitudinal joints between half sections in 3 and 9 o'clock positions on the pipe.
2. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs but secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.
3. All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor barrier must be continuous. Before installing jacket material, install vapor-barrier system.

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, same thickness of adjacent pipe insulation, not to exceed 1-1/2-inch thickness.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyisocyanurate block insulation of same thickness as pipe insulation.

C. Insulation Installation on Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of polyisocyanurate 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.

3.10 POLYOLEFIN INSULATION INSTALLATION

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 POLYSTYRENE INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation with tape or bands and tighten bands without deforming insulation materials. Orient longitudinal joints between half sections in 3 and 9 o'clock positions on the pipe.
2. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs but secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.
3. All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor barrier must be continuous. Before installing jacket material, install vapor-barrier system.

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, same thickness of adjacent pipe insulation, not to exceed 1-1/2-inch thickness.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polystyrene block insulation of same thickness as pipe insulation.

C. 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.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed section of polystyrene 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.

3.12 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. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
2. Wrap factory-presized jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
3. Continuous jacket can be spiral wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
4. 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. The 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.
5. 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.

3.13 FINISHES

A. Equipment and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.14 FIELD QUALITY CONTROL

A. Testing Agency: 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.
2. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.15 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 in paragraphs below that is not factory insulated.

C. Domestic hot-water pump insulation shall be one of the following:

1. Fiber Glass: 1.5 inches thick.
2. Mineral-Fiber Board: 1.5 inches thick and 2-lb/cu. ft. nominal density.
3. Polyisocyanurate: 1.5 inches thick.

D. Domestic hot-water storage tank insulation shall be one of the following:

1. Mineral-Fiber Board: 1.5 inches thick and 2-lb/cu. ft. nominal density.
2. Mineral-Fiber Pipe and Tank: 1.5 inches thick.

E. Piping system filter-housing insulation shall be one of the following:

1. Flexible Elastomeric: 1 inches thick.

3.16 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.

3.17 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. NPS 1 and Smaller: Insulation shall be one of the following:
   a. Flexible Elastomeric: 1/2 inch thick.
   b. Polyisocyanurate: 1/2 inch thick.
   c. Polyolefin: 1-1/2 inch thick.

2. NPS 1-1/4 and Larger: Insulation shall be one of the following:
   a. Flexible Elastomeric: 1/2 inch thick.
   b. Polyisocyanurate: 1/2 inch thick.
   c. Polyolefin: 1-1/2 inch thick.

B. Domestic Hot and Recirculated Hot Water:

1. NPS 1-1/4 and Smaller: Insulation shall be one of the following:
   a. Flexible Elastomeric: 1 inch thick.
   b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
   c. Polyisocyanurate: 1 inch thick.
   d. Polyolefin: 1-1/2 inch thick.

2. NPS 1-1/2 and Larger: Insulation shall be one of the following:
   a. Flexible Elastomeric: 1-1/2 inch thick.
   b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inch thick.
   c. Polyisocyanurate: 1 inch thick.
   d. Polyolefin: 1-1/2 inch thick.

C. 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.

D. Condensate and Equipment Drain Water:

1. All Pipe Sizes: Insulation shall be one of the following:
   a. Flexible Elastomeric: 3/4 inch thick.

3.18 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. This does not apply for equipment with factory-applied insulation and jacket. For factory applied insulation and jacket, no further field work is required.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches :
   1. PVC: 30 mils thick.
   2. Aluminum, Corrugated: 0.020 inch thick.

D. Equipment, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches:
   1. Aluminum, Corrugated 0.032 inch thick.

E. Piping, Concealed:
   1. All Service Jacket.

F. Piping, Exposed:
   1. PVC: 20 mils thick.
   2. Aluminum, Stucco Embossed: 0.020 inch thick.

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SECTION 22 1116

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. This Section includes domestic water piping inside the building.

B. Water meters will be furnished and installed by utility company.

C. Related Sections include the following:

1. Division 22 Section "Thermometers and Gages for Plumbing Piping" for thermometers, pressure gages, and fittings.
2. Division 22 Section "Domestic Water Piping Specialties" for water distribution piping specialties.

D.

1.3 DEFINITIONS

A. CPVC: Chlorinated polyvinyl chloride plastic.

B. PEX: Crosslinked polyethylene plastic.

C. PVC: Polyvinyl chloride plastic.

1.4 PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing domestic water piping systems with 125 psig, unless otherwise indicated.

1.5 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings and water meters.

B. Water Samples: Specified in Part 3 "Cleaning" Article. Samples are submitted to Health Authorities having jurisdiction.

C. Field quality-control test reports.

D. Shop drawings of potable water system for review by Engineer before construction begins.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14, "Plastics Piping System Components and Related Materials," for plastic, potable domestic water piping and components. Include marking "NSF-pw" on piping.

C. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for potable domestic water piping and components.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Pipe and Fitting Applications" Article for applications of pipe, tube, fitting, and joining materials.

B. Transition Couplings for Aboveground Pressure Piping: Coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.3 COPPER TUBE AND FITTINGS

A. Soft Copper Tube: ASTM B 88, Types K and L, water tube, annealed temper.

   1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
   2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Furnish Class 300 flanges if required to match piping.
   3. 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.

B. Hard Copper Tube: ASTM B 88, Types L and M, water tube, drawn temper.

   1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought- copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
   2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Furnish Class 300 flanges if required to match piping.
   3. 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.
   4. Copper, Grooved-End Fittings: ASTM B 75 copper tube or ASTM B 584 bronze castings.

a. Grooved-End-Tube Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, gasket suitable for hot water, and bolts and nuts.

2.4 VALVES

A. Bronze and cast-iron, general-duty valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

B. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."

PART 3 - EXECUTION

3.1 EXCAVATION

A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.2 PIPE AND FITTING APPLICATIONS

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 may be used on aboveground piping, unless otherwise indicated.

C. Grooved joints may be used on aboveground grooved-end piping.

D. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

E. Domestic Water Piping on Service Side of Water Meter inside the Building: Use any of the following piping materials for each size range:
1. NPS 4 to NPS 6: Hard copper tube, Type L; copper pressure fittings; and soldered joints.
2. NPS 4 to NPS 8: Hard copper tube, Type L or Type M with grooved ends; copper grooved-end fittings; grooved-end-tube couplings; and grooved joints.

F. Under-Building-Slab, Domestic Water Piping on House Side of Water Meter, NPS 4 and Smaller: Hard copper tube, Type L; copper pressure fittings; and soldered joints.

G. Aboveground Domestic Water Piping: Use any of the following piping materials for each size range:

1. NPS 1 and Smaller: Hard copper tube, Type L copper pressure fittings; and soldered joints.
2. NPS 1-1/4 to NPS 4: Hard copper tube, Type L; copper pressure fittings; and soldered joints.
3. NPS 2 to 6: Hard copper tube, Type L with grooved ends; copper grooved-end fittings;
4. NPS 4 to NPS 6: Hard copper tube, Type L copper pressure fittings; and soldered joints.

3.3 VALVE APPLICATIONS – See specification “General Duty Valves for Plumbing Piping”

3.4 PIPING INSTALLATION

A. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Install under-building-slab copper tubing according to CDA's "Copper Tube Handbook."

C. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."

D. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Wall penetration systems are specified in Division 22 Section "Common Work Results for Plumbing."

E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Pressure gages are specified in Division 22 Section "Thermometers and Gages for Plumbing Piping," and drain valves and strainers are specified in Division 22 Section "Domestic Water Piping Specialties."

F. Install water-pressure regulators downstream from shutoff valves. Water-pressure regulators are specified in Division 22 Section " Domestic Water Piping Specialties."

G. Install domestic water piping level without pitch and plumb.

H. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

3.5 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

C. Grooved Joints: Assemble joints with grooved-end-pipe or grooved-end-tube coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

D. 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.

3.6 WATER METER INSTALLATION

A. Rough-in domestic water piping according to utility company's requirements.

B. Water meters will be furnished and installed by utility company.

C. Install water meters according to AWWA M6 and utility's requirements.

1. Install displacement-type water meters with shutoff valve on water-meter inlet. Install valve on water-meter outlet and valved bypass around meter unless prohibited by authorities having jurisdiction.
2. Install turbine-type water meters with shutoff valve on water-meter inlet. Install valve on water-meter outlet and valved bypass around meter unless prohibited by authorities having jurisdiction.
3. Install compound-type water meters with shutoff valves on water-meter inlet and outlet and on valved bypass around meter. Support meters, valves, and piping on brick or concrete piers.
4. Install fire-service water meters with shutoff valves on water-meter inlet and outlet and on full-size valved bypass around meter. Support meter, valves, and piping on brick or concrete piers.
5. Install remote registration system according to standards of utility and of authorities having jurisdiction.

3.7 HANGER AND SUPPORT INSTALLATION

A. Pipe hanger and support devices are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Individual, Straight, Horizontal Piping Runs: According to the following:

    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet: MSS Type 49, spring cushion rolls, if indicated.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, to a minimum of 3/8 inch.

E. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
2. NPS 1-1/2: 108 inches with 3/8-inch rod.
3. NPS 2: 10 feet with 3/8-inch rod.
4. NPS 2-1/2: 11 feet with 1/2-inch rod.
5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
7. NPS 6: 12 feet with 3/4-inch rod.
8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.

F. Install supports for vertical steel piping every 15 feet.

G. 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.

H. Install supports for vertical copper tubing every 10 feet.

I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.8 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment and machines to allow service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve, and extend and connect to the following:
   1. Water Heaters: Cold-water supply and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
   2. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 22 Section "Plumbing Fixtures."
   3. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.9 FIELD QUALITY CONTROL

A. Inspect domestic water piping as follows:

   1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
   2. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

      a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
      b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

   3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
   4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

B. Test domestic water piping as follows:

   1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
   2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
   3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   4. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
   5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
   6. Prepare reports for tests and required corrective action.

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 flow of hot water in each branch.
    b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and plugs used 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 and non-potable domestic water piping as follows:

1. Purge new piping and parts of existing domestic water piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction or, if methods are not prescribed, procedures described in either AWWA C651 or AWWA C652 or as described below:

    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Fill and isolate system according to either of the following:

        1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
        2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

    c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
    d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

B. Prepare and submit reports of purging and disinfecting activities.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

END OF SECTION 22 1116

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SECTION 22 1119

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. This Section includes the following domestic water piping specialties:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Temperature-actuated water mixing valves.
5. Strainers.
6. Hose bibbs.
7. Ground hydrants.
8. Drain valves.
9. Water hammer arresters.

B. Related Sections include the following:

1. Division 22 Section "Thermometers and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.

1.3 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.4 SUBMITTALS

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

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

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. NSF Compliance:

1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Ames Co.
b. Cash Acme.
c. Conbraco Industries, Inc.
d. FEBCO; SPX Valves & Controls.
e. Rain Bird Corporation.
f. Toro Company (The); Irrigation Div.
g. Watts Industries, Inc.; Water Products Div.
h. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1001.
3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
4. Body: Bronze.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Rough bronze for outdoor or service areas (like a hose bib), chrome plated for finished areas (like a toilet room).

B. Hose-Connection Vacuum Breakers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Arrowhead Brass Products, Inc.
b. Cash Acme.
c. Conbraco Industries, Inc.
d. Legend Valve.
e. MIFAB, Inc.
f. Prier Products, Inc.
g. Watts Industries, Inc.; Water Products Div.
h. Woodford Manufacturing Company.
i. Zurn Plumbing Products Group; Light Commercial Operation.
j. Zurn Plumbing Products Group; Wilkins Div.

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: Rough bronze for outdoor or service areas (like a hose bib), chrome plated for finished areas (like a toilet room or mop sink).

C. Pressure Vacuum Breakers :
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Ames Co.
b. Conbraco Industries, Inc.
c. FEBCO; SPX Valves & Controls.
d. Flomatic Corporation.
e. Toro Company (The); Irrigation Div.
f. Watts Industries, Inc.; Water Products Div.
g. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1020.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
5. Size: same as fixture supply size
6. Design Flow Rate: same as fixture
7. Selected Unit Flow Range Limits: <Insert gpm (L/s).>
8. Accessories:

a. Valves: Ball type, on inlet and outlet.

D. Spill-Resistant Vacuum Breakers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Conbraco Industries, Inc.
b. Watts Industries, Inc.; Water Products Div.

2. Standard: ASSE 1056.
3. Operation: Continuous-pressure applications.
4. Size: Same as supply connection.
5. Accessories:

a. Valves: Ball type, on inlet and outlet.

2.2 BACKFLOW PREVENTERS

A. Intermediate Atmospheric-Vent Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Cash Acme.
b. Conbraco Industries, Inc.
c. FEBCO; SPX Valves & Controls.
d. Honeywell Water Controls.
e. Legend Valve.
f. Watts Industries, Inc.; Water Products Div.
g. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1012.
3. Operation: Continuous-pressure applications.
4. Size: See plans.

5. Body: Bronze.
6. End Connections: Union, solder joint.
7. Finish: Rough bronze.

B. Reduced-Pressure-Principle Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Ames Co.
    b. Conbraco Industries, Inc.
    c. FEBCO; SPX Valves & Controls.
    d. Flomatic Corporation.
    e. Watts Industries, Inc.; Water Products Div.
    f. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
5. Size: As required to limit pressure loss.
6. Design Flow Rate: See schedule.
7. Selected Unit Flow Range Limits: Gpm corresponding to maximum pressure loss allowed.
8. Body: Bronze for NPS 2 and smaller; stainless steel for NPS 2-1/2 and larger.
9. End Connections: Threaded for NPS 2 and smaller; flanged or grooved for NPS 2-1/2 and larger.
10. Configuration: See plans.
11. Accessories:

    a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
    b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

C. Double-Check Backflow-Prevention Assemblies:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Ames Co.
    b. Conbraco Industries, Inc.
    c. FEBCO; SPX Valves & Controls.
    d. Flomatic Corporation.
    e. Watts Industries, Inc.; Water Products Div.
    f. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1015.
3. Operation: Continuous-pressure applications, unless otherwise indicated.
4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
5. Size: As required to limit pressure loss.
6. Design Flow Rate: See schedule.
7. Selected Unit Flow Range Limits: Gpm corresponding to maximum pressure loss allowed.
8. Body: Bronze for NPS 2 and smaller; stainless steel for NPS 2-1/2 and larger.
9. End Connections: Threaded for NPS 2 and smaller; flanged or grooved for NPS 2-1/2 and larger.
10. Configuration: See plans.
11. Accessories:

    a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.

D. Double-Check, Detector-Assembly Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Ames Co.
    b. Conbraco Industries, Inc.
    c. FEBCO; SPX Valves & Controls.
    d. Watts Industries, Inc.; Water Products Div.
    e. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1048 and FMG approved or UL listed.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
5. Size: As required to limit pressure loss.
6. Design Flow Rate: See schedule.
7. Selected Unit Flow Range Limits: Gpm corresponding to maximum pressure loss allowed.
8. Body: Cast iron with interior lining complying with AWWA C550 or that is FDA approved.
9. End Connections: Flanged.
10. Configuration: See plans.
11. Accessories:

    a. Valves: Outside screw and yoke gate-type with flanged ends on inlet and outlet.
    b. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

E. Hose-Connection Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Conbraco Industries, Inc.
    b. Watts Industries, Inc.; Water Products Div.
    c. Woodford Manufacturing Company.

2. Standard: ASSE 1052.
3. Operation: Up to 10-foot head of water back pressure.
4. Inlet Size: NPS 1/2 or NPS 3/4.
5. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
6. Capacity: At least 3-gpm flow.

2.3 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Cash Acme.
    b. Conbraco Industries, Inc.
    c. Honeywell Water Controls.
    d. Watts Industries, Inc.; Water Products Div.
    e. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig.
4. Size: See plan or schedule.
5. Design Flow Rate: See plan or schedule.
6. Design Inlet Pressure: See schedule.
7. Design Outlet Pressure Setting: See schedule.

8. Body: Bronze with chrome-plated finish for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
9. Valves for Booster Heater Water Supply: Include integral bypass.
10. End Connections: Threaded for NPS 2 and smaller; flanged or grooved for NPS 2-1/2 and NPS 3.

2.4 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Water-Temperature Limiting Devices:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Armstrong International, Inc.
    b. Cash Acme.
    c. Conbraco Industries, Inc.
    d. Honeywell Water Controls.
    e. Legend Valve.
    f. Leonard Valve Company.
    g. Powers; a Watts Industries Co.
    h. Symmons Industries, Inc.
    i. Taco, Inc.
    j. Watts Industries, Inc.; Water Products Div.
    k. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig.
4. Type: Thermostatically controlled water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded union inlets and outlet.
7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Tempered-Water Setting: 110 deg F
9. Tempered-Water Design Flow Rate: See schedule
10. Valve Finish: Rough bronze.

B. Individual-Fixture, Water Tempering Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Cash Acme.
    b. Conbraco Industries, Inc.
    c. Honeywell Water Controls.
    d. Lawler Manufacturing Company, Inc.
    e. Leonard Valve Company.
    f. Powers; a Watts Industries Co.
    g. Watts Industries, Inc.; Water Products Div.
    h. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1016, thermostatically controlled water tempering valve.
3. Pressure Rating: 125 psig minimum, unless otherwise indicated.
4. Body: Bronze body with corrosion-resistant interior components.
5. Temperature Control: Adjustable.
6. Inlets and Outlet: Threaded.
7. Finish: Rough or chrome-plated bronze.
8. Tempered-Water Setting: 110 deg F
9. Tempered-Water Design Flow Rate: 0.5 gpm.

2.5 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller;flanged or grooved for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. Perforation Size:

    a. Strainers: NPS 2 and Smaller: 0.020 inch.
    b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
    c. Strainers NPS 6 and Larger: 0.10 inch.

6. Drain: Factory-installed, hose-end drain valve.

2.6 GROUND HYDRANTS

A. Nonfreeze Ground Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Josam Company.
    b. Murdock, Inc.
    c. Prier Products, Inc.
    d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    e. Tyler Pipe; Wade Div.
    f. Watts Drainage Products Inc.
    g. Woodford Manufacturing Company.
    h. Zurn Plumbing Products Group; Light Commercial Operation.
    i. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.21.3M.
3. Type: Nonfreeze, concealed-outlet ground hydrant with box.
4. Operation: Loose key.
5. Casing and Operating Rod: Of at least length required for burial of valve below frost line.
6. Inlet: NPS 3/4.
7. Outlet: Garden-hose thread complying with ASME B1.20.7.
8. Drain: Designed with hole to drain into ground when shut off.
9. Box: Standard pattern with cover.
10. Box and Cover Finish: Rough bronze.
11. Operating Key(s): Two with each ground hydrant.
12. Vacuum Breaker: ASSE 1011.

2.7 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.

B. Gate-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-80 for gate valves.
2. Pressure Rating: Class 125.
3. Size: NPS 3/4.
4. Body: ASTM B 62 bronze.
5. Inlet: NPS 3/4 threaded or solder joint.
6. Outlet: Garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

C. Stop-and-Waste Drain Valves:

1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
2. Pressure Rating: 200-psig minimum CWP or Class 125.
3. Size: NPS 3/4.
4. Body: Copper alloy or ASTM B 62 bronze.
5. Drain: NPS 1/8 side outlet with cap.

2.8 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. AMTROL, Inc.
   b. Josam Company.
   c. MIFAB, Inc.
   d. PPP Inc.
   e. Sioux Chief Manufacturing Company, Inc.
   f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   g. Tyler Pipe; Wade Div.
   h. Watts Drainage Products Inc.
   i. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.9 AIR VENTS

A. Bolted-Construction Automatic Air Vents:

1. Body: Bronze.
2. Pressure Rating: 125-psig minimum pressure rating at 140 deg F.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 or NPS 1/2 minimum inlet.

6. Inlet and Vent Outlet End Connections: Threaded.

B. Welded-Construction Automatic Air Vents:

1. Body: Stainless steel.
2. Pressure Rating: 150-psig minimum pressure rating.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Locate backflow preventers in same room as connected equipment or system.
2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
3. Do not install bypass piping around backflow preventers.

C. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop.

D. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.

1. Install thermometers and water regulators if specified.
2. Install cabinet-type units recessed in or surface mounted on wall as specified.

E. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, solenoid valve, and pump.

F. Install ground hydrants with 1 cu. yd. of crushed gravel around drain hole. Set ground hydrants with box flush with grade.

G. Install water hammer arresters in water piping according to PDI-WH 201.

H. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 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. Intermediate atmospheric-vent backflow preventers.
3. Reduced-pressure-principle backflow preventers.
4. Reduced-pressure-detector, fire-protection backflow-preventer assemblies.
5. Water pressure-reducing valves.
6. Primary, thermostatic, water mixing valves.
7. Primary water tempering 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 Division 22 Section "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:

1. Test each pressure vacuum breaker, reduced-pressure-principle backflow preventer, double-check backflow-prevention assembly, and double-check, detector-assembly backflow preventer according to authorities having jurisdiction and the device's reference standard.

B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.5 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 22 1119

SECTION 22 1123

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. This Section includes the following all-bronze and bronze-fitted centrifugal pumps for domestic hot-water circulation:

1. Close-coupled, in-line, sealless centrifugal pumps.

1.3 SUBMITTALS

A. Product Data: For each type and size of domestic water pump specified. Include certified performance curves with operating points plotted on curves; and rated capacities of selected models, furnished specialties, and accessories.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Operation and Maintenance Data: For domestic water pumps to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of domestic water pumps and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.5 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 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 CLOSE COUPLED, IN-LINE, SEALLESS CENTRIFUGAL PUMPS

A. Available Manufacturers:

   1. Armstrong Pumps Inc.
   2. Bell & Gossett Domestic Pump; ITT Industries.
   3. Grundfos Pumps Corp.
   4. Taco, Inc.

B. Description: Factory-assembled and -tested, close-coupled, in-line, sealless centrifugal pumps as defined in HI 5.1-5.6.

   1. Pump and Motor Assembly: Hermetically sealed, replaceable-cartridge-type unit with motor and impeller on common shaft and designed for installation with pump and motor shaft mounted horizontally.
   2. Casing: Bronze, with threaded companion-flange connections.
   3. Impeller: Corrosion-resistant material.

C. Capacities and Characteristics: See pump schedule.

2.3 CONTROLS

A. Time Delay Relay: Control for hot-water storage tank circulation pump. Controls shall comply with 2015 International Energy Conservation Code (IECC). Controls shall be capable of limiting the operation of the circulating pump from heating cycle start up to not greater than 5 minutes after the end of the cycle.

   1. Available Manufacturers:

      a. Honeywell International, Inc.
      b. Intermatic, Inc.
      c. Johnson Controls, Inc.
      d. Maple Chase Company.
      e. Square D.
      f. White-Rodgers Div.; Emerson Electric Co.

   2. Type: Adjustable time delay relay.
   3. Range: Up to five minutes.
   4. Setting: Five minutes.
   5. Operation of Pump: On or off.
   6. Transformer: Provide if required.
   7. Programmable Sequence of Operation: Limit pump operation to periods of burner operation plus maximum five minutes after the burner stops.

2.4 FLEXIBLE CONNECTORS

A. Available Manufacturers:

1. Anamet, Inc.
2. Flex-Hose Co., Inc.
3. Flexicraft Industries.
4. Iex-Pression, Ltd.
5. Flex-Weld, Inc.
6. Hyspan Precision Products, Inc.
7. Mercer Rubber.
8. Metraflex, Inc.
9. Proco Products, Inc.

B. Description: Corrugated, bronze inner tubing covered with bronze wire braid. Include copper-tube ends or bronze flanged ends, braze-welded to tubing. Include 125-psig minimum working-pressure rating and ends matching pump connections.

2.5 BUILDING-AUTOMATION-SYSTEM INTERFACE

A. Provide auxiliary contacts in pump controllers for interface to building automation system. Include the following:

1. On-off status of each pump.
2. Alarm status.

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 pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.

C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

D. Install in-line, sealless centrifugal pumps with motor and pump shafts horizontal.

E. Install continuous-thread hanger rods and elastomeric hangers of sufficient size to support pump weight. Vibration isolation devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment." Fabricate brackets or supports as required. Hanger and support materials are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

F. Suspend vertically mounted, in-line centrifugal pumps independent of piping. Install pumps with motor and pump shafts vertical. Use continuous-thread hanger rods and elastomeric hangers of sufficient size to support pump weight. Hanger and support materials are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

3.3 CONTROL INSTALLATION

A. Install time delay relay controls on Storage 008 wall nearby water heater.

3.4 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to 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. Refer to Division 22 Section "Domestic Water Piping."

1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:
   a. Close-coupled, vertically mounted, in-line centrifugal pumps.

2. Install shutoff valve and strainer on suction side of pumps, and check valve and throttling valve on discharge side of pumps. Install valves same size as connected piping. Refer to Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty valves for domestic water piping and Division 22 Section "Domestic Water Piping Specialties" for strainers.
3. Install pressure gages at suction and discharge of pumps. Install at integral pressure-gage tappings where provided or install pressure-gage connectors in suction and discharge piping around pumps. Refer to Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages and gage connectors.

D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.5 Interlock pump with water heater burner and time delay relay.

3.6 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.
2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. 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.

5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
6. Start motor.
7. Open discharge valve slowly.
8. Adjust timer settings.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 22 1123

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SECTION 221125

FACILITY NATURAL-GAS 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. Pipes, tubes, and fittings.
2. Piping specialties.
3. Piping and tubing joining materials.
4. Valves.
5. Pressure regulators.
6. Service meters.
7. Grout.
8. Concrete bases.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions.

1.4 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig minimum unless otherwise indicated.
2. Service Regulators: 100 psig minimum unless otherwise indicated.
3. Minimum Operating Pressure of Service Meter: 65 psig.

B. Delegated Design: Design restraints and anchors for natural-gas piping and equipment, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.5 SUBMITTALS

A. Product Data: For each type of the following:

1. Piping specialties.
2. Corrugated, stainless-steel tubing with associated components.
3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
4. Pressure regulators. Indicate pressure ratings and capacities.
5. Service meters. Indicate pressure ratings and capacities. Include bypass fittings and meter bars and supports.
6. Dielectric fittings.

B. Shop Drawings: For facility natural-gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

1. Shop Drawing Scale: 1/4 inch per foot.
2. Detail mounting, supports, and valve arrangements for service meter assembly and pressure regulator assembly.

C. Coordination Drawings: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.

D. Site Survey: Plans, drawn to scale, on which natural-gas piping is shown and coordinated with other services and utilities.

E. Qualification Data: For qualified professional engineer.

F. Welding certificates.

G. Field quality-control reports.

H. Operation and Maintenance Data: For pressure regulators and service meters to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

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

1.7 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.

B. Deliver pipes and tubes 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.

C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

D. Protect stored PE pipes and valves from direct sunlight.

1.8 PROJECT CONDITIONS

A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.

1.9 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

    a. Material Group: 1.1.
    b. End Connections: Threaded or butt welding to match pipe.
    c. Lapped Face: Not permitted underground.
    d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
    e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.

5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.

    a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.

6. Mechanical Couplings:

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) Dresser Piping Specialties; Division of Dresser, Inc.

2) Smith-Blair, Inc.
3) Victaulic.

b. Steel flanges and tube with epoxy finish.
c. Buna-nitrile seals.
d. Steel bolts, washers, and nuts.
e. Coupling shall be capable of joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
f. Steel body couplings installed underground on plastic pipe shall be factory equipped with anode.

B. Corrugated, Stainless-Steel Tubing: Comply with ANSI/IAS LC 1.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. OmegaFlex, Inc.
b. Parker Hannifin Corporation; Parflex Division.
c. Titeflex.
d. Tru-Flex Metal Hose Corp.

2. Tubing: ASTM A 240/A 240M, corrugated, Series 300 stainless steel.
3. Coating: PE with flame retardant.

a. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1) Flame-Spread Index: 25 or less.
2) Smoke-Developed Index: 50 or less.

4. Fittings: Copper-alloy mechanical fittings with ends made to fit and listed for use with corrugated stainless-steel tubing and capable of metal-to-metal seal without gaskets. Include brazing socket or threaded ends complying with ASME B1.20.1.
5. Striker Plates: Steel, designed to protect tubing from penetrations.
6. Manifolds: Malleable iron or steel with factory-applied protective coating. Threaded connections shall comply with ASME B1.20.1 for pipe inlet and corrugated tubing outlets.
7. Operating-Pressure Rating: 5 psig.

C. Aluminum Tubing: Comply with ASTM B 210 and ASTM B 241/B 241M.

1. Aluminum Alloy: Alloy 5456 is prohibited.
2. Protective Coating: Factory-applied coating capable of resisting corrosion on tubing in contact with masonry, plaster, insulation, water, detergents, and sewerage.
3. Flare Fittings: Comply with ASME B16.26 and SAE J513.

a. Copper-alloy fittings.
b. Metal-to-metal compression seal without gasket.
c. Dryseal threads shall comply with ASME B1.20.3.

D. Drawn-Temper Copper Tube: Comply with ASTM B 88, Type K or ASTM B 837, Type G.

1. Copper Fittings: ASME B16.22, wrought copper, and streamlined pattern.
2. Bronze Flanges and Flanged Fittings: ASME B16.24, Class 150.

a. Gasket Material: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
b. Bolts and Nuts: ASME B18.2.1, carbon steel or stainless steel.

3. Protective Coating for Underground Tubing: Factory-applied, extruded PE a minimum of 0.022 inch thick.

E. Annealed-Temper Copper Tube: Comply with ASTM B 88, Type K or ASTM B 837, Type G.

1. Copper Fittings: ASME B16.22, wrought copper, and streamlined pattern.
2. Flare Fittings: Comply with ASME B16.26 and SAE J513.

a. Copper fittings with long nuts.
b. Metal-to-metal compression seal without gasket.
c. Dryseal threads complying with ASME B1.20.3.

3. Protective Coating for Underground Tubing: Factory-applied, extruded PE a minimum of 0.022 inch thick.

F. Tin-Lined Copper Tube: ASTM B 280, seamless, annealed, with interior tin-plated lining.

1. Flare Fittings: Comply with ASME B16.26 and SAE J513.

a. Copper fittings with long nuts.
b. Metal-to-metal compression seal without gasket.
c. Dryseal threads complying with ASME B1.20.3.

G. PE Pipe: ASTM D 2513, SDR 11.

1. PE Fittings: ASTM D 2683, socket-fusion type or ASTM D 3261, butt-fusion type with dimensions matching PE pipe.
2. PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D 2513, SDR 11; and steel pipe complying with ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
3. Anodeless Service-Line Risers: Factory fabricated and leak tested.

a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet.
b. Casing: Steel pipe complying with ASTM A 53/A 53M, Schedule 40, black steel, Type E or S, Grade B, with corrosion-protective coating covering. Vent casing aboveground.
c. Aboveground Portion: PE transition fitting.
d. Outlet shall be threaded or flanged or suitable for welded connection.
e. Tracer wire connection.
f. Ultraviolet shield.
g. Stake supports with factory finish to match steel pipe casing or carrier pipe.

4. Transition Service-Line Risers: Factory fabricated and leak tested.

a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet connected to steel pipe complying with ASTM A 53/A 53M, Schedule 40, Type E or S, Grade B, with corrosion-protective coating for aboveground outlet.
b. Outlet shall be threaded or flanged or suitable for welded connection.
c. Bridging sleeve over mechanical coupling.
d. Factory-connected anode.
e. Tracer wire connection.
f. Ultraviolet shield.
g. Stake supports with factory finish to match steel pipe casing or carrier pipe.

5. Plastic Mechanical Couplings,NPS 1-1/2 and Smaller: Capable of joining PE pipe to PE pipe.

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) Lyall, R. W. & Company, Inc.
        2) Mueller Co.; Gas Products Div.
        3) Perfection Corporation; a subsidiary of American Meter Company.

    b. PE body with molded-in, stainless-steel support ring.
    c. Buna-nitrile seals.
    d. Acetal collets.
    e. Electro-zinc-plated steel stiffener.

6. Plastic Mechanical Couplings,NPS 2 and Larger: Capable of joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) Lyall, R. W. & Company, Inc.
        2) Mueller Co.; Gas Products Div.
        3) Perfection Corporation; a subsidiary of American Meter Company.

    b. Fiber-reinforced plastic body.
    c. PE body tube.
    d. Buna-nitrile seals.
    e. Acetal collets.
    f. Stainless-steel bolts, nuts, and washers.

7. Steel Mechanical Couplings: Capable of joining plain-end PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:

        1) Dresser Piping Specialties; Division of Dresser, Inc.
        2) Smith-Blair, Inc.

    b. Steel flanges and tube with epoxy finish.
    c. Buna-nitrile seals.
    d. Steel bolts, washers, and nuts.
    e. Factory-installed anode for steel-body couplings installed underground.

2.2 PIPING SPECIALTIES

A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

B. Basket Strainers:

1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

C. T-Pattern Strainers:

1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
2. End Connections: Grooved ends.
3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.
4. CWP Rating: 750 psig.

D. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.3 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.4 MANUAL GAS SHUTOFF VALVES

A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.

B. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.

1. CWP Rating: 125 psig.
2. Threaded Ends: Comply with ASME B1.20.1.
3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
6. Service Mark: Valves 1-1/4 inches to NPS 2) shall have initials "WOG" permanently marked on valve body.

C. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.

1. CWP Rating: 125 psig.
2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
4. Service Mark: Initials "WOG" shall be permanently marked on valve body.

D. One-Piece, Bronze Ball Valve with Bronze Trim: MSS SP-110.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. BrassCraft Manufacturing Company; a Masco company.
    b. Conbraco Industries, Inc.; Apollo Div.
    c. Lyall, R. W. & Company, Inc.
    d. McDonald, A. Y. Mfg. Co.
    e. Perfection Corporation; a subsidiary of American Meter Company.

2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated brass.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Separate packnut with adjustable-stem packing threaded ends.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

E. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. BrassCraft Manufacturing Company; a Masco company.
    b. Conbraco Industries, Inc.; Apollo Div.
    c. Lyall, R. W. & Company, Inc.
    d. McDonald, A. Y. Mfg. Co.
    e. Perfection Corporation; a subsidiary of American Meter Company.

2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

F. Cast-Iron, Nonlubricated Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. McDonald, A. Y. Mfg. Co.
    b. Mueller Co.; Gas Products Div.
    c. Xomox Corporation; a Crane company.

2. Body: Cast iron, complying with ASTM A 126, Class B.
3. Plug: Bronze or nickel-plated cast iron.

4. Seat: Coated with thermoplastic.
5. Stem Seal: Compatible with natural gas.
6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
7. Operator: Square head or lug type with tamperproof feature where indicated.
8. Pressure Class: 125 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

G. PE Ball Valves: Comply with ASME B16.40.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Kerotest Manufacturing Corp.
    b. Lyall, R. W. & Company, Inc.
    c. Perfection Corporation; a subsidiary of American Meter Company.

2. Body: PE.
3. Ball: PE.
4. Stem: Acetal.
5. Seats and Seals: Nitrile.
6. Ends: Plain or fusible to match piping.
7. CWP Rating: 80 psig.
8. Operating Temperature: 0 to plus 140 deg F.
9. Operator: Nut or flat head for key operation.
10. Include plastic valve extension.
11. Include tamperproof locking feature for valves where indicated on Drawings.

H. Valve Boxes:

1. Cast-iron, two-section box.
2. Top section with cover with "GAS" lettering.
3. Bottom section with base to fit over valve and barrel a minimum of 5 inches in diameter.
4. Adjustable cast-iron extensions of length required for depth of bury.
5. Include tee-handle, steel operating wrench with socket end fitting valve nut or flat head, and with stem of length required to operate valve.

2.5 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

B. Appliance Pressure Regulators: Comply with ANSI Z21.18.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Canadian Meter Company Inc.

b. Eaton Corporation; Controls Div.
c. Harper Wyman Co.

2. Body and Diaphragm Case: Die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber.
6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
9. Maximum Inlet Pressure: 0.5 psig.

2.6 DIELECTRIC FITTINGS

A. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Capitol Manufacturing Company.
b. Central Plastics Company.
c. Hart Industries International, Inc.
d. McDonald, A. Y. Mfg. Co.
e. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
f. Wilkins; Zurn Plumbing Products Group.

2. Minimum Operating-Pressure Rating: 150 psig.
3. Combination fitting of copper alloy and ferrous materials.
4. Insulating materials suitable for natural gas.
5. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

B. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Capitol Manufacturing Company.
b. Central Plastics Company.
c. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
d. Wilkins; Zurn Plumbing Products Group.

2. Minimum Operating-Pressure Rating: 150 psig.
3. Combination fitting of copper alloy and ferrous materials.
4. Insulating materials suitable for natural gas.
5. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

C. Dielectric-Flange Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Advance Products & Systems, Inc.
b. Calpico Inc.

c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.

2. Minimum Operating-Pressure Rating: 150 psig.
3. Companion-flange assembly for field assembly.
4. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or PE bolt sleeves, phenolic washers, and steel backing washers.
5. Insulating materials suitable for natural gas.
6. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

2.7 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

2.8 LABELING AND IDENTIFYING

A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Close equipment shutoff valves before turning off natural gas to premises or piping section.

B. Inspect natural-gas piping according to NFPA 54 and the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.

C. Comply with NFPA 54 and the International Fuel Gas Code requirements for prevention of accidental ignition.

3.3 OUTDOOR PIPING INSTALLATION

A. Comply with NFPA 54 and the International Fuel Gas Code for installation and purging of natural-gas piping.

B. Install underground, natural-gas piping buried at least 36 inches below finished grade. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

1. If natural-gas piping is installed less than 36 inches below finished grade, install it in containment conduit.

C. Install underground, PE, natural-gas piping according to ASTM D 2774.

D. Steel Piping with Protective Coating:

1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
3. Replace pipe having damaged PE coating with new pipe.

E. Copper Tubing with Protective Coating:

1. Apply joint cover kits over tubing to cover, seal, and protect joints.
2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.

F. Install fittings for changes in direction and branch connections.

G. Install pressure gage upstream and downstream from each service regulator. Pressure gages are specified in Division 22 Section "Meters and Gages for Plumbing Piping."

3.4 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.

B. Install underground valves with valve boxes.

C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

D. Install anode for metallic valves in underground PE piping.

3.5 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints:

1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
2. Cut threads full and clean using sharp dies.
3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints:

1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
2. Bevel plain ends of steel pipe.
3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.

F. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.

G. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.

H. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.6 CONNECTIONS

A. Connect to utility's gas main according to utility's procedures and requirements.

B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

C. Install piping adjacent to appliances to allow service and maintenance of appliances.

3.7 IDENTIFYING

A. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for piping and valve identification. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.8 PAINTING

A. Comply with requirements in Division 09 painting Sections for painting interior and exterior natural-gas piping.

B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, and piping specialties, except components, with factory-applied paint or protective coating.

1. Alkyd System: MPI EXT 5.1D.

a. Prime Coat: Alkyd anticorrosive metal primer.
b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
c. Topcoat: Exterior alkyd enamel gloss.
d. Color: Yellow.

C. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.
1. Install anchor bolts to elevations required for proper attachment to supported equipment.

D. Perform tests and inspections.

E. Tests and Inspections:

1. Test, inspect, and purge natural gas according to NFPA 54 and the International Fuel Gas Code and authorities having jurisdiction.

F. Natural-gas piping will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

3.9 DEMONSTRATION

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

3.10 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Valves for pipe sizes NPS 2 and smaller at service meter shall be one of the following:

1. One-piece, bronze ball valve with bronze trim.
2. Two-piece, full-port, bronze ball valves with bronze trim.
3. Bronze plug valve.

B. Valves for pipe sizes NPS 2-1/2 and larger at service meter shall be one of the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.
2. Bronze plug valve.
3. Cast-iron, nonlubricated plug valve.

C. Distribution piping valves for pipe sizes NPS 2 and smaller shall be one of the following:

1. One-piece, bronze ball valve with bronze trim.
2. Two-piece, full-port, bronze ball valves with bronze trim.
3. Bronze plug valve.

D. Distribution piping valves for pipe sizes NPS 2-1/2 and larger shall be one of the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.
2. Bronze plug valve.
3. Cast-iron, nonlubricated plug valve.

E. Valves in branch piping for single appliance shall be one of the following:

1. One-piece, bronze ball valve with bronze trim.
2. Two-piece, full-port, bronze ball valves with bronze trim.
3. Bronze plug valve.

END OF SECTION 22 1125

SECTION 22 1316

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. This Section includes the following for soil, waste, and vent piping inside the building:

1. Pipe, tube, and fittings.
2. Special pipe fittings.

B. Related Sections include the following:

1. Division 22 Section "Sanitary Sewerage Pumps."
2. Division 22 Section "Sanitary Waste Piping Specialties".

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

C. LLDPE: Linear, low-density polyethylene plastic.

D. NBR: Acrylonitrile-butadiene rubber.

E. PE: Polyethylene plastic.

F. PVC: Polyvinyl chloride plastic.

G. TPE: Thermoplastic elastomer.

1.4 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water.

1.5 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

B. Shop Drawings:
   1. Sanitary waste and vent System: Include plans, elevations and sections (as required), and details. Provide shop drawings for review before construction.

C. Field quality-control inspection and test reports.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service class.

B. Gaskets: ASTM C 564, rubber.

C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.4 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Sovent Stack Fittings: ASME B16.45 or ASSE 1043, hubless, cast-iron aerator and deaerator drainage fittings.

C. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.

1. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.

    a. Available Manufacturers:

        1) ANACO.
        2) Fernco, Inc.
        3) Ideal Div.; Stant Corp.
        4) Mission Rubber Co.
        5) Tyler Pipe; Soil Pipe Div.
        6) Charlotte

2. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.

    a. Available Manufacturers:

        1) ANACO.
        2) Clamp-All Corp.
        3) Ideal Div.; Stant Corp.
        4) Mission Rubber Co.
        5) Tyler Pipe; Soil Pipe Div.
        6) Charlotte.

3. Heavy-Duty, Shielded, Cast-Iron Couplings: ASTM A 48/A 48M, two-piece, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve.

    a. Available Manufacturers:

        1) MG Piping Products Co.
        2) Charlotte.
        3) Tyler Pipe.

D. Rigid, Unshielded Couplings: 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.

1. Available Manufacturers:

    a. ANACO.

    b. Charlotte.

    c. Tyler Pipe

2.5 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade A or B, Standard Weight or Schedule 40, galvanized. Include ends matching joining method.

B. Drainage Fittings: ASME B16.12, galvanized, threaded, cast-iron drainage pattern.

C. Pressure Fittings:

1. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, galvanized, seamless steel pipe. Include ends matching joining method.
2. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.
3. Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, galvanized, standard pattern.
4. Cast-Iron Flanges: ASME B16.1, Class 125.
5. Cast-Iron, Flanged Fittings: ASME B16.1, Class 125, galvanized.

D. Grooved-Joint Systems:

1. Available Manufacturers:

a. Anvil International.
b. Star Pipe Products; Star Fittings Div.
c. Victaulic Company.
d. Ward Manufacturing, Inc.

2. Grooved-End, Steel-Piping Fittings: ASTM A 47/A 47M, galvanized, malleable-iron casting; ASTM A 106, galvanized-steel pipe; or ASTM A 536, galvanized, ductile-iron casting; with dimensions matching steel pipe.
3. Grooved-End, Steel-Piping Couplings: AWWA C606, for steel-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.

2.6 STAINLESS-STEEL PIPE AND FITTINGS

A. Pipe and Fittings: ASME A112.3.1, drainage pattern with socket and spigot ends.

B. Gaskets: Lip seals shaped to fit socket groove, with plastic backup ring.

1. Material: EPDM, unless NBR is indicated.

2.7 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end, unless grooved or flanged ends are indicated.

1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end, unless grooved or flanged ends are indicated.

1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Gaskets: AWWA C111, rubber.

C. Grooved-Joint Systems:

1. Available Manufacturers:

a. Victaulic Company.

b. Star
c. Ward
d. Anvil.

2. Grooved-End, Ductile-Iron Fittings: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions matching pipe.
3. Grooved-End, Ductile-Iron-Piping Couplings: AWWA C606, for ductile-iron-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.

D. Flanges: ASME 16.1, Class 125, cast iron.

2.8 COPPER TUBE AND FITTINGS

A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.

1. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

B. Hard Copper Tube: ASTM B 88, Types L and M, water tube, drawn temper.

1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
3. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

C. Soft Copper Tube: ASTM B 88, Type L, water tube, annealed temper.

1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.

2.9 ABS PIPE AND FITTINGS: Note that plastic piping is not allowed in a return air plenum or exposed outside.

A. Solid-Wall ABS Pipe: ASTM D 2661, Schedule 40.

B. ABS Socket Fittings: ASTM D 2661, made to ASTM D 3311, drain, waste, and vent patterns.

2.10 PVC PIPE AND FITTINGS: Note that plastic piping is not allowed in a return air plenum or exposed outside.

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.

2.11 SPECIAL PIPE FITTINGS

A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Available Manufacturers:

a. Dallas Specialty & Mfg. Co.
b. Fernco, Inc.
c. Logan Clay Products Company (The).
d. Mission Rubber Co.
e. NDS, Inc.
f. Plastic Oddities, Inc.

2. Sleeve Materials:

a. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
b. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
c. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

B. Shielded Nonpressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Available Manufacturers:

a. Cascade Waterworks Mfg. Co.
b. Mission Rubber Co.

C. Rigid, Unshielded, Nonpressure Pipe Couplings: 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.

1. Available Manufacturers:

a. ANACO.

D. Pressure Pipe Couplings: AWWA C219 metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.

1. Available Manufacturers:

a. Cascade Waterworks Mfg. Co.
b. Dresser, Inc.; DMD Div.
c. EBAA Iron Sales, Inc.
d. Ford Meter Box Company, Inc. (The); Pipe Products Div.
e. JCM Industries, Inc.
f. Romac Industries, Inc.
g. Smith-Blair, Inc.
h. Viking Johnson.

2. Center-Sleeve Material: Manufacturer's standard.
3. Gasket Material: Natural or synthetic rubber.
4. Metal Component Finish: Corrosion-resistant coating or material.

E. Flexible Ball Joints: Ductile-iron fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include gasketed ball-joint section and ductile-iron gland, rubber gasket, and steel bolts.

1. Available Manufacturers:

a. EBAA Iron Sales, Inc.

F. Wall-Penetration Fittings: Compound, ductile-iron coupling fitting with sleeve and flexing sections for up to 20-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

1. Available Manufacturers:

a. SIGMA Corp.
b. GPD (Link Seal).

PART 3 - EXECUTION

3.1 EXCAVATION

A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

B. Aboveground, soil, waste and vent piping 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 and sovent stack fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.
3. Steel pipe, drainage fittings, and threaded joints.
4. Stainless-steel pipe and fittings, gaskets, and gasketed joints.
5. Copper DWV tube, copper drainage fittings, and soldered joints.
6. Dissimilar Pipe-Material Couplings: Flexible, Shielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

C. Underground, soil, waste, and vent piping shall be any of the following:

1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.
3. Stainless-steel pipe and fittings, gaskets, and gasketed joints.
4. Solid wall ABS pipe, ABS socket fittings, and solvent-cemented joints.
5. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
6. Cellular-core, Sewer and Drain Series, PVC pipe; PVC socket fittings; and solvent-cemented joints.
7. Dissimilar Pipe-Material Couplings: Flexible, Shielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

3.3 PIPING INSTALLATION

A. Sanitary sewer piping outside the building is specified in Division 22 Section "Facility Sanitary Sewers."

B. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."

C. Install seismic restraints on piping. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

D. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

E. Install underground, ductile-iron, special pipe fittings according to AWWA C600.

1. Install encasement on piping according to ASTM A 674 or AWWA C105.

F. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."

G. Install wall-penetration fitting at each service pipe penetration through foundation wall. Make installation watertight.

H. 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.

I. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

J. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

K. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:

1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

L. Install engineered soil and waste drainage and vent piping systems as follows:

1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
2. Sovent Drainage System: Comply with ASSE 1043 and sovent fitting manufacturer's written installation instructions.
3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.

M. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

N. Install underground ABS and PVC soil and waste drainage piping according to ASTM D 2321.

O. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.4 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. 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.

C. 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.

D. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

E. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

F. Grooved Joints: Assemble joint with keyed coupling, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

G. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.5 VALVE INSTALLATION

A. General valve installation requirements are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

B. Shutoff Valves: Install shutoff valve on each sewage pump discharge.

1. Install gate or full-port ball valve for piping NPS 2 and smaller.
2. Install gate valve for piping NPS 2-1/2 and larger.

C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

D. Backwater Valves: Install backwater valves in piping subject to sewage 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. Backwater valve are specified in Division 22 Section "Sanitary Waste Piping Specialities."

3.6 HANGER AND SUPPORT INSTALLATION

A. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Install individual, straight, horizontal piping runs according to the following:

    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet : MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet , if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
4. NPS 6: 60 inches with 3/4-inch rod.
5. NPS 8 to NPS 12: 60 inches with 7/8-inch rod.

G. Install supports for vertical cast-iron soil piping every 15 feet.

H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 84 inches with 3/8-inch rod.
2. NPS 1-1/2: 108 inches with 3/8-inch rod.
3. NPS 2: 10 feet with 3/8-inch rod.
4. NPS 2-1/2: 11 feet with 1/2-inch rod.
5. NPS 3: 12 feet with 1/2-inch rod.
6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
7. NPS 6: 12 feet with 3/4-inch rod.
8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.

I. Install supports for vertical steel piping every 15 feet.

J. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS: 84 inches with 3/8-inch rod.
2. NPS 3: 96 inches with 1/2-inch rod.
3. NPS 4: 108 inches with 1/2-inch rod.
4. NPS 6: 10 feet with 5/8-inch rod.

K. Install supports for vertical stainless-steel piping every 10 feet.

L. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 72 inches with 3/8-inch rod.

2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
3. NPS 2-1/2: 108 inches with 1/2-inch rod.
4. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
5. NPS 6: 10 feet with 5/8-inch rod.
6. NPS 8: 10 feet with 3/4-inch rod.

M. Install supports for vertical copper tubing every 10 feet.

N. Install hangers for ABS and or 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 5: 48 inches with 5/8-inch rod.
4. NPS 6: 48 inches with 3/4-inch rod.
5. NPS 8 to NPS 12: 48 inches with 7/8-inch rod.

O. Install supports for vertical ABS and or PVC piping every 48 inches.

P. Support piping and tubing not listed above according to MSS SP-69 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 drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage 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 drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

3.8 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction 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 drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, 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 to completion of inspection, water level must not drop. 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. 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. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. 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.

E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
4. Prepare reports for tests and required corrective action.

3.9 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 22 1316

SECTION 22 1319

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. This Section includes the following sanitary drainage piping specialties:

1. Backwater valves.
2. Cleanouts.
3. Floor drains/sinks.
4. Roof flashing assemblies.
5. Through-penetration firestop assemblies.
6. Miscellaneous sanitary drainage piping specialties.
7. Flashing materials.
8. Utility Protection Systems
9. Utility Protection Systems Permanent Rigid Soil Retainer

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. FRP: Fiberglass-reinforced plastic.

C. HDPE: High-density polyethylene plastic.

D. PE: Polyethylene plastic.

E. PP: Polypropylene plastic.

F. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:

1. All items listed in 1.2, A. of this specification

B. Shop Drawings: Show fabrication and installation details for frost-resistant vent terminals.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate size and location of roof penetrations.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 BACKWATER VALVES

A. Horizontal, Cast-Iron Backwater Valves <Insert drawing designation if any>:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Josam Company; Josam Div.
b. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
c. Tyler Pipe; Wade Div.
d. Watts Drainage Products Inc.
e. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.14.1.
3. Size: Same as connected piping.
4. Body: Cast iron.
5. Cover: Cast iron with bolted or threaded access check valve.
6. End Connections: Hub and spigot or hubless.
7. Type 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.

B. Drain-Outlet Backwater Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Josam Company; Josam Div.
b. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
c. Watts Drainage Products Inc.
d. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Size: Same as floor drain outlet.
3. Body: Cast iron or bronze made for vertical installation in bottom outlet of floor drain.
4. Check Valve: Removable ball float.
5. Inlet: Threaded.
6. Outlet: Threaded or spigot.

C. Horizontal, Plastic Backwater Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Canplas LLC.
b. IPS Corporation.
c. NDS Inc.
d. Oatey.
e. Plastic Oddities; a division of Diverse Corporate Technologies.
f. Sioux Chief Manufacturing Company, Inc.
g. Zurn Plumbing Products Group; Light Commercial Operation.

2. Size: Same as connected piping.
3. Body: ABS or PVC.
4. Cover: Same material as body with threaded access to check valve.
5. Check Valve: Removable swing check.
6. End Connections: Socket type.

2.2 CLEANOUTS

A. Exposed Metal Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Josam Company; Josam Div.
b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
c. Tyler Pipe; Wade Div.
d. Watts Drainage Products Inc.
e. Zurn Plumbing Products Group; Specification Drainage Operation.
f. Josam Company; Blucher-Josam Div.

2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: as required to match connected piping.
5. Closure: Countersunk plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Closure: Stainless-steel plug with seal.

B. Metal Floor Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Josam Company; Josam Div.
    b. Oatey.
    c. Sioux Chief Manufacturing Company, Inc.
    d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    e. Tyler Pipe; Wade Div.
    f. Watts Drainage Products Inc.
    g. Zurn Plumbing Products Group; Light Commercial Operation.
    h. Zurn Plumbing Products Group; Specification Drainage Operation.
    i. Josam Company; Josam Div.
    j. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
2. Standard: ASME A112.36.2M for heavy-duty, 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: Nickel-bronze, copper alloy.
11. Frame and Cover Shape: Square.
12. Top Loading Classification: Medium Duty.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
14. Standard: ASME A112.3.1.
15. Size: Same as connected branch.
16. Housing: Stainless steel.
17. Closure: Stainless steel with seal.
18. Riser: Stainless-steel drainage pipe fitting to cleanout.

C. Cast-Iron Wall Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Josam Company; Josam Div.
    b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    c. Tyler Pipe; Wade Div.
    d. Watts Drainage Products Inc.
    e. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: as required to match connected piping.
5. Closure: Countersunk 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 FLOOR DRAINS/SINKS

A. Cast-Iron Floor Drains/Sinks:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Josam Company; Josam Div.

b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
c. Tyler Pipe; Wade Div.
d. Watts Drainage Products Inc.
e. Zurn Plumbing Products Group; Light Commercial Operation.
f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.6.3

3. Features: See Schedule.

2.4 ROOF FLASHING ASSEMBLIES: See Architectural drawings and specifications.

2.5 THROUGH-PENETRATION FIRESTOP ASSEMBLIES: See Architectural drawings and specifications.

2.6 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 with increaser fitting of size indicated.

B. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.

a. NPS 2: 4-inch-minimum water seal.
b. NPS 2-1/2and Larger: 5-inch-minimum water seal.

C. 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.

D. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

E. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

F. Vent Caps:

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

G. Expansion Joints:

1. Standard: ASME A112.21.2M.
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.

2.7 FLASHING MATERIALS: See Architectural drawings and specifications.

2.8 UTILITY PROTECTION SYSTEMS:

A. Sacrificial Utility Protection Pipe Void Form Systems, hereinafter referred to as “Utility Protection Systems”. Utility Protection Systems shall always be used in conjunction with Rigid Retainers as a SYSTEM to maintain void spaces below critical building systems during and after construction. Rigid Retainers are covered by a separate specification. Utility Protection Systems serve as sacrificial falsework, which isolate critical building systems, such as utility pipes and electrical conduits, from the potentially damaging effects of expansive soils. The Utility Protection Systems furnished for this project shall be in accordance with these specifications and in reasonably close conformity with the lines, grades, design and dimensions shown on the plans or as established by the Engineer. The Utility Protection Systems shall be resistant to water and UV rays and shall be chiefly comprised of carbon steel expanded metal, which is structurally efficient and biodegradable. The carbon steel shall contain a minimum of 40% RECYCLED material. In situations where two or more specifications apply to this work, the most stringent requirements shall govern.

B. Utility Protection Systems Structure:

1. Utility protection systems shall provide a dimensionally stable void space, maintaining uniform separation between the base soil and the critical building systems. The Utility Protection Systems shall have sufficient structural strength to maintain the intended void space while experiencing the anticipated construction loads.

2. The Utility Protection Systems shall be designed to perform as sacrificial falsework and shall remain in place after construction and shall not be reused.

3. Serving as a structural fuse, Utility Protection Systems shall reduce the accumulation of forces on critical building systems which can result from soil movement. The Utility Protection Systems shall absorb or redirect the forces of soil movements by: crumpling, crushing, collapsing, deforming, material section degradation, soil extrusion, open corrugation load span designs or combination of any or all load relief design functions.

C. Utility Protection Systems Material:

1. Utility Protection Systems shall be constructed from Carbon Steel Expanded Metal, Types I & II, conforming to ASTM F1267 and shall be assembled when required with 16ga. galvanized steel C-Rings.

2. The carbon steel shall conform to ASTM A1011 and contain a minimum of 40% RECYCLED material.

3. All assembly and/or fabrications of the Utility Protection Systems shall occur entirely within the United States.

4. The Utility Protection Systems material shall not promote the formation or emergence of mold spore, organic or other biological colonization.

5. The Utility Protection Systems must be able to be delivered and stored unprotected in the open jobsite environment for a minimum of 90 days without loss of design strength.

D. Utility Protection Systems Material, Minimum Performance Requirements:

1. Utility Protection Systems shall be constructed from Carbon Steel Expanded Metal, Types I & II, conforming to ASTM F1267 and shall be assembled when required with 16ga. galvanized steel C-Rings.

2. The carbon steel shall conform to ASTM A1011 and contain a minimum of 40% RECYCLED material.

3. All assembly and/or fabrications of the Utility Protection Systems shall occur entirely within the United States.

4. The Utility Protection Systems material shall not promote the formation or emergence of mold spore, organic or other biological colonization.

5. The Utility Protection Systems must be able to be delivered and stored unprotected in the open jobsite environment for a minimum of 90 days without loss of design strength.

E. Utility Protection Systems Material, Minimum Physical Properties Requirements:

1. Utility Protection Systems shall be naturally waterproof in terms of its intended use in this section.

2. Utility Protection Systems shall have negligible buoyancy.

3. Utility Protection Systems shall maintain structural integrity in 100% relative humidity.

4. Utility Protection Systems material shall not emit offensive off-gassing odors during decomposition.

5. The structural integrity of the Utility Protection Systems shall be unaffected by high/low ambient temperatures and elevated surface temperatures from direct sunlight extremes, above or sub-freezing, frozen soil and ice buildup.

6. Utility Protection Systems must have an industry history of providing consistent performance integrity during and after all types of weather event applications, while in readiness storage or installed, without the threat of partial or full section premature collapse during concrete casting.

7. Utility Protection Systems strength shall not be affected by becoming damp, wet, or when completely submerged in standing water.

8. Utility Protection Systems must be fire-resistant and incombustible.

F. Utility Protection Systems Material, Minimum Performance Requirements:

1. Utility Protection Systems shall be constructed from Carbon Steel Expanded Metal, Types I & II, conforming to ASTM F1267 and shall be assembled when required with 16ga. galvanized steel C-Rings. The Utility Protection Systems (system) shall be designed to provide sufficient dynamic live and dead load support capacities of but not limited to all loads common to this type of construction; Installation of utility piping and/or conduit – dead/live loads, placement of backfill materials, and manpower and foot traffic loads.

2. Sub-standard Utility Protection Systems cover sheet substrates, can affect desired performance; use only the types of substrates as those approved for use and recommended by the Utility Protection Systems manufacturer.

3. Substrate materials shall originate from FSC (Forest Stewardship Council, United States) mills and be in new or like new condition, performing to APA (The Engineered Wood Association) current standards.

G. Manufacturers:

1. SuperVoid Systems, LLC

2. Or approved equal. Other Utility Protection Systems manufacturers must meet ALL of the requirements stated in these specifications and be approved prior to project bid in order to be considered.

2.9 UTILITY PROTECTIONS SYSTEM PERMANENT RIGID SOIL RETAINER:

A. Permanent Rigid Soil Retainers, hereinafter referred to as "Rigid Retainers," also known as "Rib Retainers. Rigid Retainers serve as soil retainers, which maintain and preserve void envelopes beneath structural concrete and other critical building systems and components, thereby isolating them from the potential damaging effects of expansive soils. The Rigid Retainers furnished for this project shall be in accordance with these specifications and in reasonably close conformity with the lines, grades, design and dimensions shown on the plans or as established by the Engineer. The Rigid Retainers shall be resistant to water and UV rays and shall be chiefly comprised of extruded or injection molded High Density Polyethylene (HDPE), which is structurally efficient and non-biodegradable. The HDPE shall contain a minimum of 95% RECYCLED material. (5% for colorant and plastic foaming additives) In situations where two or more specifications apply to this work, the most stringent requirements shall govern.

B. Rigid Retainer Structure:

1. Rigid Retainers shall maintain a dimensionally stable void space beneath structural concrete and other critical building systems and components by physically restraining backfill material from entering the void space. The Rigid Retainers shall have sufficient structural strength to maintain the intended void space, without excessive deflection, while experiencing the anticipated lateral earth pressures.

2. The Rigid Retainers shall be designed to perform as a permanent soil retaining structure which shall remain in place after construction and shall not be reused.

3. For "Best Practice Standards," the Rigid Retainers recommended installation is to overlap concrete castings by at least six (6) inches and extend a minimum of at least six (6) inches into the subgrade.

4. Rigid Retainers should be secured to the concrete at the top with at least three (3) anchors of sufficient size and securing strength, one at each end of the overlapping joint seal design and one centered.

5. A "Minimum Design Standard," for the Rigid Retainers shall be designed to overlap concrete castings by at least three (3) inches and extend a minimum of at least three (3) inches into the subgrade.

C. Rigid Retainer Material:

1. The Rigid Retainers shall be constructed from extruded or injection molded High Density Polyethylene (HDPE).

2. The HDPE material shall be either HDPE-8 (Crate Grade) or HDPE-8 (Pail Grade) and shall contain a minimum of 95% RECYCLED material. (5% for colorant and plastic foaming additives)

3. The HDPE shall conform to the following: ASTM D 1238 or ASTM D 1238E, ASTM D 4883, ASTM D 638, ASTM D 790, ASTM D 256, ASTM D 2240 and ASTM D 648.

4. Rigid Retainers shall be manufactured entirely within the United States.

D. Rigid Retainer Material, Minimum Physical Properties Requirements:

1. Rigid Retainer shall be naturally waterproof in terms of its intended use in this section.

2. Rigid Retainer shall have negligible buoyancy.

3. Rigid Retainer shall maintain structural integrity in 100% relative humidity.

4. Rigid Retainer material shall be non-biodegradable.

E. Rigid Retainer Material, Minimum Performance Requirements:

1. Rigid Retainers material shall provide sufficient dynamic live and dead load support capacities of but not limited to all loads common to this type of construction; Installation of backfill material – construction live loads and Manpower and foot traffic loads.

2. Rigid Retainers material shall possess sufficient structural strength to resist anticipated lateral earth pressures.

3. Rigid Retainers must be able to be delivered and stored unprotected in the open jobsite environment for a minimum of 90 days without loss of design strength.

4. The structural integrity and installation of the Rigid Retainer shall be functionally unaffected by high/low ambient temperatures and elevated surface temperatures from direct sunlight extremes, above or sub-freezing, frozen soil and ice buildup.

5. Rigid Retainer material strength shall not be affected by becoming damp, wet, or when completely submerged in standing water.

6. These Rigid Retainer general specifications, with recommended application height and position adjustments, also apply to other Rigid Retainer assemblies such as, SV – Pipe Void Systems.

F. Rigid Retainer, Industry History:

1. Rigid Retainer must have an industry history of providing consistent performance integrity during and after all types of weather event applications, while in readiness storage or installed, without the threat of partial or full section collapse during or after backfill.

G. Manufacturers:

1. SuperVoid Systems, LLC

2. Or approved equal. Other Utility Protection Systems manufacturers must meet ALL of the requirements stated in these specifications and be approved prior to project bid in order to be considered.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install backwater valves in building drain piping. 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.

C. 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.

D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

F. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:

a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.

3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

G. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

H. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

I. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.

J. Assemble open drain fittings and install with top of hub 2 inches above floor.

K. Install deep-seal traps on floor drains and other waste outlets, if indicated.

L. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

M. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

N. Install vent caps on each vent pipe passing through roof.

O. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

P. Install wood-blocking reinforcement for wall-mounting-type specialties.

Q. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

R. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FLASHING INSTALLATION (Coordinate with Architectural drawings and specifications)

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft, 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
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 pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."

F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Leak Test: After installation, charge system 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.

3.5 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.

3.6 DEMONSTRATION

Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain devices. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 22 1319

SECTION 22 1329

SANITARY SEWERAGE 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. This Section includes the following sewage pumps and accessories for sanitary drainage piping systems in buildings:

1. Submersible sewage pumps.
2. Sewage pump basins and pits.

B. Related Sections include the following:

1. Division 22 Section "Sump Pumps" for applications in storm-drainage systems.

1.3 SUBMITTALS

A. Product Data: For each type and size of sewage pump specified. Include certified performance curves with operating points plotted on curves; and rated capacities of selected models, furnished specialties, and accessories.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Operation and Maintenance Data: For each sewage pump to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of sewage pumps and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

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.

1.5 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.

1.6 COORDINATION

A. Coordinate size and location of concrete bases and pits. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SUBMERSIBLE SEWAGE PUMPS

A. Submersible Pumps: Factory-assembled and tested, duplex, single-stage, centrifugal, end-suction, submersible, direct-connected effluent pumps complying with UL 778 and with HI 1.1-1.2 and HI 1.3 for submersible sewage pumps.

1. Available Manufacturers:

a. ABS Pumps, Inc.
b. Aermotor Pumps, Inc.
c. Barnes; Crane Pumps & Systems.
d. Bell & Gossett Domestic Pump; ITT Industries.
e. Federal Pump Corp.
f. Flygt; ITT Industries.
g. Goulds Pumps; ITT Industries.
h. Grundfos Pumps Corp.
i. HOMA Pump Technology.
j. Hydromatic Pumps; Pentair Pump Group (The).
k. KSB Inc.
l. Liberty Pumps.
m. Little Giant Pump Co.
n. McDonald, A. Y. Mfg. Co.
o. Metropolitan Industries, Inc.
p. Myers, F. E.; Pentair Pump Group (The).
q. Stancor, Inc.
r. Sta-Rite Industries, Inc.
s. Zoeller Company.

2. Casing: Cast iron, with open inlet, legs that elevate pump to permit flow into impeller, and vertical discharge with companion flange for piping connection.

3. Impeller: ASTM A 48/A 48M, Class No. 25 A or higher cast iron, ASTM A 532/A 532M, abrasion-resistant cast iron, or ASTM B 584, cast bronze; statically and dynamically balanced, closed or semiopen design for clear wastewater; overhung, single suction, and keyed and secured to shaft.
4. Pump and Motor Shaft: Stainless steel, with factory-sealed, grease-lubricated ball bearings and double mechanical seals.
5. 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. Comply with Division 22 Section "Common Motor Requirements for Plumbing Equipment."

    a. Moisture-Sensing Probe: Internal moisture sensor and moisture alarm.
    b. Motor Housing Fluid: Air or oil.

6. Guide-Rail Supports: Include the following for each sewage pump:

    a. Guide Rails: Vertical pipes or structural members, made of galvanized steel or other corrosion-resistant metal, attached to baseplate and basin sidewall or cover.
    b. Baseplate: Corrosion-resistant metal plate, attached to basin floor, supporting guide-rail supports and stationary elbow.
    c. Pump Yoke: Motor-mounted or casing-mounted yokes or other attachments for aligning pump during connection of flanges.
    d. Movable Elbow: Pump discharge-elbow fitting with flange, seal, and positioning device.
    e. Stationary Elbow: Fixed discharge-elbow fitting with flange that mates to movable-elbow flange and support attached to baseplate.
    f. Lifting Cable: Stainless steel; attached to pump and cover at manhole.

B. Pump Discharge Piping: Factory or field fabricated, ASTM A 53/A 53M, Schedule 40, galvanized-steel pipe, bronze pipe, or copper tube.

C. Basin Cover: Cast iron or coated steel and suitable to support controls. See Part 2 "Sewage Pump Basins" Article for other requirements.

D. Controls: Refer to drawings for more information. Pump controls shall match pump manufacturer or be as specified by engineer.

E. Capacities and Characteristics: See schedule.

2.3 SEWAGE PUMP BASINS

A. Description: Factory fabricated basin with sump, pipe connections, and separate cover.

B. Sump: Fabricate watertight, with sidewall openings for pipe connections.

1. Material: Fiberglass or HDPE.
2. Reinforcement: Mounting plates for pumps, fittings, guide-rail supports, and accessories.
3. Anchor Flange: Same material as or compatible with sump, cast in or attached to sump, in location and of size required to anchor basin in concrete slab.

C. Cover: Fabricate with openings having gaskets, seals, and bushings; for access to pumps, pump shafts, control rods, discharge piping, vent connections, and power cables.

1. Material: Cast iron.

2. Reinforcement: Steel or cast iron, capable of supporting foot traffic for basins installed in foot-traffic areas.

D. Capacities and Characteristics:

1. Material: Fiberglass or HDPE.
2. Diameter: 3'.
3. Depth: Exact depth shall be field coordinated. Refer to detail for more information.
4. Inlet No. 1:

    a. Drainage Pipe Size: 4".
    b. Bottom of Sump to Centerline: Field coordinate.
    c. Type: Threaded outside.

5. Inlet No. 2:

    a. Drainage Pipe Size: 4".
    b. Bottom of Sump to Centerline: Field coordinate.
    c. Type: Threaded outside.

6. Sidewall Outlet:

    a. Discharge Pipe Size: 2"
    b. Bottom of Sump to Centerline: Field coordinate.
    c. Type: Hubbed outside

7. Cover:

    a. Material: Cast iron.
    b. Diameter: 3'.
    c. Vent Size: 3".

2.4 FLEXIBLE CONNECTORS

A. Available Manufacturers:

1. Anamet, Inc.
2. Flex-Hose Co., Inc.
3. Flexicraft Industries.
4. Flex-Pression, Ltd.
5. Flex-Weld, Inc.
6. Hyspan Precision Products, Inc.
7. Mercer Rubber.
8. Metraflex, Inc.
9. Proco Products, Inc.
10. Tozen America Corporation.
11. Unaflex Inc.

B. Description: 125-psig minimum working-pressure rating and ends matching pump connections:

1. Bronze Flexible Connectors: Corrugated, bronze inner tubing covered with bronze wire braid. Include copper-tube ends or bronze flanged ends, braze-welded to tubing.

2. Stainless-Steel Flexible Connectors: Corrugated, stainless-steel inner tubing covered with stainless-steel wire braid. Include stainless-steel nipples or flanges, welded to tubing.

2.5 BUILDING AUTOMATION SYSTEM INTERFACE

A. Provide auxiliary contacts in pump controllers for interface to building automation system. Include the following:

1. On-off status of each pump.
2. Alarm status.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for plumbing piping to verify actual locations of sanitary drainage and vent piping connections before sewage pump installation.

3.2 CONCRETE

A. Install concrete bases of dimensions indicated for pumps and controllers. Refer to Division 22 Section "Common Work Results for Plumbing."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of base.
2. For supported equipment, 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.

B. Cast-in-place concrete materials and placement requirements are specified in Division 03.

3.3 INSTALLATION

A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

B. Install sewage pumps according to applicable requirements in HI 1.4.

C. Install pumps and arrange to provide access for maintenance including removal of motors, impellers, couplings, and accessories.

D. Set submersible sewage pumps on basin floors. Make direct connections to sanitary drainage piping.

1. Anchor guide-rail supports to basin bottoms and sidewalls or covers. Install pumps so pump and discharge pipe disconnecting flanges make positive seals when pumps are lowered into place.

E. Install sewage pump basins and connect to drainage and vent piping. Brace interior of basins according to manufacturer's written instructions to prevent distortion or collapse during concrete placement. Set basin cover and fasten to basin top flange. Install cover so top surface is flush with finished floor.

F. Support piping so weight of piping is not supported by pumps.

3.4 CONNECTIONS

A. Piping installation requirements are specified in Division 22 Section "Sanitary Waste and Vent Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to sewage pumps to allow service and maintenance.

C. Connect sanitary drainage and vent piping to pumps. Install discharge piping equal to or greater than size of pump discharge piping. Install vent piping equal to or greater than size of pump basin vent connection. Refer to Division 22 Section "Sanitary Drainage and Vent Piping."

1. Install flexible connectors adjacent to pumps in discharge piping.
2. Install check and shutoff valves on discharge piping from each pump. Install unions on pumps having threaded pipe connections. Install valves same size as connected piping. Refer to Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty valves for sanitary waste piping.

D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.5 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.
2. Verify bearing lubrication.
3. Disconnect couplings and check motors for proper direction of rotation.
4. Verify that each pump is free to rotate by hand. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
5. Verify that pump controls are correct for required application.

B. Start pumps without exceeding safe motor power:

1. Start motors.
2. Open discharge valves slowly.
3. Check general mechanical operation of pumps and motors.

C. Test and adjust controls and safeties.

D. Remove and replace damaged and malfunctioning components.

1. Pump Controls: Set pump controls for automatic start, stop, and alarm operation as required for system application.
2. Set field-adjustable switches and circuit-breaker trip ranges as indicated, or if not indicated, for normal operation.

E. 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 outside normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain[controls and] pumps. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 22 1329

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SECTION 22 1429

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. This Section includes the following sump pumps and accessories, inside the building, for building storm drainage systems:

1. Submersible sump pumps.
2. Sump pump pits.

B. Related Sections include the following:

1. Division 22 Section "Sanitary Sewerage Pumps" for application in sanitary drainage systems.

1.3 SUBMITTALS

A. Product Data: For each type and size of sump pump specified. Include certified performance curves with operating points plotted on curves, and rated capacities of selected models, furnished specialties, and accessories.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Operation and Maintenance Data: For each sump pump to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of sump pumps and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

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.

1.5 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.

1.6 COORDINATION

A. Coordinate size and location of concrete bases and pits with the Structural Engineer. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SUBMERSIBLE SUMP PUMPS

A. Available Manufacturers:

1. ABS Pumps, Inc.
2. Aermotor Pumps, Inc.
3. Barnes; Crane Pumps & Systems.
4. Bell & Gossett Domestic Pump; ITT Industries.
5. Federal Pump Corp.
6. Gorman-Rupp Company (The).
7. Goulds Pumps; ITT Industries.
8. Grundfos Pumps Corp.
9. Liberty Pumps.
10. Little Giant Pump Co.
11. McDonald, A. Y. Mfg. Co.
12. Metropolitan Industries, Inc.
13. Myers, F. E.; Pentair Pump Group (The).
14. Paco Pumps, Inc.
15. Park.
16. Stancor, Inc.
17. Sta-Rite Industries, Inc.
18. Swaby Manufacturing Co.
19. Weil Pump Company, Inc.
20. Weinman Div.; Crane Pumps & Systems.
21. Zoeller Company.

B. Description: Factory-assembled and -tested, simplex or duplex, single-stage, centrifugal, end-suction, submersible, direct-connected sump pumps complying with UL 778 and HI 1.1-1.2 and HI 1.3 for submersible sump pumps.

C. Casing: Cast iron; with cast-iron inlet strainer, legs that elevate pump to permit flow into impeller, and vertical discharge with companion flange for piping connection.

D. Impeller: Abrasion-resistant cast iron; statically and dynamically balanced, semiopen nonclog design, overhung, single suction, keyed and secured to shaft.

E. Pump and Motor Shaft: Stainless steel, with factory-sealed, grease-lubricated ball bearings and double-mechanical seals.

F. Pump Discharge Piping: Factory or field fabricated, ASTM A 53/A 53M, Schedule 40, galvanized-steel pipe.

G. Basin Cover: Cast iron and strong enough to support controls. See Part 2 "Sump Pump Pits" Article for other requirements.

H. Controls: Refer to drawings for more information. Pump controls shall match pump manufacturer.

I. Capacity and Characteristics: See schedule.

2.3 SUMP PUMP PITS

A. Description: Concrete pit with sump, pipe connections, curb frame, and separate cover.

B. Sump: Construct of watertight, cast-in-place, reinforced concrete with sidewall openings for pipe connections. Cast-in-place concrete, formwork, and reinforcement are specified in Division 03 Section "Cast-in-Place Concrete", or "Miscellaneous Cast-in-Place Concrete".

1. Pipe Connections: Sleeved openings large enough for mechanical sleeve seals for drainage piping. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing," and drainage piping shall be solid wall schedule 40 PVC.

C. Curb Frame and Cover:

1. Curb Frame Material: Galvanized steel or steel with bituminous coating.

a. Pattern: Angle-cross-section shape with flat top surface or Z-cross-section shape with raised outer rim of height matching cover, for recessed mounting having installed cover flush with top of floor slab.

2. Cover: Fabricate with openings having gaskets, seals, and bushings, for access to pumps, pump shafts, control rods, discharge piping, vent connections, and power cables.

a. Material: Cast iron, Cast iron or steel with bituminous coating, or Steel with bituminous coating.
b. Reinforcement: Steel or cast iron, capable of supporting foot traffic for pits installed in foot-traffic areas.

D. Capacity and Characteristics: See schedule.

2.4 FLEXIBLE CONNECTORS

A. Available Manufacturers:

1. Anamet, Inc.
2. Flex-Hose Co., Inc.
3. Flexicraft Industries.

4. Flex-Pression, Ltd.
5. Flex-Weld, Inc.
6. Hyspan Precision Products, Inc.
7. Mercer Rubber.
8. Metraflex, Inc.
9. Proco Products, Inc.
10. Tozen America Corporation.
11. Unaflex Inc.

B. Description: 125-psig minimum working-pressure rating and ends matching pump connection:

1. Bronze Flexible Connectors: Corrugated, bronze inner tubing covered with bronze wire braid. Include copper-tube ends or bronze flanged ends, braze welded to tubing.
2. Stainless-Steel Flexible Connectors: Corrugated, stainless-steel inner tubing covered with stainless-steel wire braid. Include stainless-steel nipples or flanges, welded to tubing.

2.5 BUILDING AUTOMATION SYSTEM INTERFACE

A. Provide auxiliary contacts in pump controllers for interface to building automation system. Include the following:

1. On-off status of each pump.
2. Alarm status.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of plumbing piping to verify actual locations of storm drainage piping connections before sump pump installation.

3.2 CONCRETE

A. Install concrete bases of dimensions indicated for pumps and controllers. Refer to Division 22 Section "Common Work Results for Plumbing" and to Structural drawings and specifications.

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of base.
2. For supported equipment, 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.

B. Cast-in-place concrete materials and placement requirements are specified in Division 03.

3.3 SUMP PUMP INSTALLATION

A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

B. Install sump pumps according to applicable requirements in HI 1.4.

C. Install pumps and arrange to provide access for maintenance including removal of motors, impellers, couplings, and accessories.

D. Set submersible sump pumps on pit floor. Make direct connections to storm drainage piping.

E. Construct sump pump pits and connect to drainage piping. Set pit curb frame recessed in and anchored to concrete. Fasten pit cover to pit curb flange. Install cover so top surface is flush with finished floor.

F. Support piping so weight of piping is not supported by pumps.

3.4 CONNECTIONS

A. Piping installation requirements are specified in Division 22 Section "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to sump pumps to allow service and maintenance.

C. Connect storm drainage piping to pumps. Install discharge piping equal to or greater than size of pump discharge piping. Refer to Division 22 Section "Facility Storm Drainage Piping."

1. Install flexible connectors adjacent to pumps in discharge piping.
2. Install check and shutoff valves on discharge piping from each pump. Install unions on pumps having threaded pipe connections. Install valves same size as connected piping. Refer to Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty valves for drainage piping.

D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.5 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.
2. Verify bearing lubrication.
3. Disconnect couplings and check motors for proper direction of rotation.
4. Verify that each pump is free to rotate by hand. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
5. Verify that pump controls are correct for required application.

B. Start pumps without exceeding safe motor power:

1. Start motors.
2. Open discharge valves slowly.
3. Check general mechanical operation of pumps and motors.

C. Test and adjust controls and safeties.

D. Remove and replace damaged and malfunctioning components.

1. Pump Controls: Set pump controls for automatic start, stop, and alarm operation as required for system application.
2. Set field-adjustable switches and circuit-breaker trip ranges as indicated, or if not indicated, for normal operation.

E. 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 outside normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 22 1429

SECTION 22 3300

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. This Section includes the following electric water heaters:
   1. Thermostat-control, instantaneous electric water heaters.
   2. Light-commercial electric water heaters.
   3. Commercial, storage electric water heaters.
   4. Compression tanks.
   5. Water heater accessories.

1.3 SUBMITTALS

A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Product Certificates: For each type of commercial and instantaneous electric water heater, signed by product manufacturer.

D. Source quality-control test reports.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For electric water heaters to include in emergency, operation, and maintenance manuals.

G. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain same type of electric water heaters through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of electric water heaters and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

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. ASME Compliance: Where indicated, fabricate and label commercial water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

E. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for all components that will be in contact with potable water.

1.5 COORDINATION

A. Coordinate size and location of concrete bases with Architectural and Structural Drawings.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric water heaters that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including storage tank and supports.
b. Faulty operation of controls.
c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Period(s): From date of Owner Acceptance.

a. Instantaneous Electric Water Heaters: Five year(s).
b. Light-Commercial Electric Water Heaters:

1) Storage Tank: Five years.
2) Controls and Other Components: Five years.

c. Commercial Electric Water Heaters:

1) Storage Tank: Five years.
2) Controls and Other Components: Five years.

d. Compression Tanks: Five year(s).

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 INSTANTANEOUS ELECTRIC WATER HEATERS

A. Thermostat-Control, Instantaneous Electric Water Heaters: Comply with UL 499 for tankless electric (water heater) heating appliance.

1. Available Manufacturers:

    a. Chronomite Laboratories, Inc.
    b. IMI Waterheating, Ltd.
    c. Keltech, Inc.
    d. Niagara Industries, Inc.
    e. EEmax

2. Construction: Copper piping or tubing complying with NSF 61 barrier materials for potable water, without storage capacity.

    a. Connections: ASME B1.20.1 pipe thread.
    b. Pressure Rating: 150 psig.
    c. Heating Element: Resistance heating system.
    d. Temperature Control: Thermostat.
    e. Safety Control: High-temperature-limit cutoff device or system.
    f. Jacket: Aluminum or steel with enameled finish or plastic.

3. Support: Bracket for wall mounting.
4. Capacity and Characteristics:

    a. Temperature Control: Adjustable thermostat.

        1) Features: See schedule

2.3 LIGHT-COMMERCIAL ELECTRIC WATER HEATERS

A. Description: Comply with UL 174 for household, storage electric water heaters.

1. Available Manufacturers:

    a. American Water Heater Company.
    b. Bradford White Corporation.
    c. Electric Heater Company (The); Hubbell Heaters Division.
    d. Heat Transfer Products, Inc.
    e. Lochinvar Corporation.
    f. Rheem Water Heater Div.; Rheem Manufacturing Company.
    g. Ruud Water Heater Div.; Rheem Manufacturing Company.
    h. Smith, A. O. Water Products Company.
    i. State Industries, Inc.

2. Storage-Tank Construction: Steel, vertical arrangement.

    a. Tappings: ASME B1.20.1 pipe thread.
    b. Pressure Rating: 150 psig
    c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.

3. Factory-Installed Storage-Tank Appurtenances:

    a. Anode Rod: Replaceable magnesium.
    b. Dip Tube: Provide unless cold-water inlet is near bottom of tank.
    c. Drain Valve: ASSE 1005.

d. Insulation: Comply with ASHRAE/IESNA 90.1 or ASHRAE 90.2.
e. Jacket: Steel with enameled finish.
f. Heat Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
g. Heating Elements: Two; electric, screw-in immersion type; wired for simultaneous operation, unless otherwise indicated.
h. Temperature Control: Adjustable thermostat for each element.
i. Safety Control: High-temperature-limit cutoff device or system.
j. Relief Valve: ASME rated and stamped and complying with ASME PTC 25.3 for combination temperature and pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.

4. Special Requirements: NSF 5 construction with legs for off-floor installation.
5. Capacity and Characteristics: See schedule.

2.4 COMMERCIAL ELECTRIC WATER HEATERS

A. Commercial Electric Booster Heaters: Comply with UL 1453 requirements for booster-type water heaters.

1. Available Manufacturers:

a. Bradford White Corporation.
b. Coates Heater Co.
c. Electric Heater Company (The); Hubbell Heaters Division.
d. Lochinvar Corporation.
e. Rheem Water Heater Div.; Rheem Manufacturing Company.
f. Ruud Water Heater Div.; Rheem Manufacturing Company.
g. Smith, A. O. Water Products Company.

2. Storage-Tank Construction: Corrosion-resistant metal.

a. Tappings: ASME B1.20.1 pipe thread.
b. Pressure Rating: 150 psig.
c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.

3. 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: Rectangular shaped, with stainless-steel front panel, unless otherwise indicated.
e. Heating Elements: Electric, screw-in or bolt-on immersion type arranged in multiples of three.

1) Option: Booster heaters with 9 kW or less total may have 2 or 3 elements.
2) Staging: Input not exceeding 18 kW per step.

f. Temperature Control: Adjustable thermostat, to setting of at least 180 deg F.
g. Safety Controls: High-temperature-limit and low-water cutoff devices or systems.
h. Relief Valve: ASME rated and stamped and complying with ASME PTC 25.3, combination temperature and pressure relief valve. Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.

i. Gages: Combination temperature and pressure type or separate thermometer and pressure gage.

4. Special Requirements: NSF 5 construction with brackets or legs for installation.
5. Capacity and Characteristics: See schedule.

B. Commercial, Storage Electric Water Heaters: Comply with UL 1453 requirements for storage-tank-type water heaters.

1. Available Manufacturers:

a. American Water Heater Company.
b. Bock Water Heaters, Inc.
c. Bradford White Corporation.
d. Cemline Corporation.
e. Electric Heater Company (The); Hubbell Heaters Division.
f. GSW Water Heating Company.
g. HESco Industries, Inc.
h. Lochinvar Corporation.
i. Precision Boilers.
j. PVI Industries, LLC.
k. RECO USA.
l. Rheem Water Heater Div.; Rheem Manufacturing Company.
m. Ruud Water Heater Div.; Rheem Manufacturing Company.
n. Smith, A. O. Water Products Company.
o. State Industries, Inc.

2. Storage-Tank Construction: ASME-code, steel with horizontal or 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 barrier materials for potable-water tank linings, including extending lining material into tappings.

3. Factory-Installed Storage-Tank Appurtenances:

a. Anode Rod: Replaceable magnesium.
b. 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.

1) Staging: Input not exceeding 18 kW per step.

f. Temperature Control: Adjustable thermostat.
g. Safety Controls: High-temperature-limit and low-water cutoff devices or systems.
h. Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3, for combination temperature and pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than water heater

working-pressure rating. Select one relief valve with sensing element that extends into storage tank.

4. Special Requirements: NSF 5 construction.
5. Energy Management System Interface: Normally closed dry contacts for enabling and disabling water heater.
6. Capacity and Characteristics: See schedule.

2.5 COMPRESSION TANKS

A. Description: Steel pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.

1. Available Manufacturers:

   a. AMTROL Inc.
   b. Armstrong Pumps, Inc.
   c. Flexcon Industries.
   d. Honeywell Sparco.
   e. Myers, F. E.; Pentair Pump Group (The).
   f. Smith, A. O.; Aqua-Air Div.
   g. State Industries, Inc.
   h. Taco, Inc.
   i. Watts Regulator Co.
   j. Wessels Co.

2. Construction:

   a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1, pipe thread.
   b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
   c. Air-Charging Valve: Factory installed.

3. Capacity and Characteristics: See schedule.

2.6 WATER HEATER ACCESSORIES

A. Combination Temperature and Pressure Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3. Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.

B. Pressure Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3. Include pressure setting less than water heater working-pressure rating.

C. Water Heater Stand and Drain-Pan Units: High-density-polyethylene-plastic, 18-inch-high, enclosed-base stand complying with IAPMO PS 103 and IAS No. 2. Include integral or separate drain pan with raised edge and NPS 1 drain outlet with ASME B1.20.1 pipe thread.

D. Water Heater Stands: Water heater manufacturer's factory-fabricated steel stand for floor mounting and capable of supporting water heater and water. Include dimension that will support bottom of water heater a minimum of 18 inches above the floor.

E. Water Heater Mounting Brackets: Water heater manufacturer's factory-fabricated steel bracket for wall mounting and capable of supporting water heater and water.

F. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of water heater and include drain outlet not less than NPS 3/4.

G. Piping Manifold Kits: Water heater manufacturer's factory-fabricated inlet and outlet piping arrangement for multiple-unit installation. Include piping and valves for field assembly that are capable of isolating each water heater and of providing balanced flow through each water heater.

H. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2.

I. Water Regulators: ASSE 1003, water-pressure reducing valve. Set at 25-psig- maximum outlet pressure, unless otherwise indicated.

J. Shock Absorbers: ASSE 1010 or PDI WH 201, Size A water hammer arrester.

2.7 SOURCE QUALITY CONTROL

A. Test and inspect water heater storage tanks, specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test commercial water heater storage tanks before shipment to minimum of one and one-half times pressure rating.

C. Prepare test reports.

PART 3 - EXECUTION

3.1 WATER HEATER INSTALLATION

A. Install commercial water heaters on concrete bases.

1. Exception: Omit concrete bases for commercial water heaters if installation on stand, bracket, suspended platform, or direct on floor is indicated.
2. Concrete base construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Install water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

C. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

D. Install combination temperature and pressure relief valves in water piping for water heaters without storage. 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.

E. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Division 22 Section "Domestic Water Piping Specialties" for hose-end drain valves.

F. Install thermometer on outlet piping of water heaters. Refer to Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.

G. Install thermometers on inlet and outlet piping of household, collector-to-tank, solar-electric water heaters. Refer to Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.

H. Install pressure gage(s) on inlet and outlet of commercial electric water- heater piping. Refer to Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages.

I. Assemble and install inlet and outlet piping manifold kits for multiple water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each water heater. Include shutoff valve, thermometer in each water heater inlet and outlet, and throttling valve in each water heater outlet. Refer to Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty valves and to Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.

J. Install water regulator, with integral bypass relief valve, in booster-heater inlet piping and water hammer arrester in booster-heater outlet piping.

K. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.

L. Fill water heaters with water.

M. Charge compression tanks with air.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. 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. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, confirm proper operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace water heaters that do not pass tests and inspections and retest as specified above.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial and instantaneous electric water heaters. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 22 3300

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SECTION 22 4000

PLUMBING FIXTURES

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 conventional plumbing fixtures and related components:

1. Faucets for lavatories and sinks.
2. Flushometers.
3. Toilet seats.
4. Protective shielding guards.
5. Fixture supports.
6. Water closets.
7. Urinals.
8. Lavatories.
9. Commercial sinks.
10. Service sinks.

B. Related Sections include the following (as applicable):

1. Division 10 Section "Toilet, Bath, and Laundry Accessories."
2. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.
3. Division 22 Section "Drinking Fountains and Water Coolers."

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.

D. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.

E. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

F. FRP: Fiberglass-reinforced plastic.

G. PMMA: Polymethyl methacrylate (acrylic) plastic.

H. PVC: Polyvinyl chloride plastic.

I. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.4 SUBMITTALS

A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.

D. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.

1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.

D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:

1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
2. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
3. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
4. Stainless-Steel Commercial, Handwash Sinks: NSF 2 construction.
5. Stainless-Steel Residential Sinks: ASME A112.19.3.
6. Vitreous-China Fixtures: ASME A112.19.2M.
7. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.

8. Water-Closet, Flushometer Tank Trim: ASSE 1037.

H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:

1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
4. Faucets: ASME A112.18.1.
5. Hose-Connection Vacuum Breakers: ASSE 1011.
6. Hose-Coupling Threads: ASME B1.20.7.
7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
8. NSF Potable-Water Materials: NSF 61.
9. Pipe Threads: ASME B1.20.1.
10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
11. Supply Fittings: ASME A112.18.1.
12. Brass Waste Fittings: ASME A112.18.2.

I. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:

1. Atmospheric Vacuum Breakers: ASSE 1001.
2. Brass and Copper Supplies: ASME A112.18.1.
3. Dishwasher Air-Gap Fittings: ASSE 1021.
4. Manual-Operation Flushometers: ASSE 1037.
5. Plastic Tubular Fittings: ASTM F 409.
6. Brass Waste Fittings: ASME A112.18.2.
7. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.

J. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Disposers: ASSE 1008 and UL 430.
2. Dishwasher Air-Gap Fittings: ASSE 1021.
3. Flexible Water Connectors: ASME A112.18.6.
4. Floor Drains: ASME A112.6.3.
5. Grab Bars: ASTM F 446.
6. Hose-Coupling Threads: ASME B1.20.7.
7. Off-Floor Fixture Supports: ASME A112.6.1M.
8. Pipe Threads: ASME B1.20.1.
9. Plastic Toilet Seats: ANSI Z124.5.
10. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.6 WARRANTY

A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace components of whirlpools that fail in materials or workmanship within specified warranty period. Warranty periods shall be coordinated with the Owner. All warranties date from the date of Owner Acceptance.

1. Failures include, but are not limited to, the following:

a. Structural failures of unit shell.
b. Faulty operation of controls, blowers, pumps, heaters, and timers.
c. Deterioration of metals, metal finishes, and other materials beyond normal use.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

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.
3. Flushometer Valve, Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than 1 of each type.
4. Provide hinged-top wood or metal box, or individual metal boxes, with separate compartments for each type and size of extra materials listed above.
5. Toilet Seats: Equal to 5 percent of amount of each type installed.

PART 2 - PRODUCTS

2.1 LAVATORY FAUCETS

A. Lavatory Faucets:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. TOTO USA, Inc.
b. Or approved equal.

2. Description: See schedule.

2.2 SINK FAUCETS

A. Sink Faucets:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard Companies, Inc.
b. Chicago Faucets.
c. Delta Faucet Company.
d. Elkay Manufacturing Co.
e. Just Manufacturing Company.
f. Kohler Co.
g. Moen, Inc.
h. T & S Brass and Bronze Works, Inc.
i. Zurn Plumbing Products Group; Commercial Brass Operation.
j. Or approved equal.

2. Description: See schedule.

2.3 FLUSHOMETERS

A. Flushometers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Sloan Valve Company.
b. Zurn Plumbing Products Group; Commercial Brass Operation.
c. TOTO USA, Inc.

d. Coyne & Delany Co.

2. Description: See schedule.

2.4 TOILET SEATS

A. Toilet Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. American Standard Companies, Inc.
   b. Bemis Manufacturing Company.
   c. Church Seats.
   d. Eljer.
   e. Kohler Co.
   f. Olsonite Corp.

2. Description: Toilet seat for water-closet-type fixture. See schedule.

2.5 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Engineered Brass Co.
   b. Insul-Tect Products Co.; a Subsidiary of MVG Molded Products.
   c. McGuire Manufacturing Co., Inc.
   d. Plumberex Specialty Products Inc.
   e. TCI Products.
   f. TRUEBRO, Inc.
   g. Zurn Plumbing Products Group; 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, Inc.

2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

2.6 FIXTURE SUPPORTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Josam Company.
2. MIFAB Manufacturing Inc.
3. Smith, Jay R. Mfg. Co.
4. Tyler Pipe; Wade Div.
5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.

6. Zurn Plumbing Products Group; Specification Drainage Operation.

B. Water-Closet Supports:

1. Description: Combination carrier designed for accessible and standard mounting height of wall-mounting, water-closet-type fixture. Include single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement; faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

C. Urinal Supports:

1. Description: Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture or II, urinal carrier with hanger and bearing plates for wall-mounting, urinal-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

D. Lavatory Supports:

1. Description: Type I, lavatory carrier with exposed arms and tie rods or II, lavatory carrier with concealed arms and tie rod or III, lavatory carrier with hanger plate and tie rod for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

E. Sink Supports:

1. Description: Type I, sink carrier with exposed arms and tie rods or II, sink carrier with hanger plate, bearing studs, and tie rod or III, sink carrier with hanger plate and exposed arms for sink-type fixture. Include steel uprights with feet.

2.7 WATER CLOSETS

A. Water Closets:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Standard Companies, Inc.
   b. Eljer.
   c. Kohler Co.
   d. TOTO USA, Inc.
   e. Sloan Valve Company.

2. Description: See schedule.

2.8 URINALS

A. Urinals:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. American Standard Companies, Inc.
   b. Eljer.
   c. Kohler Co.
   d. TOTO USA, Inc.
   e. Sloan Valve Company.

2. Description: See schedule.

2.9 LAVATORIES

A. Lavatories:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard Companies, Inc.
b. Eljer.
c. Kohler Co.
d. Eljer.
e. TOTO USA, Inc.

2. Description: See schedule.

2.10 COMMERCIAL SINKS

A. Commercial Sinks:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Advance Tabco.
b. Elkay Manufacturing Co.
c. Just Manufacturing Company.

2. Description: See schedule.

2.11 SERVICE SINKS

A. Service Sinks:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard Companies, Inc.

b. Fiat
c. Eljer.
d. Kohler Co.
e. Crane Plumbing, L.L.C./Fiat Products.

2. Description: See schedule.

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 plumbing fixture installation.

B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.

1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.

C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.

D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

E. Install wall-mounting fixtures with tubular waste piping attached to supports.

F. Install counter-mounting fixtures in and attached to casework.

G. Install fixtures level and plumb according to roughing-in drawings.

H. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

1. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

I. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

J. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.

K. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.

L. Install toilet seats on water closets.

M. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

N. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.

O. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

P. Install traps on fixture outlets.

1. Exception: Omit trap on fixtures with integral traps.
2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

Q. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."

R. Set service basins in leveling bed of cement grout. Grout is specified in Division 22 Section "Common Work Results for Plumbing."

S. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.

B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

E. Install fresh batteries in sensor-operated mechanisms.

3.5 ADJUSTING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Operate and adjust disposersand controls. Replace damaged and malfunctioning units and controls.

C. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.

D. Replace washers and seals of leaking and dripping faucets and stops.

E. Install fresh batteries in sensor-operated mechanisms.

3.6 CLEANING

A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:

1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
2. Remove sediment and debris from drains.

B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.7 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 22 4000

SECTION 22 4700

DRINKING FOUNTAINS AND 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. This Section includes the following drinking fountains and water coolers and related components:
   1. Pressure water coolers.
   2. Fixture supports.

1.3 DEFINITIONS

A. Accessible Drinking Fountain or Water Cooler: Fixture that can be approached and used by people with disabilities.

B. Cast Polymer: Dense, cast-filled-polymer plastic.

C. Drinking Fountain: Fixture with nozzle for delivering stream of water for drinking.

D. Fitting: Device that controls flow of water into or out of fixture.

E. Fixture: Drinking fountain or water cooler unless one is specifically indicated.

F. Remote Water Cooler: Electrically powered equipment for generating cooled drinking water.

G. Water Cooler: Electrically powered fixture for generating and delivering cooled drinking water.

1.4 SUBMITTALS

A. Product Data: For each fixture indicated. Include rated capacities, furnished specialties, and accessories.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For fixtures to include in emergency, operation, and maintenance manuals.

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. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for fixtures for people with disabilities.

C. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

D. ARI Standard: Comply with ARI's "Directory of Certified Drinking Water Coolers" for style classifications.

E. ARI Standard: Comply with ARI 1010, "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers," for water coolers and with ARI's "Directory of Certified Drinking Water Coolers" for type and style classifications.

F. ASHRAE Standard: Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant, unless otherwise indicated.

1.6 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filter Cartridges: Equal to 10 percent of amount installed for each type and size indicated, but no fewer than 1 of each.

PART 2 - PRODUCTS

2.1 PRESSURE WATER COOLERS

A. Water Coolers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Elkay Manufacturing Co.
b. Halsey Taylor.
c. Haws Corporation.

2. Description: See schedule.

2.2 FIXTURE SUPPORTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Josam Co.
2. Smith, Jay R. Mfg. Co.
3. Tyler Pipe; Wade Div.
4. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
5. Zurn Plumbing Products Group; Specification Drainage Operation.

B. Description: ASME A112.6.1M, water cooler carriers. Include vertical, steel uprights with feet and tie rods and bearing plates with mounting studs matching fixture to be supported.

1. Type I: Hanger-type carrier with two vertical uprights.
2. Type II: Bilevel, hanger-type carrier with three vertical uprights.
3. Supports for Accessible Fixtures: Include rectangular, vertical, steel uprights instead of steel pipe uprights.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before fixture installation. Verify that sizes and locations of piping and types of supports match those indicated.

B. Examine walls and floors for suitable conditions where fixtures are to be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Use carrier off-floor supports for wall-mounting fixtures, unless otherwise indicated.

B. Use mounting frames for recessed water coolers, unless otherwise indicated.

C. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view. Plain copper tube, fittings, and valves may be used in concealed locations.

3.3 INSTALLATION

A. Install off-floor supports affixed to building substrate and attach wall-mounting fixtures, unless otherwise indicated.

B. Install mounting frames affixed to building construction and attach recessed water coolers to mounting frames, unless otherwise indicated.

C. Install fixtures level and plumb. For fixtures indicated for children, install at height required by authorities having jurisdiction.

D. Install water-supply piping with shutoff valve on supply to each fixture to be connected to water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

E. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

F. Install pipe escutcheons at wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding pipe fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."

G. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.4 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.5 FIELD QUALITY CONTROL

A. Water Cooler Testing: After electrical circuitry has been energized, test for compliance with requirements. Test and adjust controls and safeties.

1. Remove and replace malfunctioning units and retest as specified above.
2. Report test results in writing.

3.6 ADJUSTING

A. Adjust fixture flow regulators for proper flow and stream height.

B. Adjust water cooler temperature settings.

3.7 CLEANING

A. After completing fixture installation, 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.

END OF SECTION 22 4700

SECTION 23 0500

COMMON WORK RESULTS 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 the following:

1. Piping materials and installation instructions common to most piping systems.
2. Transition fittings.
3. Dielectric fittings.
4. Mechanical sleeve seals.
5. Sleeves.
6. Escutcheons.
7. Grout.
8. HVAC demolition.
9. Equipment installation requirements common to equipment sections.
10. Painting and finishing.
11. Concrete bases.
12. Supports and anchorages.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. CPVC: Chlorinated polyvinyl chloride plastic.
2. PE: Polyethylene plastic.
3. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is on the “Alternate Manufacturer Evaluation Form”, subsequently approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes 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. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

1.8 AS-BUILT DRAWINGS

A. DEFINITIONS

1. Contractor Markups – Drawings that are marked and annotated to show the project As-Built and constructed by the contractor. They are part of the working as-built set.
2. As-Built Drawings – The amended “As-designed” drawing revised to show the project as the contractor built and constructed it. The revisions from Contractor Markups and field inspection notes are transferred to the Final as-built set of drawings. The final as-built drawings include modifications during construction, field requested changes, shop drawing modifications, and contractor designs, MEPCE will not provide CAD mechanical files to the Contractor.

B. DESCRIPTION OF WORK

Section includes: Administrative and procedural requirements for as-built process for contractor to follow.

C. RECORD DOCUMENT SUBMITTALS

Record As-Built Drawings: General Contractor shall maintain on-site 2 sets of as-built Contract Drawings, in Contractor Field Office. Working as-built drawings shall be kept current on a weekly basis and at least one paper set of as-built drawings shall be available on the jobsite at all times. Note that MEPCE WILL NOT accept our own drawings back with a different title block as shop drawings.

a. Changes to Drawings, including those that involve only narrative, shall be clearly and neatly marked in red pen or pencil, and shall be noted on appropriate drawings. Changes to the Contract Drawings include:

b.

1. Changes to material or equipment for substitutions approved through the Architect/Engineer’s submittal process.
2. Where contract drawings or specifications show options or alternates, only the option selected for construction shall be shown on the final as-built prints. Cross out such words and phrases as “approved equal” and list specifically the material provided. This shall include actual make and model number of equipment installed, as well as voltage and MCA.
3. Shop drawing information.
4. RFIs and Change Order information.
5. Changes made by the Inspector to accommodate field conditions.
6. Actual location, kinds and sizes of all existing and new utility lines, especially underground lines within the construction area. Measurements shall be shown for all change of direction points and all surface or underground components such as valves, manholes, drop inlets, clean outs, meters, etc.
7. Changes in location of equipment and architectural features.
8. Systems designed or enhanced by the Contractor, such as HVAC controls, fire alarm, fire sprinkler and irrigation systems.
9. All construction changes that result from the final inspection.

c. General Contractor shall note each entry with a notation referencing source of information (Example: RFI #94, CO #3, or field notes of same).

1. As-built record drawings shall be updated no less frequently than once per week.
2. Verification of current as-built record drawing status is included in the monthly payment approval process that shall be noted in the inspector's log notes.
3. Individual(s) responsible for the verification of the as-built process shall be identified to the Architect/Engineer.

d. When completed, scanned pdf copies of the as-built drawings shall be sent to the Owner and Architect/Engineer for final approval. Compliance and delivery of the final as-built drawings will be enforced through the approval of progress payments. The quality of the final as-built drawings will be reflected in the construction contractor's performance evaluation.

D. MARK-UP GUIDELINE

The following information is provided to improve the quality of the marked-up prints and thereby facilitate preparation of final as-built drawings. The most important guideline is that the marked-up changes on the prints shall be complete and understandable.

1. Frequently use written explanation on As-Built drawings to describe changes. Do not rely totally on graphic means to convey the revision.
2. Legibility of lettering and digit values shall be clean and clear and readable from a scanned copy.
3. Whenever a revision is made, make changes to affect related section views, details, legend, plans and elevation view, schedules, notes and call-out designations, and mark accordingly to avoid conflicting data on all other sheets.
4. When changes are required on small-scale drawings or on drawings with limited area available, large-scale inserts shall be drawn or sketched, with leaders to the location where applicable.
5. When attached prints (or sketches) are provided with marked-up print, indicate whether:
    a. Entire drawing shall be added to contract drawings or
    b. Whether the contract drawings shall be changed to agree, or
    c. For reference only to further details not required for initial design.
6. Make the comments on the drawing complete without reference to letters, memo's or materials that are not also a part of the As-Built. For instance, do not just say, "As per Change Order #12", when the actual change order states, "Changed water pipe from 2-1/2" to 3". This also applies for changes as per the Architect/Engineer, Owner or Inspector.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
    1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. Solvent Cements for Joining Plastic Piping:

1. CPVC Piping: ASTM F 493.
2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.4 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
1. Manufacturers:

a. Cascade Waterworks Mfg. Co.
b. Dresser Industries, Inc.; DMD Div.
c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
d. JCM Industries.
e. Smith-Blair, Inc.
f. Viking Johnson.

2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
3. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
4. Aboveground Pressure Piping: Pipe fitting.

B. Flexible Transition Couplings for Underground Non-pressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

1. Manufacturers:
    a. Cascade Waterworks Mfg. Co.
    b. Fernco, Inc.
    c. Mission Rubber Company.
    d. Plastic Oddities, Inc.

2.5 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

1. Available Manufacturers:

    a. Capitol Manufacturing Co.
    b. Watts Industries, Inc.; Water Products Div.
    c. Zurn Industries, Inc.; Wilkins Div.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

1. Available Manufacturers:

    a. Capitol Manufacturing Co.
    b. Epco Sales, Inc.
    c. Watts Industries, Inc.; Water Products Div.

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Available Manufacturers:

    a. Advance Products & Systems, Inc.
    b. Central Plastics Company.
    c. Pipeline Seal and Insulator, Inc.

2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

1. Available Manufacturers:

    a. Calpico, Inc.
    b. Lochinvar Corp.

G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

1. Available Manufacturers:

a. Perfection Corp.
b. Precision Plumbing Products, Inc.
c. Victaulic Co. of America.

2.6 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Available Manufacturers:

a. Advance Products & Systems, Inc.
b. Metraflex Co.
c. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Carbon steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

2.8 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. Split-Casting, Deep pattern: With concealed hinge, set screw or spring clips, and chrome-plated finish.

C. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

1. Finish: Polished chrome-plated.

D. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.

E. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.9 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

B. 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 Coordination Drawings.

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 to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: Split-case, deep-pattern type.
b. Chrome-Plated Piping: Split case, cast-brass type with polished chrome-plated finish.

c. Insulated Piping: Split-case, stamped-steel type with spring clips.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with polished chrome-plated finish.
e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split case, stamped-steel type.
f. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-case, cast-brass type with polished chrome-plated finish.
g. Bare Piping in Unfinished Service Spaces: Split-case, stamped-steel type with exposed-rivet hinge and set screw.
h. Bare Piping in Equipment Rooms: Split-case, stamped-steel type with set screw or spring clips.
i. Bare Piping at Floor Penetrations in Equipment Rooms: Split-case, floor-plate type.

2. Existing Piping: Use the following:

a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge and spring clips.
c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and spring clips.
e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
f. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.
g. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.
h. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.
i. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.

M. Install sleeves for pipes passing through concrete and masonry walls, and concrete floor and roof slabs.

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. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.

1) Seal space outside of sleeve fittings with grout.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using 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.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

O. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

Q. Verify final equipment locations for roughing-in.

R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. 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 unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.3 PIPING CONNECTIONS

A. 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. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.5 PAINTING

A. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project. Coordinate with Structural Engineer.

1. Construct concrete bases shall be at least 3” larger than mounted equipment on all sides.
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 the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's 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 anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete" or "Miscellaneous Cast-in-Place Concrete."

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.8 GROUTING

A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 23 0500

SECTION 23 0513

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 requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.

B. Comply with NEMA MG 1 unless otherwise indicated.

C. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS 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:

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.

2.4 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 23 0513

SECTION 23 0519

THERMOMETERS AND GAGES 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. Thermometers.
2. Gages.
3. Test plugs.

B. Related Sections:
1. Division 23 Section "Facility Natural-Gas Piping" for gas meters.

1.3 DEFINITIONS

A. CR: Chlorosulfonated polyethylene synthetic rubber.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated; include performance curves.

B. Shop Drawings: Schedule for thermometers, gages indicating manufacturer's number, scale range, and location for each.

C. Product Certificates: For each type of thermometer, gage signed by product manufacturer.

PART 2 - PRODUCTS

2.1 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Trerice
2. Weiss

3. Weksler Instruments

B. Case: Die-cast aluminum or brass, 7 inches long.

C. Tube: Red or blue reading, mercury or organic-liquid filled, with magnifying lens.

D. Tube Background: Satin-faced, non-reflective aluminum with permanently etched scale markings.

E. Window: Glass or plastic.

F. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.

G. Stem: Copper-plated steel, aluminum, or brass for thermowell installation and of length to suit installation.

H. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.2 THERMOWELLS

A. Manufacturers: Same as manufacturer of thermometer being used.

B. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer.

2.3 PRESSURE GAGES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AMETEK, Inc.; U.S. Gauge Div.
2. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
3. Ernst Gage Co.
4. KOBOLD Instruments, Inc.
5. Marsh Bellofram.
6. Palmer - Wahl Instruments Inc.
7. Trerice, H. O. Co.
8. Weiss Instruments, Inc.
9. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.

B. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.

1. Case: Dry drawn steel or cast aluminum, 4-1/2-inch diameter.
2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
6. Pointer: Red or other dark-color metal.
7. Window: Glass or plastic.
8. Ring: Metal.
9. Accuracy: Grade B, plus or minus 2 percent of middle half of whole scale.
10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
11. Range for Fluids under Pressure: Two times operating pressure.

C. Pressure-Gage Fittings:

1. Valves: NPS 1/4 brass or stainless-steel needle type.
2. Syphons: NPS 1/4 coil of brass tubing with threaded ends.
3. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

2.4 TEST PLUGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flow Design, Inc.
2. MG Piping Products Co.
3. National Meter, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Co.
6. Trerice, H. O. Co.
7. Watts Industries, Inc.; Water Products Div.

B. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.

C. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

D. Core Inserts: One or two self-sealing rubber valves.

1. Insert material for air, water, oil, or gas service at 20 to 200 deg F shall be CR.
2. Insert material for air or water service at minus 30 to plus 275 deg F shall be EPDM.

PART 3 - EXECUTION

3.1 THERMOMETER APPLICATIONS

A. Install bimetallic-actuated dial thermometers in the following locations:

1. Inlet and outlet of each hydronic zone.
2. Inlet and outlet of each hydronic chiller.
3. Inlet and outlet of each hydronic coil in air-handling units and built-up central systems.

B. Provide the following temperature ranges for thermometers:
1. Chilled Water: 0 to 100 deg F, with 2-degree scale divisions.

3.2 GAGE APPLICATIONS

A. Install pressure gages for discharge of each pressure-reducing valve.

B. Install pressure gages at chilled- and condenser-water inlets and outlets of chillers.

C. Install pressure gages at suction and discharge of each pump.

3.3 INSTALLATIONS

A. Install direct-mounting thermometers and adjust vertical and tilted positions.

B. Install thermowells with socket extending one-third of diameter of pipe and in vertical position in piping tees where thermometers are indicated.

C. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.

D. Install needle-valve and snubber fitting in piping for each pressure gage for fluids.

E. Install test plugs in tees in piping.

3.4 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance for meters, gages, machines, and equipment.

3.5 ADJUSTING

A. Calibrate meters according to manufacturer's written instructions, after installation.

B. Adjust faces of meters and gages to proper angle for best visibility.

END OF SECTION 23 0519

SECTION 23 0523

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. This Section includes the following general-duty valves:

1. Copper-alloy ball valves.
2. Ferrous-alloy butterfly valves.
3. Bronze check valves.
4. Gray-iron swing check valves.
5. Spring-loaded, lift-disc check valves.
6. Bronze gate valves.
7. Cast-iron gate valves.
8. Bronze globe valves.
9. Chainwheel actuators.

B. Related Sections include the following:
1. Division 23 Section "Identification for HVAC Piping and Equipment" for valve tags and charts.
2. Division 23 piping sections for specialty valves applicable to those sections only.

1.3 DEFINITIONS

A. The following are standard abbreviations for valves:

1. CWP: Cold working pressure.
2. EPDM: Ethylene-propylene-diene terpolymer rubber.
3. NBR: Acrylonitrile-butadiene rubber.
4. PTFE: Polytetrafluoroethylene plastic.
5. SWP: Steam working pressure.
6. TFE: Tetrafluoroethylene plastic.

1.4 SUBMITTALS

A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

1.5 QUALITY ASSURANCE

A. ASME Compliance: ASME B31.9 for building services piping valves.

1. Exceptions: Domestic hot- and cold-water piping valves unless referenced.

B. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.

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. Set butterfly valves closed or slightly open.
6. 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 VALVES, GENERAL

A. Refer to Part 3 "Valve Applications" Article for applications of valves.

B. Bronze Valves: NPS 2 and smaller with threaded ends, unless otherwise indicated.

C. Ferrous Valves: NPS 2-1/2 and larger with flanged or grooved ends, unless otherwise indicated.

D. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

E. Valve Sizes: Same as upstream pipe, unless otherwise indicated.

F. Valve Actuators:

1. Chainwheel: For attachment to valves, of size and mounting height, as indicated in the "Valve Installation" Article in Part 3.
2. Gear Drive: For quarter-turn valves NPS 8 and larger.

3. Handwheel: For valves other than quarter-turn types.
4. Lever Handle: For quarter-turn valves NPS 6 and smaller, except plug valves.

G. Extended Valve Stems: On insulated valves.

H. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.

I. Valve Grooved Ends: AWWA C606.

J. Threaded: With threads according to ASME B1.20.1.

K. Valve Bypass and Drain Connections: MSS SP-45.

2.2 COPPER-ALLOY BALL VALVES

A. Manufacturers:

1. Two-Piece and Three Piece, Copper-Alloy Ball Valves:

a. Conbraco Industries, Inc.; Apollo Div.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Div.
e. Grinnell Corporation.
f. Hammond Valve.
g. Jamesbury, Inc.
h. Jomar International, LTD.
i. Milwaukee Valve Company.
j. Nexus Valve Specialties.
k. NIBCO INC.
l. R & M Energy Systems (Borger, TX).
m. Red-White Valve Corp.
n. Watts Industries, Inc.; Water Products Div.

B. Copper-Alloy Ball Valves, General: MSS SP-110.

C. Two-Piece, Copper-Alloy Ball Valves: Brass or bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig (4140-kPa) minimum CWP rating and blowout-proof stem.

D. Three-Piece, Copper-Alloy Ball Valves: Brass or bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig minimum CWP rating and blowout-proof stem.

2.3 FERROUS-ALLOY BUTTERFLY VALVES

A. Available Manufacturers:

B. Manufacturers:

1. Single-Flange, Ferrous-Alloy Butterfly Valves:

a. American Valve, Inc.

b. Bray International, Inc.
c. Cooper Cameron Corp.; Cooper Cameron Valves Div.
d. Crane Co.; Crane Valve Group; Center Line.
e. Crane Co.; Crane Valve Group; Jenkins Valves.
f. Crane Co.; Crane Valve Group; Stockham Div.
g. Dover Corp.; Dover Resources Company; Norriseal Div.
h. General Signal; DeZurik Unit.
i. Grinnell Corporation.
j. Hammond Valve.
k. Kitz Corporation of America.
l. Legend Valve & Fitting, Inc.
m. Metraflex Co.
n. Milwaukee Valve Company.
o. Mueller Steam Specialty.
p. NIBCO INC.
q. Process Development & Control.
r. Red-White Valve Corp.
s. Techno Corp.
t. Tyco International, Ltd.; Tyco Valves & Controls.
u. Watts Industries, Inc.; Water Products Div.

2. Flanged, Ferrous-Alloy Butterfly Valves:
a. Bray International, Inc.
b. Cooper Cameron Corp.; Cooper Cameron Valves Div.
c. Grinnell Corporation.
d. Mueller Steam Specialty
e. Tyco International, Ltd.; Tyco Valves & Controls.

3. Grooved-End, Ductile-Iron Butterfly Valves:
a. Central Sprinkler Co.; Central Grooved Piping Products.
b. Grinnell Corporation.
c. Hammond Valve.
d. McWane, Inc.; Kennedy Valve Div.
e. Milwaukee Valve Company.
f. Mueller Steam Specialty.
g. NIBCO INC.
h. Victaulic Co. of American.

C. Ferrous-Alloy Butterfly Valves, General: MSS SP-67, Type I, for tight shutoff, with disc and lining suitable for potable water, unless otherwise indicated.

D. Single-Flange, 150-psig CWP Rating, Ferrous-Alloy Butterfly Valves: Wafter-lug type with one- or two-piece stem.

E. Flanged, 150-psig CWP Rating, Ferrous-Alloy Butterfly Valves: Flanged-end type with one- or two-piece stem.

F. Grooved-End, 175-psig CWP Rating, Ferrous-Alloy Butterfly Valves: Ductile-iron or steel body with grooved or shouldered ends.

2.4 BRONZE CHECK VALVES

A. Manufacturers:

1. Horizontal Lift Check Valves with Metal Disc:

    a. Cincinnati Valve Co.
    b. Crane Co.; Crane Valve Group; Crane Valves.
    c. Crane Co.; Crane Valve Group; Stockham Div.
    d. Red-white Valve Corp.
    e. Walworth Co.

2. Vertical Lift Check Valves with Metal Disc:

    a. Cincinnati Valve Co.
    b. Crane Co.; Crane Valve Group; Crane Valves.
    c. Crane Co.; Crane Valve Group; Stockham Div.
    d. Red-white Valve Corp.

3. Swing Check Valves with Metal Disc:

    a. American Valve, Inc.
    b. Cincinnati Valve Co.
    c. Crane Co.; Crane Valve Group; Crane Valves.
    d. Crane Co.; Crane Valve Group; Jenkins Valves.
    e. Crane Co.; Crane Valve Group; Stockham Div.
    f. Grinnell Corporation.
    g. Hammond Valve.
    h. Kitz Corporation of America.
    i. Legend Valve & Fitting, Inc.
    j. Milwaukee Valve Company.
    k. NIBCO INC.
    l. Powell, Wm. Co.
    m. Red-White Valve Corp.
    n. Walworth Co.
    o. Watts Industries, Inc.; Water Products Div.

B. Bronze Check Valves, General: MSS SP-80.

C. Class 125, Bronze, Horizontal Lift Check Valves: Bronze body with bronze disc and seat.

D. Class 125, Bronze, Vertical Lift Check Valves: Bronze body with bronze disc and seat.

E. Class 125, Bronze, Swing Check Valves: Bronze body with bronze disc and seat.

2.5 GRAY-IRON SWING CHECK VALVES

A. Manufacturers:

1. Type I, Gray-Iron Swing Check Valves with Metal Seats:

    a. Cincinnati Valve Co.
    b. Crane Co.; Crane Valve Group; Crane Valves.
    c. Crane Co.; Crane Valve Group; Jenkins Valves.
    d. Crane Co.; Crane Valve Group; Stockham Div.
    e. Flomatic Valves.
    f. Grinnell Corporation.

g. Hammond Valve.
h. Milwaukee Valve Company.
i. Mueller Co.
j. NIBCO INC.
k. Powell, Wm. Co.
l. Red-White Valve Corp. m. Walworth Co.
m. Watts Industries, Inc.; Water Products Div.

2. Grooved-End, Ductile-Iron Swing Check Valves:

a. Grinnell Corporation.
b. Mueller Co.
c. Victaulic Co. of America.

B. Gray-Iron Swing Check Valves, General: MSS SP-71.

C. Class 125, gray-iron, swing check valves with metal seats.

D. 175-psig CWP Rating, Grooved-End, Swing Check Valves; Ductile-iron body with grooved or shouldered ends.

2.6 FERROUS-ALLOY WAFER CHECK VALVES

A. Manufacturers:

1. Dual-Plate, Ferrous-Alloy, Wafer-Lug Check Valves;
a. Crane Co.; Crane Valve Group; Crane Valves.
b. Gulf Valve Co.
c. Valve and Primer Corp.

2.7 SPRING-LOADED, LIFT-DISC CHECK VALVES

A. Manufacturers:

1. Wafer Lift-Disc Check Valves:

a. Mueller Steam Specialty.
b. Durabla Fluid Technology, Inc.
c. Flomatic Valves.
d. GA Industries, Inc.
e. Grinnell Corporation.
f. Hammond Valve.
g. Metraflex Co.
h. Milwaukee Valve Company.
i. Mueller Steam Specialty.
j. Multiplex Manufacturing Co.
k. NIBCO INC.
l. SSI Equipment, Inc.
m. Val-Matic Valve & Mfg. Corp. m. Valve and Primer Corp.

B. Lift-Disc Check Valves, General: FCI 74-1, with spring-loaded bronze or alloy disc and bronze or alloy seat.

C. Class 125, Wafer Lift-Disc Check Valves: Wafer style with cast-iron shell with diameter made to fit within bolt circle.

2.8 BRONZE GATE VALVES

A. Manufacturers:

1. Type 1, Bronze, Nonrising-Stem Gate Valves:

a. American Valve, Inc.
b. Cincinnati Valve Co.
c. Crane Co.; Crane Valve Group; Crane Valves.
d. Crane Co.; Crane Valve Group; Jenkins Valves.
e. Crane Co.; Crane Valve Group; Stockham Div.
f. Grinnell Corporation.
g. Hammond Valve.
h. Kitz Corporation of America.
i. Legend Valve & Fitting, Inc.
j. Milwaukee Valve Company.
k. NIBCO INC.
l. Powell, Wm. Co.
m. Red-White Valve Corp.
n. Walworth Co.

2. Type 2, Bronze, Rising-Stem, Gate Valves:

a. American Valve, Inc.
b. Cincinnati Valve Co.
c. Crane Co.; Crane Valve Group; Crane Valves.
d. Crane Co.; Crane Valve Group; Jenkins Valves.
e. Crane Co.; Crane Valve Group; Stockham Div.
f. Grinnell Corporation.
g. Hammond Valve.
h. Kitz Corporation of America.
i. Legend Valve & Fitting, Inc.
j. Milwaukee Valve Company.
k. NIBCO INC.
l. Powell, Wm. Co.
m. Red-White Valve Corp.
n. Walworth Co.

B. Bronze Gate Valves, General: MSS SP-80, with ferrous-alloy handwheel.

C. Class 125, Bronze Gate Valves: Bronze body with rising stem and bronze solid wedge and union-ring bonnet.

D. Class 125, Bronze Gate Valves: Bronze body with rising stem and bronze solid or split wedge and union-ring bonnet.

2.9 CAST-IRON GATE VALVES

A. Manufacturers:

1. Cast-Iron, Nonrising-Stem Gate Valves:

    a. Cincinnati Valve Co.
    b. Crane Co.; Crane Valve Group; Crane Valves.
    c. Crane Co.; Crane Valve Group; Jenkins Valves.
    d. Crane Co.; Crane Valve Group; Stockham Div.
    e. Grinnell Corporation.
    f. Hammond Valve.
    g. Kitz Corporation of America.
    h. Legend Valve & Fitting, Inc.
    i. Milwaukee Valve Company.
    j. NIBCO INC.
    k. Powell, Wm. Co.
    l. Red-White Valve Corp.
    m. Walworth Co.
    n. Watts Industries, Inc.; Water Products Div.

2. Cast-iron, Rising-Stem Gate Valves;

    a. Cincinnati Valve Co.
    b. Crane Co.; Crane Valve Group; Crane Valves.
    c. Crane Co.; Crane Valve Group; Jenkins Valves.
    d. Crane Co.; Crane Valve Group; Stockham Div.
    e. Grinnell Corporation.
    f. Hammond Valve.
    g. Kitz Corporation of America.
    h. Legend Valve & Fitting, Inc.
    i. Milwaukee Valve Company.
    j. NIBCO INC.
    k. Powell, Wm. Co.
    l. Red-White Valve Corp.
    m. Walworth Co.
    n. Watts Industries, Inc.; Water Products Div.

B. Cast-Iron Gate Valves, General: MSS SP-70, Type I.

C. Class 125, NRS, Bronze-Mounted, Cast-Iron Gate Valves: Cast-iron body with bronze trim, nonrising stem, and solid-wedge disc.

D. Class 125, OS&Y, Bronze-Mounted, Cast-Iron Gate Valves: Cast-iron body with bronze trim, rising stem, and solid-wedge disc.

2.10 CHAINWHEEL ACTUATORS

A. Manufacturers:

1. Babbitt Steam Specialty Co.
2. Roto Hammer Industries, Inc.

B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.

1. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve.
2. Brackets: Type, number, size, and fasteners required to mount actuator on valve.

3. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

B. 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.

C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

D. Examine threads on valve and mating pipe for form and cleanliness.

E. 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.

F. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE APPLICATIONS

A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:

1. Equipment isolation Service: Ball or butterfly valves.

2. Shutoff Service: Ball, butterfly, or gate valves.
3. Throttling Service: Ball, butterfly,.
4. Pump Discharge: Spring-loaded, lift-disc check valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

C. Chilled, Condenser, and Heating Hot Water Piping: Use the following types of valves:

1. Ball Valves, NPS 2 and Smaller: Two or Three-piece, 600-psig CWP rating, copper alloy.
2. Ball Valves, NPS 2-1/2 and Larger: Class 150, ferrous alloy.
3. Butterfly Valves, NPS 2-1/2 and Larger: Single-flange or Flanged, 150-psig CWP rating for dead-end service, ferrous alloy, with EPDM liner.
4. Grooved-End, Ductile-Iron Butterfly Valves, NPS 2-1/2 and Larger:175-psig CWP rating.
5. Lift Check Valves, NPS 2 and Smaller: Class 125 or 150, horizontal or vertical, bronze.
6. Swing Check Valves, NPS 2 and Smaller: Class 125 or 150, bronze.
7. Swing Check Valves, NPS 2-1/2 and Larger: Class 125, gray iron.
8. Grooved-End, Ductile-Iron, Swing Check Valves, NPS 2-1/2 and Larger: 175-psig CWP rating.

9. Wafer Check Valves, NPS 2-1/2 and Larger: Dual-plate, wafer-lug or double-flanged, Class 125 or 150 ferrous alloy.
10. Spring-Loaded, Lift-Disc Check Valves: Class 125 or 250, cast iron.
11. Gate Valves, NPS 2 and Smaller: Class 125 or 150, bronze.
12. Gate Valves, NPS 2-1/2 and Larger: Class 125, NRS or OS&Y, bronze-mounted cast iron.

D. Domestic Water Piping: Use the following types of valves:
1. Ball Valves, NPS 2 and Smaller: Two or Three-piece, 600-psig CWP rating, copper alloy.
2. Ball Valves, NPS 2-1/2 and Larger: Class 150 ferrous alloy.
3. Butterfly Valves, NPS 2-1/2 and Larger: Single-flange or Flanged, 150-psig CWP rating, ferrous alloy, with EPDM liner.
4. Grooved-End, Ductile-Iron Butterfly Valves, NPS 2-1/2 and Larger: 175-psig CWP rating.
5. Lift Check Valves, NPS 2 and Smaller: Class 125 horizontal or vertical, bronze.
6. Swing Check Valves, NPS 2 and Smaller: Class 125, bronze.
7. Swing Check Valves, NPS 2-1/2 and Larger: Class 125, gray iron.
8. Grooved-End, Ductile-Iron, Swing Check Valves, NPS 2-1/2 and Larger: 175-psig CWP rating.
9. Wafer Check Valves, NPS 2-1/2 and Larger: Dual-plate, wafer-lug or double-flanged, Class 125 or 150, ferrous alloy.
10. Spring-Loaded, Lift-Disc Check Valves, NPS 2 and Smaller: Class 125 or 150.
11. Spring-Loaded, Lift-Disc Check Valves, NPS 2-1/2 and Larger: Class 125, cast iron.
12. Gate Valves, NPS 2 and Smaller: Class 125 or 150, bronze.
13. Gate Valves, NPS 2-1/2 and Larger: Class 125 NRS or OS&Y, bronze-mounted cast iron.

E. Select valves with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged or threaded ends.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 and larger: Flanged, grooved, or threaded ends.

3.3 VALVE INSTALLATION

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

C. Locate valves for easy access and provide separate support where necessary.

D. Install valves in horizontal piping with stem at or above center of pipe.

E. Install valves in position to allow full stem movement.

F. Install chainwheel operators on valves NPS 4 and larger and more than 96 inches above floor.

G. Extend chains to 60 inches above finished floor elevation.

H. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.

2. Dual-Plate Check Valves: In horizontal or vertical position, between flanges.
3. Lift Check Valves: With stem upright and plumb.

3.4 JOINT CONSTRUCTION

A. Refer to Division 23 Section "Common Work Results for HVAC" for basic piping joint construction.

B. Grooved Joints: Assemble joints with keyed coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

3.5 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

END OF SECTION 23 0523

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SECTION 23 0529

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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following hangers and supports for HVAC system piping and equipment:

1. Steel 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 include the following:

1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Division 23 Section(s) for vibration isolation restraint devices.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Steel pipe hangers and supports.
2. Fiberglass pipe hangers.
3. Thermal-hanger shield inserts.
4. Powder-actuated fastener systems.

B. Shop Drawings: Provide shop drawings for each location required for multiple piping supports and trapeze hangers. Provide manufacturer's catalog data including load capacity.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."

B. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."

PART 2 - PRODUCTS

2.1 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Available Manufacturers:

1. AAA Technology & Specialties Co., Inc.
2. B-Line Systems, Inc.; a division of Cooper Industries.
3. Carpenter & Paterson, Inc.
4. ERICO/Michigan Hanger Co.
5. Grinnell Corp.
6. National Pipe Hanger Corporation.
7. PHS Industries, Inc.

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

D. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.3 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Available Manufacturers:

1. B-Line Systems, Inc.; a division of Cooper Industries.
2. Grinnell Corp.; Power-Strut Unit.
3. National Pipe Hanger Corp.
4. Unistrut Corp.; Tyco International, Ltd.

C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.

D. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.

2.4 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Available Manufacturers:

1. Carpenter & Paterson, Inc.
2. ERICO/Michigan Hanger Co.
3. PHS Industries, Inc.
4. Pipe Shields, Inc.

C. Material for Cold Piping: ASTM C 552, Type I cellular glass or water-repellent-treated, ASTM C 533, Type I calcium silicate with vapor barrier.

D. Material for Hot Piping: ASTM C 552, Type I cellular glass or water-repellent-treated, ASTM C 533, Type I calcium silicate.

E. For Trapeze or Clamped System: Insert and shield cover entire circumference of pipe.

F. For Clevis or Band Hanger: Insert and shield cover lower 180 degrees of pipe.

G. Insert Length: Extend 2 inches beyond sheet metal shield. FASTENER SYSTEMS

2.5 POWDER-ACTUATED FASTENERS

A. Description: 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. Note that written permission must be obtained from Architect, Owner or Structural Engineer if this method is used on structural members.

1. Available Manufacturers:

a. Hilti, Inc.
b. ITW Ramset/Red Head.
c. Masterset Fastening Systems, Inc.

d. MKT Fastening, LLC.
e. Powers Fasteners.

2.6 MECHANICAL-EXPANSION ANCHORS:

A. Description: Insert-wedge-type stainless steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used. Note that written permission must be obtained from Architect, Owner or Structural Engineer if this method is used on structural members

1. Available Manufacturers:

a. B-Line Systems, Inc.; a division of Cooper Industries.
b. Empire Industries, Inc.
c. Hilti, Inc.
d. ITW Ramset/Red Head.
e. MKT Fastening, LLC.
f. Powers Fasteners.

2.7 PIPE STAND FABRICATION

A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod-roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

1. Available Manufacturers:

a. ERICO/Michigan Hanger Co.
b. MIRO Industries.

C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

1. Available Manufacturers:

a. MIRO Industries.

D. High-Type, Single-Pipe Stand: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.

1. Available Manufacturers:

a. ERICO/Michigan Hanger Co.
b. MIRO Industries.
c. Portable Pipe Hangers.

2. Base: Stainless steel.
3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.

4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.

1. Available Manufacturers:

a. Portable Pipe Hangers.

2. Bases: One or more plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe support made from structural-steel shape, continuous-thread rods, and rollers for mounting on permanent stationary roof curb.

2.8 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.9 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use padded hangers for piping that is subject to scratching.

F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated
2. stationary pipes, NPS 1/2 to NPS 30.
3. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
4. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
5. Adjustable Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary
6. pipes, NPS 1/2 to NPS 8.
7. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For
8. suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
9. U-Bolts (MSS Type 24): For support of heavy pipe, NPS 1/2 to NPS 30.
10. 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.
11. 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 and with U-bolt to retain pipe.
12. 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.
13. 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.
14. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
15. 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.
16. 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.
17. 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.

G. Vertical Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.

H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
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.

I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.

2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
8. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
9. 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.

10. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.

J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe, 360-degree insert of high density, 100-psi minimum compressive-strength, water-repellant-treated calcium silicate or cellular-glass pipe insulation, same thickness as adjoining insulation with vapor barrier and encased in 360-degree sheet metal shield.

K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.

L. Use (with permission) powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.2 HANGER AND SUPPORT INSTALLATION

A. Pipe Hanger and Support Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Channel Support System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.
1. Field assemble and install according to manufacturer's written instructions.

C. Heavy-Duty Steel Trapeze Installation: Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated, heavy-duty trapezes.
1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.

2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D-1.1.

D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

E. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

F. 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.

G. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. Refer to Division 07 Section "Roof Accessories" for curbs.

H. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

J. 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.

K. Install lateral bracing with pipe hangers and supports to prevent swaying.

L. 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.

M. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.

O. Insulated Piping: Comply with the following:

1. Attach clamps and spacers to piping.

a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

    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 inserts.
6. Insert Material: Length at least as long as protective shield.
7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections or Section "High-Performance Coatings."

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 23 0529

SECTION 23 0533

HEAT TRACING 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. This Section includes heat tracing with the following electric heating cables:
   1. Self-regulating, parallel resistance.

1.3 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each type of product indicated.

   1. Schedule heating capacity, length of cable, spacing, and electrical power requirement for each electric heating cable required.

B. Shop Drawings: For electric heating cable. Include plans, sections, details, and attachments to other work.

   1. Wiring Diagrams: Power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For electric heating cables to include in operation and maintenance manuals.

E. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace electric heating cable that fails in materials or workmanship within specified warranty period.
   1. Warranty Period: 10 years from date of Owner Acceptance.

PART 2 - PRODUCTS

2.1 SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. BH Thermal Corporation.
2. Chromalox, Inc.; Wiegard Industrial Division; Emerson Electric Company.
3. Delta-Therm Corporation.
4. Easy Heat Inc.
5. Nelson Heat Trace.
6. Pyrotenax; a division of Tyco Thermal Controls.
7. Raychem; a division of Tyco Thermal Controls.
8. Thermon Manufacturing Co.

B. Heating Element: Pair of parallel No. 16 AWG, nickel-coated stranded copper bus wires embedded in crosslinked conductive polymer core, which varies heat output in response to temperature along its length. Terminate with waterproof, factory-assembled nonheating leads with connectors at one end, and seal the opposite end watertight. Cable shall be capable of crossing over itself once without overheating.

C. Electrical Insulating Jacket: Flame-retardant polyolefin.

D. Cable Cover: Stainless-steel braid, and polyolefin outer jacket with UV inhibitor.

E. Maximum Operating Temperature (Power On): 140 deg F.

F. Maximum Exposure Temperature (Power Off): 150 deg F.

G. Maximum Operating Temperature: 160 deg F.

H. Capacities and Characteristics: See schedule or plans.

2.2 CONTROLS

A. Remote bulb unit with adjustable temperature range from 30 to 50 deg F.

B. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected cable.

C. Remote bulb on capillary, resistance temperature device, or thermistor for directly sensing pipe-wall temperature.

D. Corrosion-resistant, waterproof control enclosure.

2.3 ACCESSORIES

A. Cable Installation Accessories: Fiberglass tape, heat-conductive putty, cable ties, silicone end seals and splice kits, and installation clips all furnished by manufacturer, or as recommended in writing by manufacturer.

B. Warning Labels: Refer to Division 23 Section "Identification for HVAC Piping and Equipment."

C. Warning Tape: Continuously printed "Electrical Tracing"; vinyl, at least 3 mils thick, and with pressure-sensitive, permanent, waterproof, self-adhesive back.

1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch.
2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces and substrates to receive electric heating cables for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Ensure surfaces and pipes in contact with electric heating cables are free of burrs and sharp protrusions.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install electric heating cable across expansion joints according to manufacturer's written recommendations using slack cable to allow movement without damage to cable.

B. Install electric heating cables after piping has been tested and before insulation is installed.

C. Install electric heating cables according to IEEE 515.1.

D. Install insulation over piping with electric cables according to Division 23 Section "HVAC Insulation."

E. Install warning tape on piping insulation where piping is equipped with electric heating cables.

F. Set field-adjustable switches and circuit-breaker trip ranges.

G. Protect installed heating cables, including nonheating leads, from damage.

3.3 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Testing: Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction, or concrete.

1. Test cables for electrical continuity and insulation integrity before energizing.
2. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.

B. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounting cables.

C. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 23 0533

SECTION 23 0553

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 nameplates.
2. Equipment markers.
3. Access panel and door markers.
4. Pipe markers.
5. Stencils.
6. Valve tags.
7. Valve schedules.
8. Warning tags.

1.3 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 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.5 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 IDENTIFICATION DEVICES

A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.

1. Data:
    a. Manufacturer, product name, model number, and serial number.
    b. Capacity, operating and power characteristics, and essential data.
2. Location: Accessible and visible.
3. Fasteners: As required to mount on equipment.

B. Equipment Markers: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2. Fabricate in sizes required for message

1. Terminology: Match schedules as closely as possible.
2. Data:
    a. Name and plan number.
    b. Equipment service.
    c. Design capacity.
    d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
3. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.
4. Fasteners: Self-tapping, stainless-steel screws.

C. Access Panel and Door Markers: 1/16-inch- thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8-inch center hole for attachment.

1. Fasteners: Self-tapping, stainless-steel screws.

2.2 PIPE IDENTIFICATION DEVICES

A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

1. Colors: Comply with ASME A13.1, unless otherwise indicated.
2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
3. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 degrees around pipe at each location.
4. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

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 markers, equipment markers, equipment signs, and similar operational instructions.

1. Stencil Material: Fiberboard or metal.
2. Stencil Paint: Exterior, gloss, alkyd enamel or acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, alkyd enamel or 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, with numbering scheme approved by Architect or Engineer. Provide 5/32-inch hole for fastener.

1. Material: 0.032-inch thick brass or aluminum.
2. Valve-Tag Fasteners: Brass wire-link or beaded chain; or S-hook.

2.5 VALVE SCHEDULES

A. 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-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws.

2. Frame: Extruded Aluminum.

3. Glazing: ASTM C 1036, Type 1, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

2.6 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 APPLICATIONS, GENERAL

A. Products specified are for applications referenced in other Division 15 Sections. If more than single-type material, device, or label is specified for listed applications, selection is installer's option.

3.2 EQUIPMENT IDENTIFICATION

A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:

1. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
2. Pumps, compressors, chillers, condensers, and similar motor-driven units.
3. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
4. Fans, blowers, primary balancing dampers, and mixing boxes.
5. Packaged HVAC central-station and zone-type units.

B. Install equipment markers with mechanical fasteners on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.

1. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24inches, 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.
2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:
    a. Main control and operating valves, including safety devices and hazardous units such as gas outlets
    b. Fire department hose valves and hose stations.
    c. Meters, gages, thermometers, and similar units.
    d. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
    e. Pumps, compressors, chillers, condensers, and similar motor-driven units.
    f. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
    g. Fans, blowers, primary balancing dampers, and mixing boxes.
    h. Packaged HVAC central-station and zone-type units.
    i. Tanks and pressure vessels.
    j. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.

C. Stenciled Equipment Marker Option: Stenciled markers may be provided instead of laminated p lastic equipment markers, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.

D. Install access panel markers with screws on equipment access panels.

3.3 PIPE IDENTIFICATION

A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.

1. Pipes with OD, Including Insulation, Less Than 6 Inches: Pretensioned pipe markers. Use size to ensure a tight fit.
2. Pipes with OD, Including Insulation, 6 Inches and Larger: Shaped pipe markers. Use size to match pipe and secure with fasteners.

B. Stenciled Pipe Marker Option: Stenciled markers may be provided instead of manufactured pipe markers, at Installer's option. Install stenciled pipe markers 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 markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed 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 non-accessible 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 markers

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. 1-1/2 inches, round, natural color.

3.5 WARNING-TAG INSTALLATION

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

3.6 ADJUSTING

A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.7 CLEANING

A. Clean faces of mechanical identification devices and glass frames of valve schedules.

END OF SECTION 23 0553

SECTION 23 0593

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. This Section includes TAB to produce design objectives for the following:

1. Air Systems:
   a. Constant-air-volume systems.
   b. Variable-air-volume systems.

2. Hydronic Piping Systems:
   a. Constant-flow systems.
   b. Variable-flow systems.
3. HVAC equipment quantitative-performance settings.
4. Verifying that automatic control devices are functioning properly.
5. Reporting results of activities and procedures specified in this Section.

1.3 DEFINITIONS

A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.

C. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.

D. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.

E. NC: Noise criteria.

F. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

G. RC: Room criteria.

H. Report Forms: Test data sheets for recording test data in logical order.

I. Smoke-Control System: An engineered system that uses fans to produce airflow and pressure differences across barriers to limit smoke movement.

J. Smoke-Control Zone: A space within a building that is enclosed by smoke barriers and is a part of a zoned smoke-control system.

K. Stair Pressurization System: A type of smoke-control system that is intended to positively pressurize stair towers with outdoor air by using fans to keep smoke from contaminating the stair towers during an alarm condition.

L. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.

M. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

N. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

O. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

P. TAB: Testing, adjusting, and balancing.

Q. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

R. Test: A procedure to determine quantitative performance of systems or equipment.

S. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.4 SUBMITTALS

A. Qualification Data: Within 15 days from Contractor's Notice to Proceed, submit 2 copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 45 days from Contractor's Notice to Proceed, submit 2 copies of the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within 30 days from Contractor's Notice to Proceed, submit 2 copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.

D. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.

E. Sample Report Forms: Submit two sets of sample TAB report forms.

F. Warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. TAB Firm Qualifications: Engage a TAB firm certified by AABC.

B. TAB Conference: Meet with Owner's and Architect's representatives on approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls installers, and other support personnel. Provide seven days' advance notice of scheduled meeting time and location.

1. Agenda Items: Include at least the following:

a. Submittal distribution requirements.
b. The Contract Documents examination report.
c. TAB plan.
d. Work schedule and Project-site access requirements.
e. Coordination and cooperation of trades and subcontractors.
f. Coordination of documentation and communication flow.

C. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.

D. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems."

E. Instrumentation Type, Quantity, and Accuracy: As described in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems".

F. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.

1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

1.6 PROJECT CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.7 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

B. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.8 WARRANTY

A. National Project Performance Guarantee: Provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:

1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
2. Systems are balanced to optimum performance capabilities within design and installation limits.

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.

1. Contract Documents are defined in the General and Supplementary Conditions of Contract.
2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

B. Examine approved submittal data of HVAC systems and equipment.

C. Examine Project Record Documents described in Division 01 Section "Project Record Documents."

D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine equipment performance data including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.

F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.

G. Examine system and equipment test reports.

H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

J. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

K. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.

L. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.

M. Examine strainers for clean screens and proper perforations.

N. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

O. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

P. Examine system pumps to ensure absence of entrained air in the suction piping.

Q. Examine equipment for installation and for properly operating safety interlocks and controls.

R. Examine automatic temperature system components to verify the following:

1. Dampers, valves, and other controlled devices are operated by the intended controller.
2. Dampers and valves are in the position indicated by the controller.
3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
6. Sensors are located to sense only the intended conditions.
7. Sequence of operation for control modes is according to the Contract Documents.
8. Controller set points are set at indicated values.
9. Interlocked systems are operating.
10. Changeover from heating to cooling mode occurs according to indicated values.

S. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system readiness checks and prepare system readiness reports. Verify the following:

1. Permanent electrical power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.

8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" and this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.

C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

D. 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. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.

E. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling unit components.

L. Check for proper sealing of air duct system.

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 fan static pressures to determine actual static pressure as follows:

    a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
    b. Measure static pressure directly at the fan outlet or through the flexible connection.
    c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
    d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.

    a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.

3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.
4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
5. Obtain approval from Engineer for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

    1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.

        a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

    2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure terminal outlets and inlets without making adjustments.

    1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.

    1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
    2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a maximum set-point airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.

B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set outside-air dampers at minimum, and return- and exhaust-air dampers at a position that simulates full-cooling load.
2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
3. Measure total system airflow. Adjust to within indicated airflow.
4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow as described for constant-volume air systems.

    a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.

6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.
7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
8. Record the final fan performance data.

3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:

1. Open all manual valves for maximum flow.
2. Check expansion tank liquid level.
3. Check makeup-water-station pressure gage for adequate pressure for highest vent.
4. Check flow-control valves for specified sequence of operation and set at indicated flow.
5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.

6. Set system controls so automatic valves are wide open to heat exchangers.
7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.8 PROCEDURES FOR HYDRONIC SYSTEMS

A. Measure water flow at pumps. Use the following procedures, except for positive-displacement pumps:

1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
4. Report flow rates that are not within plus or minus 5 percent of design.

B. Set calibrated balancing valves, if installed, at calculated presettings.

C. Measure flow at all stations and adjust, where necessary, to obtain first balance.

1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

D. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.

E. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:

1. Determine the balancing station with the highest percentage over indicated flow.
2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
3. Record settings and mark balancing devices.

F. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.

G. Measure the differential-pressure control valve settings existing at the conclusions of balancing.

3.9 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.10 PROCEDURES FOR PRIMARY-SECONDARY-FLOW HYDRONIC SYSTEMS

A. Balance the primary system crossover flow first, then balance the secondary system.

3.11 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer, model, and serial numbers.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.12 PROCEDURES FOR CHILLERS

A. Balance water flow through each evaporator and condenser to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:

1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
2. If water-cooled chillers, condenser-water entering and leaving temperatures, pressure drop, and water flow.
3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
4. Power factor if factory-installed instrumentation is furnished for measuring kilowatt.
5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatt.
6. Capacity: Calculate in tons of cooling.
7. If air-cooled chillers, verify condenser-fan rotation and record fan and motor data including number of fans and entering- and leaving-air temperatures.

3.13 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record compressor data.

3.14 PROCEDURES FOR HEAT EXCHANGERS

A. Measure water flow through all circuits.

B. Adjust water flow to within specified tolerances.

C. Measure inlet and outlet water temperatures.

D. Measure inlet steam pressure.

E. Check the setting and operation of safety and relief valves. Record settings.

3.15 PROCEDURES FOR HEAT-TRANSFER COILS

A. Water Coils: Measure the following data for each coil:

1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.
7. Air pressure drop.

3.16 PROCEDURES FOR TEMPERATURE MEASUREMENTS

A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.

B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.

C. Measure outside-air, wet- and dry-bulb temperatures.

3.17 TEMPERATURE-CONTROL VERIFICATION

A. Verify that controllers are calibrated and commissioned.

B. Check transmitter and controller locations and note conditions that would adversely affect control functions.

C. Record controller settings and note variances between set points and actual measurements.

D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).

E. Check free travel and proper operation of control devices such as damper and valve operators.

F. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water flow measurements. Note the speed of response to input changes.

G. Check the interaction of electrically operated switch transducers.

H. Check the interaction of interlock and lockout systems.

I. Check main control supply-air pressure and observe compressor and dryer operations.

J. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or nongrounded power supply.

K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.18 TOLERANCES

A. Set HVAC system airflow and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 5 to plus 10 percent.
2. Air Outlets and Inlets: 0 to minus 10 percent.
3. Heating-Water Flow Rate: 0 to minus 10 percent.
4. Cooling-Water Flow Rate: 0 to minus 5 percent.

3.19 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.

B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.20 FINAL REPORT

A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.

B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.

1. Include a list of instruments used for procedures, along with proof of calibration.

C. Final Report Contents: In addition to certified field report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.

D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:

1. Title page.
2. Name and address of TAB firm.

3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB firm who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer, type size, and fittings.
14. Notes to explain why certain final data in the body of reports varies from indicated values.
15. Test conditions for fans and pump performance forms including the following:

    a. Settings for outside-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings
    f. Settings for supply-air, static-pressure controller.
    g. Other system operating conditions that affect performance.

E. 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 outside, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

F. Air-Handling Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data: Include the following:

    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. Sheave dimensions, center-to-center, and amount of adjustments in inches .
    j. Number of belts, make, and size.
    k. Number of filters, type, and size.

2. Motor Data:

    a. 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. Sheave dimensions, center-to-center, 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. Outside airflow in cfm.
    j. Return airflow in cfm.
    k. Outside-air damper position.
    l. Return-air damper position.
    m. Vortex damper position.

G. Apparatus-Coil Test Reports:

1. Coil Data:

    a. System identification.
    b. Location.
    c. Coil type.
    d. Number of rows.
    e. Fin spacing in fins per inch o.c.
    f. Make and model number.
    g. Face area in sq. ft..
    h. Tube size in NPS.
    i. Tube and fin materials.
    j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

    a. Airflow rate in cfm.
    b. Average face velocity in fpm.
    c. Air pressure drop in inches wg.
    d. Outside-air, wet- and dry-bulb temperatures in deg F.
    e. Return-air, wet- and dry-bulb temperatures in deg F.
    f. Entering-air, wet- and dry-bulb temperatures in deg F.
    g. Leaving-air, wet- and dry-bulb temperatures in deg F.
    h. Water flow rate in gpm.
    i. Water pressure differential in feet of head or psig.
    j. Entering-water temperature in deg F.
    k. Leaving-water temperature in deg F.
    l. Refrigerant expansion valve and refrigerant types.

m. Refrigerant suction pressure in psig.
n. Refrigerant suction temperature in deg F.
o. Inlet steam pressure in psig.

H. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:

1. Unit Data:

a. System identification.
b. Location.
c. Coil identification.
d. Capacity in kW.
e. Number of stages.
f. Connected volts, phase, and hertz.
g. Rated amperage.
h. Airflow rate in cfm.
i. Face area in sq. ft.
j. Minimum face velocity in fpm.

2. Test Data (Indicated and Actual Values):

a. Heat output in kW.
b. Airflow rate in cfm.
c. Air velocity in fpm.
d. Entering-air temperature in deg F.
e. Leaving-air temperature in deg F.
f. Voltage at each connection.
g. Amperage for each phase.

I. Round 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.

J. Air-Terminal-Device Reports:

1. Unit Data:

a. System and air-handling unit identification.
b. Location and zone.
c. Test apparatus used.

d. Area served.
e. Air-terminal-device make.
f. Air-terminal-device number from system diagram.
g. Air-terminal-device type and model number.
h. Air-terminal-device size.
i. Air-terminal-device 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.

K. 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. Sheave dimensions, center-to-center, and amount of adjustments in inches.

2. Motor Data:

a. 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. Sheave dimensions, center-to-center, and amount of adjustments in inches.
g. Number of belts, make, and size.

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.

L. 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. Sheave dimensions, center-to-center, and amount of adjustments in inches .

2. Motor Data:

a. 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. Sheave dimensions, center-to-center, and amount of adjustments in inches .
g. Number of belts, make, and size.

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.

M. 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.

N. Air-Terminal-Device Reports:

1. Unit Data:

a. System and air-handling unit identification.
b. Location and zone.
c. Test apparatus used.
d. Area served.
e. Air-terminal-device make.
f. Air-terminal-device number from system diagram.
g. Air-terminal-device type and model number.
h. Air-terminal-device size.

i. Air-terminal-device 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.

O. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:

a. System and air-handling unit identification.
b. Location and zone.
c. Room or riser served.
d. Coil make and size.
e. Flowmeter type.

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm.
b. Entering-water temperature in deg F.
c. Leaving-water temperature in deg F.
d. Water pressure drop in feet of head or psig.
e. Entering-air temperature in deg F.
f. Leaving-air temperature in deg F.

P. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:

a. System and air-handling unit identification.
b. Location and zone.
c. Room or riser served.
d. Coil make and size.
e. Flowmeter type.

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm.
b. Entering-water temperature in deg F.
c. Leaving-water temperature in deg F.
d. Water pressure drop in feet of head or psig.
e. Entering-air temperature in deg F.
f. Leaving-air temperature in deg F.

Q. Packaged Chiller Reports:

1. Unit Data:

a. Unit identification.
b. Make and model number.
c. Manufacturer's serial number.
d. Refrigerant type and capacity in gal.
e. Starter type and size.
f. Starter thermal protection size.
g. Compressor make and model number.
h. Compressor manufacturer's serial number.

2. Air-Cooled Condenser Test Data (Indicated and Actual Values):

a. Refrigerant pressure in psig.
b. Refrigerant temperature in deg F.
c. Entering- and leaving-air temperature in deg F.

3. Evaporator Test Reports (Indicated and Actual Values):

a. Refrigerant pressure in psig.
b. Refrigerant temperature in deg F.
c. Entering-water temperature in deg F.
d. Leaving-water temperature in deg F.
e. Entering-water pressure in feet of head or psig.
f. Water pressure differential in feet of head or psig.

4. Compressor Test Data (Indicated and Actual Values):

a. Suction pressure in psig.
b. Suction temperature in deg F.
c. Discharge pressure in psig.
d. Discharge temperature in deg F.
e. Oil pressure in psig.
f. Oil temperature in deg F.
g. Voltage at each connection.
h. Amperage for each phase.
i. Kilowatt input.
j. Crankcase heater kilowatt.
k. Chilled-water control set point in deg F.
l. Condenser-water control set point in deg F.
m. Refrigerant low-pressure-cutoff set point in psig.
n. Refrigerant high-pressure-cutoff set point in psig.

5. Refrigerant Test Data (Indicated and Actual Values):

a. Oil level.
b. Refrigerant level.
c. Relief valve setting in psig.
d. Unloader set points in psig.
e. Percentage of cylinders unloaded.
f. Bearing temperatures in deg F.
g. Vane position.
h. Low-temperature-cutoff set point in deg F.

R. Instrument Calibration Reports:

1. Report Data:

    a. Instrument type and make.
    b. Serial number.
    c. Application.
    d. Dates of use.
    e. Dates of calibration.

3.21 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report.
2. Randomly check the following for each system:

    a. Measure airflow of at least 10 percent of air outlets.
    b. Measure water flow of at least 5 percent of terminals.
    c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
    d. Measure sound levels at two locations.
    e. Measure space pressure of at least 10 percent of locations.
    f. Verify that balancing devices are marked with final balance position.
    g. Note deviations to the Contract Documents in the Final Report.

B. Final Inspection:

1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by owner.
2. TAB firm test and balance engineer shall conduct the inspection in the presence of owner.
3. Owner shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to either 10 percent of the total measurements recorded, or the extent of measurements that can be accomplished in a normal 8-hour business day.
4. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. 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.
6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.
7. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

3.22 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

END OF SECTION 23 0593

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SECTION 23 0700

HVAC 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:

1. Insulation Materials:
   a. Mineral fiber.
   b. Polyisocyanurate.
   c. Polyolefin.
   d. Polystyrene.
2. Fire-rated insulation systems.
3. Insulating cements.
4. Adhesives.
5. Mastics.
6. Lagging adhesives.
7. Sealants.
8. Factory-applied jackets.
9. Field-applied fabric-reinforcing mesh.
10. Field-applied cloths.
11. Field-applied jackets.
12. Tapes.
13. Securements.
14. Corner angles.

B. Related Sections:
   1. Division 23 Section "Metal Ducts" for duct liners.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

B. Shop Drawings:

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.

3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.
8. Detail field application for each equipment type.

C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use.

1. Sample Sizes:

a. Preformed Pipe Insulation Materials: 12 inches long by NPS 2 .
b. Sheet Form Insulation Materials: 12 inches square.
c. Jacket Materials for Pipe: 12 inches long by NPS 2 .
d. Sheet Jacket Materials: 12 inches square.
e. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

D. Qualification Data: For qualified Installer.

E. 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.

F. Field quality-control reports.

1.4 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. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and 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.

1.7 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 Part 3 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. 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 III with factory-applied FSP 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.; Duct Wrap.
b. Johns Manville; Microlite.
c. Knauf Insulation; Duct Wrap.
d. Manson Insulation Inc.; Alley Wrap.
e. Owens Corning; All-Service Duct Wrap.

G. 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. Johns Manville; HTB 23 Spin-Glas.
b. Owens Corning; High Temperature Flexible Batt Insulations.

H. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications,with factory-applied FSK jacket. For equipment applications, provide insulation with factory-applied FSK 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.; 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.

I. High-Temperature, Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type III, without factory-applied jacket.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Fibrex Insulations Inc.; FBX.
b. Johns Manville; 1000 Series Spin-Glas.
c. Owens Corning; High Temperature Industrial Board Insulations.
d. Rock Wool Manufacturing Company; Delta Board.
e. Roxul Inc.; Roxul RW.
f. Thermafiber; Thermafiber Industrial Felt.

J. 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 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, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
3. Type II, 1200 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type II, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

K. Mineral-Fiber, Pipe Insulation Wicking System: Preformed pipe insulation complying with ASTM C 547, Type I, Grade A, with absorbent cloth factory applied to the entire inside surface of preformed pipe insulation and extended through the longitudinal joint to outside surface of insulation under insulation jacket. Factory apply a white, polymer, vapor-retarder jacket with self-sealing adhesive tape seam and evaporation holes running continuously along the longitudinal seam, exposing the absorbent cloth.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Knauf Insulation; Permawick Pipe Insulation.
b. Owens Corning; VaporWick Pipe Insulation.

L. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied FSK jacket complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. 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.; CrimpWrap.
b. Johns Manville; MicroFlex.
c. Knauf Insulation; Pipe and Tank Insulation.
d. Manson Insulation Inc.; AK Flex.
e. Owens Corning; Fiberglas Pipe and Tank Insulation.

M. Polyisocyanurate: Unfaced, preformed, rigid cellular polyisocyanurate material intended for use as thermal insulation.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Apache Products Company; ISO-25.
b. Dow Chemical Company (The); Trymer.
c. Duna USA Inc.; Corafoam.
d. Elliott Company; Elfoam.

2. Comply with ASTM C 591, Type I or Type IV, except thermal conductivity (k-value) shall not exceed 0.19 Btu x in./h x sq. ft. x deg F at 75 deg F after 180 days of aging.
3. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less for thickness up to 1-1/2 inches as tested by ASTM E 84.
4. Fabricate shapes according to ASTM C 450 and ASTM C 585.
5. Factory-Applied Jacket: Requirements are specified in "Factory-Applied Jackets" Article.

a. Pipe Applications: PVDC-SSL.
b. Equipment Applications: PVDC-SSL.

N. 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 Inc.; IMCOLOCK, IMCOSHEET, NOMALOCK, and NOMAPLY.
c. RBX Corporation; Therma-cell.

O. Polystyrene: Rigid, extruded cellular polystyrene intended for use as thermal insulation. Comply with ASTM C 578, Type IV or Type XIII, except thermal conductivity (k-value) shall not exceed 0.26 Btu x in./h x sq. ft. x deg F after 180 days of aging. Fabricate shapes according to ASTM C 450 and ASTM C 585.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Dow Chemical Company (The); Styrofoam.
b. Knauf Insulation; Knauf Polystyrene.

2.2 FIRE-RATED INSULATION SYSTEMS

A. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a **2**-hour fire rating by a NRTL acceptable to authority having jurisdiction.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corp.; FlameChek.
b. Johns Manville; Firetemp Wrap.
c. Nelson Firestop Products; Nelson FSB Flameshield Blanket.
d. Thermal Ceramics; FireMaster Duct Wrap.
e. 3M; Fire Barrier Wrap Products.
f. Unifrax Corporation; FyreWrap.
g. Vesuvius; PYROSCAT FP FASTR Duct Wrap.

2.3 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Insulco, Division of MFS, Inc.; Triple I.
b. P. K. Insulation Mfg. Co., Inc.; Super-Stik.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

1. Products: Subject to compliance with requirements, provide one of the following:

a. P. K. Insulation Mfg. Co., Inc.; Thermal-V-Kote.

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Insulco, Division of MFS, Inc.; SmoothKote.
b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
c. Rock Wool Manufacturing Company; Delta One Shot.

2.4 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. Phenolic, Polyisocyanurate, and Polystyrene 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 Products, Division of ITW; CP-96.
b. Foster Products Corporation, H. B. Fuller Company; 81-33.

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 LCC; 520 Adhesive.
c. Foster Products Corporation, H. B. Fuller Company; 85-75.
d. RBX Corporation; Rubatex Contact Adhesive.

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 Products, Division of ITW; CP-82.
b. Foster Products Corporation, H. B. Fuller Company; 85-20.
c. ITW TACC, Division of Illinois Tool Works; S-90/80.
d. Marathon Industries, Inc.; 225.
e. Mon-Eco Industries, Inc.; 22-25.

E. Polystyrene Adhesive: Solvent- or water-based, synthetic resin adhesive with a service temperature range of minus 20 to plus 140 deg F.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-96.

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 Products, Division of ITW; CP-82.
b. Foster Products Corporation, H. B. Fuller Company; 85-20.
c. ITW TACC, Division of Illinois Tool Works; S-90/80.
d. Marathon Industries, Inc.; 225.
e. Mon-Eco Industries, Inc.; 22-25.

G. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Dow Chemical Company (The); 739, Dow Silicone.
b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
c. P.I.C. Plastics, Inc.; Welding Adhesive.
d. Red Devil, Inc.; Celulon Ultra Clear.

2.5 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-35.
b. Foster Products Corporation, H. B. Fuller Company; 30-90.
c. ITW TACC, Division of Illinois Tool Works; CB-50.
d. Marathon Industries, Inc.; 590.
e. Mon-Eco Industries, Inc.; 55-40.
f. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96, 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, 59 percent by volume and 71 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 Products, Division of ITW; CP-30.
b. Foster Products Corporation, H. B. Fuller Company; 30-35.
c. ITW TACC, Division of Illinois Tool Works; CB-25.
d. Marathon Industries, Inc.; 501.
e. 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 Products, Division of ITW; Encacel.
b. Foster Products Corporation, H. B. Fuller Company; 60-95/60-96.
c. Marathon Industries, Inc.; 570.
d. Mon-Eco Industries, Inc.; 55-70.

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 Products, Division of ITW; CP-10.
b. Foster Products Corporation, H. B. Fuller Company; 35-00.
c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
d. Marathon Industries, Inc.; 550.
e. Mon-Eco Industries, Inc.; 55-50.
f. Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 200 deg F.
4. Solids Content: 63 percent by volume and 73 percent by weight.
5. Color: White.

2.6 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 Products, Division of ITW; CP-52.
b. Foster Products Corporation, H. B. Fuller Company; 81-42.
c. Marathon Industries, Inc.; 130.
d. Mon-Eco Industries, Inc.; 11-30.
e. Vimasco Corporation; 136.

2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct, equipment, and pipe insulation.
3. Service Temperature Range: Minus 50 to plus 180 deg F.
4. Color: White.

2.7 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass, Phenolic, and Polyisocyanurate Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-76.
b. Foster Products Corporation, H. B. Fuller Company; 30-45.
c. Marathon Industries, Inc.; 405.
d. Mon-Eco Industries, Inc.; 44-05.
e. Pittsburgh Corning Corporation; Pittseal 444.
f. Vimasco Corporation; 750.

2. Joint Sealants for Polystyrene Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-70.
b. Foster Products Corporation, H. B. Fuller Company; 30-45/30-46.
c. Marathon Industries, Inc.; 405.
d. Mon-Eco Industries, Inc.; 44-05.

e. Vimasco Corporation; 750.

3. Materials shall be compatible with insulation materials, jackets, and substrates.
4. Permanently flexible, elastomeric sealant.
5. Service Temperature Range: Minus 100 to plus 300 deg F.
6. Color: White or gray.

B. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-76-8.
b. Foster Products Corporation, H. B. Fuller Company; 95-44.
c. Marathon Industries, Inc.; 405.
d. Mon-Eco Industries, Inc.; 44-05.
e. Vimasco Corporation; 750.

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.

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 Products, Division of ITW; 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.

2.8 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. PVDC Jacket for Indoor Applications: 4-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96 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 one of the following:

1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

6. PVDC Jacket for Outdoor Applications: 6-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms when tested according to ASTM E 96 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 one of the following:

      1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

7. 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 one of the following:

      1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

8. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.9 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric for Pipe Insulation: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch for covering pipe and pipe fittings.

   1. Products: Subject to compliance with requirements, provide one of the following:

      a. Vimasco Corporation; Elastafab 894.

B. Woven Glass-Fiber Fabric for Duct and Equipment Insulation: Approximately 6 oz./sq. yd.with a thread count of 5 strands by 5 strands/sq. inch for covering equipment.

   1. Products: Subject to compliance with requirements, provide one of the following:

      a. Childers Products, Division of ITW; Chil-Glas No. 5.

C. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch, in a Leno weave, for duct, equipment, and pipe.

   1. Products: Subject to compliance with requirements, provide one of the following:

      a. Foster Products Corporation, H. B. Fuller Company; Mast-A-Fab.
      b. Vimasco Corporation; Elastafab 894.

2.10 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

2.11 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Johns Manville; Zeston.
    b. P.I.C. Plastics, Inc.; FG Series.
    c. Proto PVC Corporation; LoSmoke.
    d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.
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.

5. Factory-fabricated tank heads and tank side panels.

D. Metal Jacket:

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Childers Products, Division of ITW; Metal Jacketing Systems.
    b. PABCO Metals Corporation; Surefit.
    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 or Factory cut and rolled to size.
    b. Finish and thickness are indicated in field-applied jacket schedules.
    c. Moisture Barrier for Indoor Applications: 2.5-mil-thick, heat-bonded polyethylene and kraft paper.
    d. Moisture Barrier for Outdoor Applications: 3-mil thick Polysurlyn.
    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.

E. PVDC Jacket for Indoor Applications: 4-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Dow Chemical Company (The), Saran 540 Vapor Retarder Film.

2.12 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. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
b. Compac Corp.; 104 and 105.
c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
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. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
b. Compac Corp.; 110 and 111.
c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
d. Venture Tape; 1525 CW, 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. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
    b. Compac Corp.; 130.
    c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
    d. 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. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
    b. Compac Corp.; 120.
    c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
    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 for Indoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Dow Chemical Company (The); Saran 540 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.

F. PVDC Tape for Outdoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Dow Chemical Company (The); Saran 560 Vapor Retarder Tape.

2. Width: 3 inches.
3. Film Thickness: 6 mils.
4. Adhesive Thickness: 1.5 mils.
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/inch in width.

2.13 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products; Bands.
b. PABCO Metals Corporation; Bands.
c. RPR Products, Inc.; Bands.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 3/4 inch wide with wing or closed seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch 3/4 inch wide with wing or closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers: Note that insulation pins shall NOT BE USED for cooled, dehumidified supply/return air insulation. Use for heated air systems only.

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.; CWP-1.
2) GEMCO; Cupped Head Weld Pin.
3) Midwest Fasteners, Inc.; Cupped Head.
4) Nelson Stud Welding; CHP.

3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Products: Subject to compliance with requirements, provide one of the following:

1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
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, 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. Comply with the following requirements:

   a. Products: Subject to compliance with requirements, provide one of the following:

      1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
      2) GEMCO; Press and Peel.
      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 or aluminum 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. Products: Subject to compliance with requirements, provide 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.
b. Childers Products.
c. PABCO Metals Corporation.
d. RPR Products, Inc.

2.14 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 316.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation 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.
3. 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. 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, ducts and fittings, and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and 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 as recommended by insulation material manufacturer to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and 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. Manholes.
5. Handholes.
6. 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. 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 Division 07 Section "Penetration Firestopping"irestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Duct: Install insulation continuously through floor penetrations that are not fire rated. 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. Pipe: Install insulation continuously through floor penetrations.
3. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

A. Insulation Installation on Pumps:
1. Provide a removable waterproof jacket with a minimum R-factor = 8.0. Jacket shall be suitable for hot or chilled water pumps as required. Jacket shall allow for required maintenance on pump.

3.6 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, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as 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.

3.7 MINERAL-FIBER INSULATION INSTALLATION

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 but 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.

E. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    b. On duct sides with dimensions larger than 18 inches , place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not overcompress insulation during installation.
    e. Impale insulation over pins and attach speed washers.
    f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 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 2 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.

F. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    b. On duct sides with dimensions larger than 18 inches , space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not overcompress insulation during installation.
    e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 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 2 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- (150-mm-) 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.

3.8 POLYISOCYANURATE INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with tape or bands and tighten without deforming insulation materials. Orient longitudinal joints between half sections in 3 and 9 o'clock positions on the pipe.

2. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs but secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.
3. All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor barrier must be continuous. Before installing jacket material, install vapor-barrier system.

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, same thickness of adjacent pipe insulation, not to exceed 1-1/2-inch (38-mm) thickness.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyisocyanurate block insulation of same thickness as pipe insulation.

C. Insulation Installation on Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of polyisocyanurate 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.

3.9 POLYOLEFIN INSULATION INSTALLATION

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.

3.10 POLYSTYRENE INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation with tape or bands and tighten bands without deforming insulation materials. Orient longitudinal joints between half sections in 3 and 9 o'clock positions on the pipe.
2. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs but secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.
3. All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor barrier must be continuous. Before installing jacket material, install vapor-barrier system.

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, same thickness of adjacent pipe insulation, not to exceed 1-1/2-inch thickness.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polystyrene block insulation of same thickness as pipe insulation.

C. 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.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed section of polystyrene 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.

3.11 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; 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. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
2. Wrap factory-presized jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
3. Continuous jacket can be spiral wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
4. 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. The 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.
5. 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.

3.12 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 Division 07 Section "Penetration Firestopping."

3.13 FINISHES

A. Duct, Equipment, and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.14 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. 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 two location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
2. 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 two 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.
3. 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.

3.15 DUCT INSULATION SCHEDULE, GENERAL

A. Supply and return air duct shall be internally lined, refer to Division 23 “metal ducts”.

B. Outside air duct shall be externally lined:

1. Mineral-Fiber Blanket: 1-1/2 inches thick with minimum of R-6 rating with FSK jacket.

C. Items Not Insulated:

1. Factory-insulated flexible ducts.
2. Factory-insulated plenums and casings.
3. Flexible connectors.
4. Vibration-control devices.
5. Factory-insulated access panels and doors.

3.16 PLENUM INSULATION SCHEDULE

A. Concealed plenum insulation shall be one of the following:
   1. Mineral-Fiber Blanket: 1-1/2 inches thick with minimum of R-6 rating with FSK jacket.

B. Concealed plenum insulation shall be one of the following:
   1. Mineral-Fiber Blanket: 1-1/2 inches thick with minimum of R-6 rating with FSK jacket.

3.17 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. Exposed piping less than twelve feet above finished floor shall have PVC jacketing, including elbows.

C. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

   1. Drainage piping located in crawl spaces.
   2. Chrome-plated pipes and fittings unless there is a potential for personnel injury or if the pipes produce condensate drippage.

3.18 INDOOR PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water:

   1. All Pipe Sizes: Insulation shall be one of the following:
      a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick with factory applied all service jacket.

B. Chilled Water Piping:

   1. All Pipe Sizes: Insulation shall be one of the following:
      a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inch thick with factory applied service jacket.

C. Refrigerant Suction and Hot-Gas Piping:

   1. All Pipe Sizes: Insulation shall be one of the following:
      a. Polyisocyanurate: 1 inch thick.
      b. Polyolefin: 1 inch thick.
      c. Flexible Elastomeric: 1 inch thick.

D. Refrigerant Suction and Hot-Gas Flexible Tubing:

   1. All Pipe Sizes: Insulation shall be one of the following:

      a. Flexible Elastomeric: 1 inch thick.
      b. Polyolefin: 1 inch thick.

3.19 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Chilled Water Supply and Return:

1. All Pipe Sizes: Insulation shall be one of the following:
   a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick with aluminimum jacket.

B. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be one of the following:
   a. Flexible Elastomeric: 1-1/2 inches thick.
   b. Polyisocyanurate: 1 inch thick.
   c. Polyolefin: 2 inches thick.

C. Refrigerant Suction and Hot-Gas Flexible Tubing:

1. All Pipe Sizes: Insulation shall be one of the following:

   a. Flexible Elastomeric: 1-1/2 inches thick.
   b. Polyolefin: 2 inches thick.
   c. Polyisocyanurate: 1 inch thick.

3.20 OUTDOOR, UNDERGROUND PIPING INSULATION SCHEDULE

A. Chilled water piping, All Sizes: All piping shall be pre-insualted piping systems by Insul-Pipe, Thermacor, Perma-Pipe, Insul-Ter or approved equal. All shall have sealed jacket of corrosion-proof and water proof material. All insulation R-Values shall meet the 20015 IECC Code, 503.2.8.

3.21 MANUFACTURERS

A. Products of the following manufacturers which comply with all requirements are acceptable:

1. Perma Pipe

2. Thermal Pipe Systems, Inc.

3. Thermacor

4. Insul-Pipe

3.22 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material that does not have a factory applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Equipment, Concealed:

1. None.

D. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches. Note that this only applies if no factory applied jacket is provided with the equipment.
   1. Aluminum Corrugated 0.032 inch thick.

E. Equipment, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches. Note that this only applies if no factory applied jacket is provided with the equipment.
   1. Aluminum, Deep Corrugations 2-1/2-Inch- Box Ribs: 0.040 inch thick.

3.23 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed or exposed:

   1. If piping is not insulated, no jacket is required.
   2. If piping is insulated, provide aluminum jacket.

D. Piping, Exposed:
   1. Aluminum, Smoothwith Z-Shaped Locking Seam: 0.020 inch thick.

END OF SECTION 23 0700

SECTION 23 0800

COMMISSIONING OF HVAC

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.

B. OPR, BoD, and BoD-HVAC documentation prepared by Owner and Architect contains requirements that apply to this Section.

1.2 SUMMARY

A. This Section includes requirements for commissioning the HVAC system and its subsystems and equipment. This Section supplements the general requirements specified in Division 01 Section "General Commissioning Requirements."

B. Related Sections include the following:

1. Division 01 Section "General Commissioning Requirements" for general requirements for commissioning processes that apply to this Section.

1.3 DEFINITIONS

A. Architect: Includes Architect identified in the Contract for Construction between Owner and Contractor, plus consultant/design professionals responsible for design of HVAC, electrical, communications, controls for HVAC systems, and other related systems.

B. BoD: Basis of Design.

C. BoD-HVAC: HVAC systems basis of design.

D. CxA: Commissioning Authority.

E. OPR: Owner's Project Requirements.

F. Systems, Subsystems, and Equipment: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, and equipment.

G. TAB: Testing, Adjusting, and Balancing.

1.4 CONTRACTOR'S RESPONSIBILITIES

A. The following responsibilities are in addition to those specified in Division 01 Section "General Commissioning Requirements."

B. Each Contractor:

1. Attend procedures meeting for TAB Work.
2. Certify that TAB Work is complete.

C. Mechanical Contractor:

1. Attend TAB verification testing.
2. Provide measuring instruments and logging devices to record test data, and data acquisition equipment to record data for the complete range of testing for the required test period.

D. HVAC Instrumentation and Control Contractor: With the CxA, review control designs for compliance with the OPR and BoD, controllability with respect to actual equipment to be installed, and recommend adjustments to control designs and sequence of operation descriptions.

E. TAB Contractor:

1. Contract Documents Review: With the CxA, review the Contract Documents before developing TAB procedures.

a. Verify the following:

1) Accessibility of equipment and components required for TAB Work.
2) Adequate number and placement of duct balancing dampers to allow proper balancing while minimizing sound levels in occupied spaces.
3) Adequate number and placement of balancing valves to allow proper balancing and recording of water flow.
4) Adequate number and placement of test ports and test instrumentation to allow reading and compilation of system and equipment performance data needed to conduct both TAB and commissioning testing.
5) Air and water flow rates have been specified and compared to central equipment output capacities.

b. Identify discontinuities and omissions in the Contract Documents.
c. This review of the Contract Documents by the TAB Subcontractor satisfies requirements for a design review report as specified in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

2. Additional Responsibilities: Participate in tests specified in Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls" and

F. Electrical Contractor:

1. With the Mechanical Contractor, coordinate installations and connections between and among electrical and HVAC systems, subsystems, and equipment.
2. Attend TAB verification testing.

1.5 COMMISSIONING DOCUMENTATION

A. The following are in addition to documentation specified in Division 01 Section "General Commissioning Requirements."

B. BoD HVAC: Owner will provide BoD-HVAC documents, prepared by Architect and approved by Owner, to the CxA and each Contractor for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.

C. Test Checklists: CxA with assistance of Architect shall develop test checklists for HVAC systems, subsystems, and equipment, including interfaces and interlocks with other systems. CxA shall prepare separate checklists for each mode of operation and provide space to indicate whether the mode under test responded as required. In addition to the requirements specified in Division 01 Section "General Commissioning Requirements," checklists shall include, but not be limited to, the following:

1. Calibration of sensors and sensor function.
2. Testing conditions under which test was conducted, including (as applicable) ambient conditions, set points, override conditions, and status and operating conditions that impact the results of test.
3. Control sequences for HVAC systems.
4. Strength of control signal for each set point at specified conditions.
5. Responses to control signals at specified conditions.
6. Sequence of response(s) to control signals at specified conditions.
7. Electrical demand or power input at specified conditions.
8. Power quality and related measurements.
9. Expected performance of systems, subsystems, and equipment at each step of test.
10. Narrative description of observed performance of systems, subsystems, and equipment. Notation to indicate whether the observed performance at each step meets the expected results.
11. Interaction of auxiliary equipment.
12. Issues log.

1.6 SUBMITTALS

A. The following submittals are in addition to those specified in Division 01 Section "General Commissioning Requirements."

B. Testing Procedures: CxA shall submit detailed testing plan, procedures, and checklists for each series of tests. Submittals shall include samples of data reporting sheets that will be part of the reports.

C. Certificate of Readiness: CxA shall compile certificates of readiness from each Contractor certifying that systems, subsystems, equipment, and associated controls are ready for testing.

D. Certificate of Completion of Installation, Prestart, and Startup: CxA shall certify that installation, prestart, and startup activities have been completed. Certification shall include completed checklists provided by TAB Contractor as specified in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

E. Certified Pipe Cleaning and Flushing Report: CxA shall certify that pipe cleaning, flushing, hydrostatic testing, and chemical treating have been completed.

F. Test and Inspection Reports: CxA shall compile and submit test and inspection reports and certificates, and shall include them in systems manual and commissioning report.

G. Corrective Action Documents: CxA shall submit corrective action documents.

H. Certified TAB Reports: CxA shall submit verified, certified TAB reports.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TESTING PREPARATION

A. Prerequisites for Testing:

1. Certify that HVAC systems, subsystems, and equipment have been completed, calibrated, and started; are operating according to the OPR, BoD, and Contract Documents; and that Certificates of Readiness are signed and submitted.
2. Certify that HVAC instrumentation and control systems have been completed and calibrated; are operating according to the OPR, BoD, and Contract Documents; and that pretest set points have been recorded.
3. Certify that TAB procedures have been completed, and that TAB reports have been submitted, discrepancies corrected, and corrective work approved.
4. Test systems and intersystem performance after approval of test checklists for systems, subsystems, and equipment.
5. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shut down, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
6. Verify each operating cycle after it has been running for a specified period and is operating in a steady-state condition.
7. Inspect and verify the position of each device and interlock identified on checklists. Sign off each item as acceptable, or failed. Repeat this test for each operating cycle that applies to system being tested.
8. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
9. Annotate checklist or data sheet when a deficiency is observed.
10. Verify equipment interface with monitoring and control system and TAB criteria; include the following:

    a. Supply and return flow rates for VAV and constant volume systems in each operational mode.
    b. Operation of terminal units in both heating and cooling cycles.
    c. Minimum outdoor-air intake in each operational mode and at minimum and maximum airflows.
    d. Building pressurization.
    e. Total exhaust airflow and total outdoor-air intake.
    f. Operation of indoor-air-quality monitoring systems.

11. Verify proper responses of monitoring and control system controllers and sensors to include the following:

    a. For each controller or sensor, record the indicated monitoring and control system reading and the test instrument reading. If initial test indicates that the test reading is outside of the control range of the installed device, check calibration of the installed device and adjust as required. Retest malfunctioning devices and record results on checklist or data sheet.
    b. Report deficiencies and prepare an issues log entry.

12. Verify that HVAC equipment field quality-control testing has been completed and approved. CxA shall direct, witness, and document field quality-control tests, inspections, and startup specified in individual Division 23 Sections.

B. Testing Instrumentation: Install measuring instruments and logging devices to record test data for the required test period. Instrumentation shall monitor and record full range of operating conditions and shall allow for

calculation of total capacity of system for each mode of operation. For individual room cooling tests, provide temporary heaters to impose a cooling load indicated in BoD. Operational modes include the following:

1. Occupied and unoccupied.
2. Warm up and cool down.
3. Emergency power supply.
4. Life-safety and safety systems.
5. Smoke Removal.
6. Fire safety.
7. Temporary upset of system operation.
8. Partial occupancy conditions.
9. Special cycles.

3.2 TAB VERIFICATION

A. TAB Contractor shall coordinate with CxA for work required in Division 23 Section "Testing, Adjusting, and Balancing for HVAC" TAB Contractor shall copy CxA with required reports, sample forms, checklists, and certificates.

B. Each Contractor, HVAC Contractor, and CxA shall witness TAB Work.

C. TAB Preparation:

1. TAB Contractor shall provide CxA with data required for "Pre-Field TAB Engineering Reports" specified in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

    a. CxA shall use this data to certify that prestart and startup activities have been completed for systems, subsystems, and equipment installation.

D. Ductwork Air Leakage Testing:

1. Architect will identify, for HVAC Contractor and CxA, portions of duct systems to have ductwork air leakage testing. Ductwork air leakage testing shall be performed according to Division 23 Section "Metal Ducts," and shall be witnessed by the CxA.
2. On approval of preliminary ductwork air leakage testing report, the CxA shall coordinate verification testing of ductwork air leakage testing. Verification testing shall include random retests of portions of duct section tests, reported in preliminary ductwork air leakage testing report. The HVAC Contractor shall perform tests using the same instrumentation (by model and serial number) as for original testing; the CxA shall witness verification testing.

E. Verification of Final TAB Report:

1. CxA shall select, at random, 10 percent of report for field verification.
2. CxA shall notify TAB Contractor 10 days in advance of the date of field verification; however, notice shall not include data points to be verified. The TAB Contractor shall use the same instruments (by model and serial number) that were used when original data were collected.
3. Failure of an item is defined as follows:

    a. For all readings other than sound, a deviation of more than 10 percent.

        1) For sound pressure readings, a deviation of 3 dB. (Note: Variations in background noise must be considered.)

4. Failure of more than 10 percent of selected items shall result in rejection of final TAB report.

F. If deficiencies are identified during verification testing, CxA shall notify the HVAC Contractor and Architect, and shall take action to remedy the deficiency. Architect shall review final tabulated checklists and data sheets to determine if verification is complete and that system is operating according to the Contract Documents.

G. CxA shall certify that TAB Work has been successfully completed.

3.3 TESTING

A. Test systems and intersystem performance after test checklists for systems, subsystems, and equipment have been approved.

B. Perform tests using design conditions whenever possible.

1. Simulate conditions by imposing an artificial load when it is not practical to test under design conditions and when written approval for simulated conditions is received from CxA. Before simulating conditions, calibrate testing instruments. Set and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
2. Alter set points when simulating conditions is not practical and when written approval is received from CxA.
3. Alter sensor values with a signal generator when design or simulating conditions and altering set points are not practical. Do not use sensor to act as signal generator to simulate conditions or override values.

C. Scope of HVAC Contractor Testing:

1. Testing scope shall include entire HVAC installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. It shall include measuring capacities and effectiveness of operational and control functions.
2. Test all operating modes, interlocks, control responses, responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.

D. Detailed Testing Procedures: CxA, with HVAC Contractor , TAB Contractor , and HVAC Instrumentation and Control Contractor , shall prepare detailed testing plans, procedures, and checklists for HVAC systems, subsystems, and equipment.

E. HVAC Instrumentation and Control System Testing:

1. Field testing plans and testing requirements are specified in Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operation for HVAC Controls" The CxA, HVAC Contractor, and the HVAC Instrumentation and Control Contractor shall collaborate to prepare testing plans.
2. CxA shall convene a meeting of appropriate entities to review test report of HVAC instrumentation and control systems.

F. Pipe cleaning, flushing, hydrostatic tests, and chemical treatment requirements are specified in Division 23 piping Sections. HVAC Contractor shall prepare pipe system cleaning, flushing, and hydrostatic testing. CxA shall review and comment on plan and final reports. CxA shall certify that pipe cleaning, flushing, hydrostatic tests, and chemical treatment have been completed. Plan shall include the following:

1. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed Drawings for each pipe sector showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be

formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.
2. Description of equipment for flushing operations.
3. Minimum flushing water velocity.
4. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.

G. Energy Supply System Testing: HVAC Contractor shall prepare a testing plan to verify performance of all systems and equipment. Plan shall include the following:

1. Sequence of testing and testing procedures for each equipment item and pipe section to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to Drawings for each pipe sector showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in system testing plan.
2. Tracking checklist for managing and ensuring that all pipe sections have been tested.

H. Refrigeration System Testing: HVAC Contractor shall prepare a testing plan to verify performance of chillers and other refrigeration systems. Plan shall include the following:

1. Sequence of testing and testing procedures for each item of equipment and section of pipe to be tested, identified by identification marker. Markers shall be keyed to Drawings showing the physical location of each item of equipment and pipe test section. Drawings shall be formatted to allow each item of equipment and section of piping to be physically located and identified when referred to in the system testing plan.
2. Tracking checklist for managing and ensuring that all pipe sections have been tested.

I. HVAC Distribution System Testing: HVAC Contractor shall prepare a testing plan to verify performance of air and hydronic distribution systems; special exhaust; and other distribution systems. Include HVAC terminal equipment and unitary equipment. Plan shall include the following:

1. Sequence of testing and testing procedures for each item of equipment and section of pipe to be tested, identified by identification marker. Markers shall be keyed to Drawings showing the physical location of each item of equipment and pipe test section. Drawings shall be formatted to allow each item of equipment and section of piping to be physically located and identified when referred to in the system testing plan.
2. Tracking checklist for managing and ensuring that all pipe sections have been tested.

J. For description of HVAC systems, see plans and equipment schedules.

K. Deferred Testing:

1. If tests cannot be completed because of a deficiency outside the scope of the HVAC system, the deficiency shall be documented and reported to Owner. Deficiencies shall be resolved and corrected by appropriate parties and test rescheduled.
2. If the testing plan indicates specific seasonal testing, appropriate initial performance tests shall be completed and documented and additional tests scheduled.

L. Testing Reports:

1. Reports shall include measured data, data sheets, and a comprehensive summary describing the operation of systems at the time of testing.
2. Include data sheets for each controller to verify proper operation of the control system, the system it serves, the service it provides, and its location. For each controller, provide space for recording its

readout, the reading at the controller's sensor(s), plus comments. Provide space for testing personnel to sign off on each data sheet.

3. Prepare a preliminary test report. Deficiencies will be evaluated by Architect to determine corrective action. Deficiencies shall be corrected and test repeated.
4. If it is determined that the system is constructed according to the Contract Documents, Owner will decide whether modifications required to bring the performance of the system to the OPR and BoD documents shall be implemented or if tests will be accepted as submitted. If corrective Work is performed, Owner will decide if tests shall be repeated and a revised report submitted.

END OF SECTION 23 0800

SECTION 23 0900

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 1 Specification Sections, apply to this Section.

1.2 DEFINITIONS

A. Standard

1. ASHRAE: American Society Heating, Refrigeration, Air Conditioning Engineers
2. AHU: Air Handling Unit
3. BACnet: Building Automation Controls Network
4. BMS: Building Management System
5. DDC: Direct Digital Control
6. EIA: Electronic Industries Alliance
7. GUI: Graphical User Interface
8. HVAC: Heating, Ventilation, and Air Conditioning
9. IEEE: Institute Electrical Electronic Engineers
10. MER: Mechanical Equipment Room
11. PID: Proportional, Integral, Derivative
12. VAV: Variable Air Volume Box

B. Communications and protocols

1. ARP: Address Resolution Protocol
2. BACnet: Building Automation and Control Networks
3. CORBA: Common Object Request Broker Architecture
4. CSMA/CD: Carrier Sense Multiple Access/Collision Detect
5. DDE: Dynamic Data Exchange
6. FTP: File Transfer Protocol
7. FTT: Free Topology Transceivers
8. HTTP: Hyper Text Transfer Protocol
9. IIOP: Internet Inter-ORB Protocol
10. IP: Internet Protocol
11. LAN: Local Area Network
12. LON: Echelon Communication – Local Operating Network
13. MS/TP: Master Slave Token Passing
14. OBIX: Open Building Information Exchange
15. ODBC: Open Database Connectivity

16. ORB: Object Request Broker
17. SNVT: Standard Network Variables Types
18. SQL: Structured Query Language
19. UDP: User Datagram Protocol
20. XML: eXtensible Markup Language

C. Controllers

1. ASD: Application Specific Device
2. AAC: Advanced Application Controller
3. ASC: Application Specific Controller.
4. CAC: Custom Application Controller.
5. DCU: Distributed Control Unit
6. LCM: Local Control Module
7. MC: MicroControllers
8. MPC: Multi-purpose Controller
9. NSC: Network Server Controller
10. PEM: Package Equipment Module
11. PPC: Programmable Process Controller
12. RC: Room controller
13. SDCU: Standalone Digital Control Units
14. SLC: Supervisory Logic Controller
15. UEC: Unitary Equipment Controller
16. VAVDDC: Variable Air Volume Direct Digital Controller

D. Tools and Software

1. AFDD: Automated Fault Detection and Diagnostic
2. APEO: Automated Predictive Energy Optimization
3. DR: Demand Response
4. CCDT: Configuration, Commissioning and Diagnostic Tool
5. BPES: BACnet Portable Engineering Station
6. LPES: LON Portable Engineering Station
7. POT: Portable Operator's Terminal
8. PEMS: Power and Energy Management Software

1.3 QUALIFICATIONS OF BIDDER AND PRE-BID SUBMITTAL

A. All bidders must be building automation contractors in the business of installing direct digital control building automation systems for a minimum of 3 years.

B. The Building Management System contractor shall have a full service facility within 100 miles of the project that is staffed with engineers trained and certified by the manufacturer in the configuration, programming and service of the automation system. The contractor's technicians shall be fully capable of providing instructions and routine emergency maintenance service on all system components.

C. All bidders must be authorized distributors or branch offices of the manufacturers specified.

D. The following bidders have been pre-qualified:

1. Schneider Electric

2. Alerton
3. Automated Logic

1.4 SCOPE OF WORK

A. The Contractor shall furnish and install a complete building automation system including all necessary hardware and all operating and applications software necessary to perform the control sequences of operation as called for in this specification. Network level components of the system – workstations, servers, etc. shall communicate using the BACnet protocol, as defined by ASHRAE Standard 135-2004, or EIA standard 709.1, the LonTalk™ protocol, or Modbus protocol. No gateways shall be used for communication to controllers furnished under this section. At a minimum, provide controls for the following:
   1. Air handling units
   2. Exhaust and outside air fans
   3. Chilled water system including pumps and chillers
   4. Variable volume terminal boxes
   5. Monitoring points for packaged equipment such as emergency generators, etc.
   6. Power wiring to DDC devices, smoke control dampers, and BAS panels except as otherwise specified.
B. Except as otherwise noted, the control system shall consist of all necessary Ethernet Network Controllers, Standalone Digital Control Units, Room Controllers, workstations, software, sensors, transducers, relays, valves, dampers, damper operators, control panels, and other accessory equipment, along with a complete system of electrical interlocking wiring to fill the intent of the specification and provide for a complete and operable system. Except as otherwise specified, provide operators for equipment such as dampers if the equipment manufacturer does not provide these. Coordinate requirements with the various Contractors.
C. The BAS contractor shall review and study all HVAC drawings and the entire specification to familiarize themselves with the equipment and system operation and to verify the quantities and types of dampers, operators, alarms, etc. to be provided.
D. All interlocking wiring, wiring and installation of control devices associated with the equipment listed below shall be provided under this Contract. When the BAS system is fully installed and operational, the BAS Contractor and representatives of the Owner will review and check out the system – see System Acceptance and Testing section of this document. At that time, the BAS contractor shall demonstrate the operation of the system and prove that it complies with the intent of the drawings and specifications.
E. Provide services and manpower necessary for commissioning of the system in coordination with the HVAC Contractor, Balancing Contractor and Owner's representative.
F. All work performed under this section of the specifications will comply with all governing codes, laws and governing bodies. If the drawings and/or specifications are in conflict with governing codes, the Contractor, with guidance from the engineer, shall submit a proposal with appropriate modifications to the project to meet code restrictions. If this specification and associated drawings exceed governing code requirements, the specification will govern. The Contractor shall obtain and pay for all necessary construction permits and licenses.

1.5 SYSTEM DESCRIPTION

A. In accordance to the scope of work, the system shall also provide a graphical, web-based, operator interface that allows for instant access to any system through a standard browser. The contractor must provide PC-based programming workstations, operator workstations and microcomputer controllers of modular design providing distributed processing capability, and allowing future expansion of both input/output points and

processing/control functions.

For this project, the system shall consist of the following components:

1. Administration and Programming Workstation(s): The BAS Contractor shall include Operation software and architecture as described in Part 2 of the specification. These workstations must be running the standard workstation software developed and tested by the manufacturer of the network server controllers and the standalone controllers. No third party front-end workstation software will be acceptable. Workstations must conform to the B-OWS BACnet device profile.
2. Web-Based Operator Workstations: The BAS Contractor shall furnish licenses for web connection to the BAS system. Web-based users shall have access to all system points and graphics, shall be able to receive and acknowledge alarms, and shall be able to control setpoints and other parameters. All engineering work, such as trends, reports, graphics, etc. that are accomplished from the WorkStation shall be available for viewing through the web browser interface without additional changes. The web-based interface must conform to the B-OWS BACnet device profile. There will be no need for any additional computer based hardware to support the web-based user interface.
3. Ethernet-based Network Router and/or Network Server Controller(s): The BAS Contractor shall furnish needed quantity of Ethernet-based Network Server Controllers as described in Part 2 of the specification. These controllers will connect directly to the Operator Workstation over Ethernet at a minimum of 100mbps, and provide communication to the Standalone Digital Control Units and/or other Input/Output Modules. Network Server Controllers shall conform to BACnet device profile B-BC. Network controllers that utilize RS232 serial communications or ARCNET to communicate with the workstations will not be accepted.
   Network Controllers shall be tested and certified by the BACnet Testing Laboratory (BTL) as BACnet Building Controllers (B-BC).
4. Standalone Digital Control Units (SDCUs): Provide the necessary quantity and types of SDCUs to meet the requirements of the project for mechanical equipment control including air handlers, central plant control, and terminal unit control. Each SDCU will operate completely standalone, containing all of the I/O and programs to control its associated equipment. Each BACnet protocol SDCU shall conform to the BACnet device profile B-AAC. BACnet SDCUs shall be tested and certified by the BACnet Testing Laboratory (BTL) as BACnet Advanced Application Controllers (B-AAC).

B. The Local Area Network (LAN) shall be either a 10 or 100 Mpbs Ethernet network supporting BACnet, Modbus, XML and HTTP for maximum flexibility for integration of building data with enterprise information systems and providing support for multiple Network Server Controllers (NSCs), user workstations and a local host computer system.
C. The Enterprise Ethernet (IEEE 802.3) LAN shall utilize Carrier Sense Multiple/Access/Collision Detect (CSMA/CD), Address Resolution Protocol (ARP) and User Datagram Protocol (UDP) operating at 10 or 100 Mbps.
D. The system shall enable an open architecture that utilizes EIA standard 709.1, the LonTalk™ protocol and/or ANSI / ASHRAE™ Standard 135-2004, BACnet functionality to assure interoperability between all system components. Native support for the LonTalk™ protocol and the ANSI / ASHRAE™ Standard 135-2004, BACnet protocol are required to assure that the project is fully supported by the HVAC open protocols to reduce future building maintenance, upgrade, and expansion costs.
E. The system shall enable an architecture that utilizes a MS/TP selectable 9.6-76.8 KBaud protocol, as a common communication protocol between controllers and integral ANSI / ASHRAE™ Standard 135-2004, BACnet functionality to assure interoperability between all system components. The AAC shall be capable of

communicating as a MS/TP device or as a BACnet IP device communicating at 10/100 Mbps on a TCP/IP trunk. The ANSI / ASHRAE™ Standard 135-2004, BACnet protocol is required to assure that the project is fully supported by the leading HVAC open protocol to reduce future building maintenance, upgrade, and expansion costs.

F. LonTalk™ packets may be encapsulated into TCP/IP messages to take advantage of existing infrastructure or to increase network bandwidth where necessary or desired.
    1. Any such encapsulation of the LonTalk™ protocol into IP datagrams shall conform to existing LonMark™ guide functionality lines for such encapsulation and shall be based on industry standard protocols.
    2. The products used in constructing the BMS shall be LonMark™ compliant.
    3. In those instances in which Lon-Mark™ devices are not available, the BMS contractor shall provide device resource files and external interface definitions for LonMark devices.

G. The software tools required for network management of the LonTalk™ protocol and the ANSI / ASHRAE™ Standard 135-2004, BACnet protocol must be provided with the system. Drawings are diagrammatic only. Equipment and labor not specifically referred to herein or on the plans and are required to meet the functional intent, shall be provided without additional cost to the Owner. BACnet clients shall comply with the BACnet Operator Workstation (B-OWS) device profile; with the ability to support data read and write functionality. Physical connection of BACnet devices shall be via Ethernet IP or MS/TP. Physical connection of LonWorks devices shall be via Ethernet IP or FTT-10A.

H. The system shall provide support for Modbus TCP and RTU protocols natively, and not require the use of gateways.

I. Complete temperature control system to be DDC with electronic sensors and electronic/electric actuation of Mechanical Equipment Room (MER) valves and dampers and electronic actuation of terminal equipment valves and actuators as specified herein. The BMS is intended to seamlessly connect devices throughout the building regardless of subsystem type, i.e. variable frequency drives, low voltage lighting systems, electrical circuit breakers, power metering and card access should easily coexist on the same network channel.
    1. The supplied system must incorporate the ability to access all data using HTML5 enabled browsers without requiring proprietary operator interface and configuration programs. The system shall not require JAVA to be enabled in the browser.
    2. Data shall reside on a supplier-installed server for all database access.
    3. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network.

J. All work described in this section shall be installed, wired, circuit tested and calibrated by factory certified technicians qualified for this work and in the regular employment of the approved manufacturer's local field office. The approved manufacturer's local field office shall have a minimum of 3 years of installation experience with the manufacturer and shall provide documentation in the bid and submittal package verifying longevity of the installing company's relationship with the manufacturer when requested. Supervision, hardware and software engineering, calibration and checkout of the system shall be by the employees of the approved manufacturer's local field office and shall not be subcontracted. The control contractor shall have an in place support facility within 100 miles of the site with factory certified technicians and engineers, spare parts inventory and all necessary test and diagnostic equipment for the installed system, and the control contractor shall have 24 hours/day, 7 days/week emergency service available.

K. Provide the Commissioning, configuration and diagnostic tool (CCDT), color display personnel computer, software, and interfaces to provide uploading/downloading of High Point Count Controllers (AAC), Unitary Equipment Controllers (UEC) and VAV controllers (VAVDDC) monitoring all BACnet objects, monitoring overrides of all controller physical input/output points, and editing of controller resident time schedules.

L. The system shall have the capability to provide a web-based AFDD (automated fault detection and diagnostic) system. The AFDD system shall be able to interface directly with the project BAS and energy/performance metering system to provide information on HVAC systems that are being controlled. Pricing is to be a separate line item from the BAS proposal. See specification section 25 08 01 for exact requirements.

M. The system shall have the capability to provide a web-enabled PEMS (power and energy management system) monitoring system intended to monitor an entire electrical distribution infrastructure, from incoming utility feeds down to low voltage distribution points. It shall be designed to monitor and manage energy consumption throughout an enterprise, whether within a single facility or across a network of facilities, to improve energy availability and reliability, and to measure and manage energy efficiency. It shall be a standard product offering with no custom programming required. It shall provide a seamless user experience ("Single pane of glass") for managing the mechanical systems (HVAC and lighting) and monitoring the power distribution system (transformers, breakers, relays, switches, capacitors, UPS, invertors, etc.) Pricing is to be a separate line item from the BAS proposal. See specification 26 09 13 for exact requirements.

N. The system shall provide an app running on a fixed or mobile device (iOS (iPad), Android (tablet), Windows) offering a consistent, aesthetic, customized graphical interface, that allows to aggregate in a graphical manner various types of services such as room temperature control, lighting control, curtain control, remote TV, etc. System shall communicate via web services and have the ability to be designed once and deployed to multiple devices at the same time. Pricing is to be a separate line item from the BAS proposal. Provide costs for develop and deploy and tiered costs for multiple levels of device purchases.

O. The system shall provide an integrated security management system. The Security Management System (SMS) is the key central component for managing physical access control and security. The system shall provide a variety of integral functions including: controlling of access and egress; provisioning badges; monitoring, tracking and interface alarms and; view, and link video surveillance to SMS events. See specification section 28 13 00 for exact requirements

1.6 WORK BY OTHERS

A. The BAS Contractor shall cooperate with other contractors performing work on this project necessary to achieve a complete and neat installation. To that end, each contractor shall consult the drawings and specifications for all trades to determine the nature and extent of others' work.

B. The BAS contractor shall furnish all control valves, sensor wells, flow meters, and other similar equipment for installation by the Mechanical Contractor and/or others. Airflow stations for air handling units to be provided by air handling unit manufacturer.

C. The BAS Contractor shall provide field supervision to the designated contractor for the installation of the following:

1. Automatic control dampers
2. Air Flow stations
3. Control Valves
4. Sensor wells
5. Flow meters
6. The Electrical Contractor shall provide:
    a. All power wiring to motors, heat trace, junction boxes for power to BAS panels.
    b. Furnish smoke detectors and wire to the building fire alarm system. HVAC Contractor to mount devices. BAS Contractor to hardwire to fan shut down.
    c. Auxiliary contact (pulse initiator) on the electric meter for central monitoring of kWh and KW. Electrical Contractor shall provide the pulse rate for remote readout to the BAS. BAS contractor to coordinate this with the electrical contractor.

1.7 CODE COMPLIANCE

A. Provide BAS components and ancillary equipment, which are UL-916 listed and labeled.
B. All equipment or piping used in conditioned air streams, spaces or return air plenums shall comply with NFPA 90A Flame/Smoke/Fuel contribution rating of 25/50/0 and all applicable building codes or requirements.
C. All wiring shall conform to the National Electrical Code.
D. All smoke dampers shall be rated in accordance with UL 555S.
E. Comply with FCC rules, Part 15 regarding Class A radiation for computing devices and low power communication equipment operating in commercial environments.
F. Comply with FCC, Part 68 rules for telephone modems and data sets.

1.8 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.
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. Carbon Dioxide: Plus or minus 50 ppm.
p. Electrical: Plus or minus 5 percent of reading.

1.9 SUBMITTALS

A. All shop drawings shall be prepared in with CAD software. In addition to the drawings, the Contractor shall furnish a CD containing the identical information. Drawings shall be B size or larger.
B. Shop drawings shall include a riser diagram depicting locations of all controllers and workstations, with associated network wiring. Also included shall be individual schematics of each mechanical system showing all connected points with reference to their associated controller. Typicals will be allowed where appropriate.
C. Submittal data shall contain manufacturer's data on all hardware and software products required by the specification.
D. Software submittals shall contain narrative descriptions of sequences of operation, program listings, point lists, and a complete description of the graphics, reports, alarms and configuration to be furnished with the workstation software
E. Submit electronic submittal data and shop drawings to the Engineer for review prior to ordering or fabrication of the equipment. The Contractor, prior to submitting, shall check all documents for accuracy.
F. The Engineer will make corrections, if required, and return to the Contractor. The Contractor will then resubmit with the corrected or additional data. This procedure shall be repeated until all corrections are made to the satisfaction of the Engineer and the submittals are fully approved.
G. The following is a list of post construction submittals that shall be updated to reflect any changes during construction and re-submitted as “As-Built”.
    1. System architecture drawing.
    2. Layout drawing for each control panel
    3. Wiring diagram for individual components
    4. System flow diagram for each controlled system
    5. Instrumentation list for each controlled system
    6. Sequence of control
    7. Binding map
    8. A matrix sheet detailing all system addresses and communication settings for the following:
        a. All IP network addresses & settings
        b. All BMS device addresses & communication settings
    9. Operation and Maintenance Manuals
H. Information common to the entire system shall be provided. This shall include but not be limited to the following.
    1. Product manuals for the key software tasks.
    2. Operating the system.
    3. Administrating the system.
    4. Engineering the operator workstation.
    5. Application programming.
    6. Engineering the network.
    7. Setting up the web server.
    8. Report creation.
    9. Graphics creation.
    10. All other engineering tasks.
    11. System Architecture Diagram.
    12. List of recommended maintenance tasks associated with the system servers, operator workstations, data servers, web servers and web clients.
    13. Define the task.
    14. Recommend a frequency for the task.
    15. Reference the product manual that includes instructions on executing the task.

16. Names, addresses, and telephone numbers of installing contractors and service representatives for equipment and control systems.
17. Licenses, guarantees, and warranty documents for equipment and systems.
18. Submit one copy for each building, plus two extra copies.

I. Information common to the systems in a single building shall be provided.
1. System architecture diagram for components within the building annotated with specific location information.
2. As-built drawing for each control panel.
3. As-built wiring design diagram for all components.
4. Installation design details for each I/O device.
5. As-built system flow diagram for each system.
6. Sequence of control for each system.
7. Binding map for the building.
8. Product data sheet for each component.
9. Installation data sheet for each component.
10. Submit two copies for each building and two extra copies.

J. Software shall be provided:
1. Submit a copy of all software installed on the servers and workstations.
2. Submit all licensing information for all software installed on the servers and workstations.
3. Submit a copy of all software used to execute the project even if the software was not installed on the servers and workstations.
4. Submit all licensing information for all of the software used to execute the project.
5. All software revisions shall be as installed at the time of the system acceptance.
6. Firmware Files
7. Submit a copy of all firmware files that were downloaded to or pre-installed on any devices installed as part of this project.
8. This does not apply to firmware that is permanently burned on a chip at the factory and can only be replaced by replacing the chip.
9. Submit a copy of all application files that were created during the execution of the project.
10. Submit a copy of all graphic page files created during the execution of the project.

1.10 COORDINATION

A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.
B. Coordinate supply of conditioned electrical circuits for control units and operator workstation.
C. Coordinate with the Owner's IT department on locations for UNC's, Ethernet communication cabling and TCP/IP addresses.

1.11 OWNERSHIP

A. The Owner shall retain licenses to software for this project.
B. The licensing agreement shall not preclude the use of the software by individuals under contract to the owner for commissioning, servicing or altering the system in the future. Use of the software by individuals under contract to the owner shall be restricted to use on the owner’s computers and only for the purpose of commissioning, servicing, or altering the installed system.

C. All project developed software, files and documentation shall become the property of the Owner. These include but are not limited to:
    1. Server and workstation software
    2. Application programming tools
    3. Configuration tools
    4. Network diagnostic tools
    5. Addressing tools
    6. Application files
    7. Configuration files
    8. Graphic files
    9. Report files
    10. Graphic symbol libraries
    11. All documentation

1.12 QUALITY ASSURANCE - SYSTEM STARTUP AND COMMISSIONING

A. Each point in the system shall be tested for both hardware and software functionality. In addition, each mechanical and electrical system under control of the BAS will be tested against the appropriate sequence of operation specified by the Commissioning Agent's pre-functional and functional testing. Successful completion of the system test shall constitute the beginning of the warranty period. All this testing shall be witnessed by the commissioning agent A written report signed by the BAS contractor and Commissioning agent will be submitted to the owner indicating that the installed system functions in accordance with the plans and specifications.
B. The BAS Contractor shall provide a technician for a minimum 5 days manpower and engineering services required to assist the HVAC Contractor and Balancing Contractor in testing, adjusting, and balancing all systems in the building. The BAS Contractor shall coordinate all requirements to provide a complete air balance and water balance with the Balancing Contractor and shall include all labor and materials in his contract.
C. Startup Testing shall be performed for each task on the startup test checklist, which shall be initiated by the technician and dated upon test was completion along with any recorded data such as voltages, offsets or tuning parameters. Any deviations from the submitted installation plan shall also be recorded.
D. Required elements of the startup testing include:
    1. Measurement of voltage sources, primary and secondary
    2. Verification of proper controller power wiring.
    3. Verification of component inventory when compared to the submittals.
    4. Verification of labeling on components and wiring.
    5. Verification of connection integrity and quality (loose strands and tight connections).
    6. Verification of bus topology, grounding of shields and installation of termination devices.
    7. Verification of point checkout.
    8. Each I/O device is landed per the submittals and functions per the sequence of control.
    9. Analog sensors are properly scaled and a value is reported
    10. Binary sensors have the correct normal position and the state is correctly reported.
    11. Analog outputs have the correct normal position and move full stroke when so commanded.
    12. Binary outputs have the correct normal state and respond appropriately to energize/de-energize commands.
    13. Documentation of analog sensor calibration (measured value, reported value and calculated offset).
    14. Documentation of Loop tuning (sample rate, gain and integral time constant).

E. A performance verification test shall also be completed for the operator interaction with the system. Test elements shall be written to require the verification of all operator interaction tasks including, but not limited to the following.
    1. Graphics navigation.
    2. Trend data collection and presentation.
    3. Alarm handling, acknowledgement and routing.
    4. Time schedule editing.
    5. Application parameter adjustment.
    6. Manual control.
    7. Report execution.
    8. Automatic backups.
    9. Web Client access.
F. A Startup Testing Report and a Performance Verification Testing Report shall be provided upon test completion.

1.13 WARRANTY AND MAINTENANCE

A. All components, system software, and parts furnished and installed by the BMS contractor shall be guaranteed against defects in materials and workmanship for 1 year of substantial completion. Labor to repair, reprogram, or replace these components shall be furnished by the BMS contractor at no charge during normal working hours during the warranty period. Materials furnished but not installed by the BMS contractor shall be covered to the extent of the product only. Installation labor shall be the responsibility of the trade contractor performing the installation. All corrective software modifications made during warranty periods shall be updated on all user documentation and on user and manufacturer archived software disks. The Contractor shall respond to the owner's request for warranty service within 24 standard working hours.

1.14 TRAINING

A. The BAS Contractor shall provide on-site training to the Owner’s representative and maintenance personnel per the following description:
B. On-site training shall consist of a minimum of 8 hours of hands-on instruction geared at the operation and maintenance of the systems. The curriculum shall include
    1. System Overview
    2. System Software and Operation
    3. System access
    4. Software features overview
    5. Changing setpoints and other attributes
    6. Scheduling
    7. Editing programmed variables
    8. Displaying color graphics
    9. Running reports
    10. Workstation maintenance
    11. Viewing application programming
    12. Operational sequences including start-up, shutdown, adjusting and balancing.
    13. Equipment maintenance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following manufacturers:
   1. Schneider Electric.
   2. Manufacturer approved by Engineer.

2.2 SYSTEM ARCHITECTURE

A. General
   1. The Building Automation System (BAS) shall consist of Network Server/Controllers (NSCs), a family of Standalone Digital Control Units (SDCUs), Administration and Programming Workstations (APWs), and Web-based Operator Workstations (WOWs). The BAS shall provide control, alarm detection, scheduling, reporting and information management for the entire facility, and Wide Area Network (WAN) if applicable.
   2. An Enterprise Level BAS shall consist of an Enterprise Server, which enables multiple NSCs (including all graphics, alarms, schedules, trends, programming, and configuration) to be accessible from a single Workstation simultaneously for operations and engineering tasks.
   3. The Enterprise Level BAS shall be able to host up to 250 servers, or NSCs, beneath it.
   4. For Enterprise reporting capability and robust reporting capability outside of the trend chart and listing ability of the Workstation, a Reports Server shall be installed on a Microsoft Windows SQL based computer. The Reports Server can be installed on the same computer as the Enterprise Server.
   5. The system shall be designed with a top-level 10/100bT Ethernet network, using the BACnet/IP, LonWorks IP, and/or Modbus TCP protocol.

B. Modbus RTU/ASCII (and J-bus), Modbus TCP, BACnet MS/TP, BACnet IP, LonTalk FTT-10A, and WebServices shall be native to the NSCs. There shall not be a need to provide multiple NSCs to support all the network protocols, nor should there be a need to supply additional software to allow all three protocols to be natively supported.

C. A sub-network of SDCUs using the BACnet IP protocol shall connect the local, stand-alone controllers with Ethernet-level Network Server Controllers/IP Routers.

D. TCP/IP Level
   1. The TCP/IP layer connects all of the buildings on a single Wide Area Network (WAN) isolated behind the campus firewall. Fixed IP addresses for connections to the campus WAN shall be used for each device that connects to the WAN.

E. Fieldbus Level with Standalone Digital Control Units (SDCUs)
   1. The fieldbus layer shall support all of the following types of SDCUs:
      a. BACnet IP SDCU requirements: The system shall consist of one or more BACnet/IP field buses managed by the Network Server Controller. The field bus layer shall consist of up to 50 IP SDCUs in daisy chain topology, or 39 if using RSTP, per layer, with a max of 5 sub networks in daisy chain for a total of 250 SDCUs or 6 sub networks in RSTP for a total of 234 SDCUs. The field bus layer shall consist ONLY of BACnet IP SDCUs. No other protocols, including BACnet MS/TP, shall be acceptable.

F. BAS LAN Segmentation
   1. The BAS shall be capable of being segmented, through software, into multiple local area networks (LANs) distributed over a wide area network (WAN). Workstations can manage a single LAN (or

building), and/or the entire system with all portions of that LAN maintaining its own, current database.

G. Standard Network Support

1. All NSCs, Workstation(s) and Servers shall be capable of residing directly on the owner's Ethernet TCP/IP LAN/WAN with no required gateways. Furthermore, the NSC's, Workstation(s), and Server(s) shall be capable of using standard, commercially available, off-the-shelf Ethernet infrastructure components such as routers, switches and hubs. With this design the owner may utilize the investment of an existing or new enterprise network or structured cabling system. This also allows the option of the maintenance of the LAN/WAN to be performed by the owner's Information Systems Department as all devices utilize standard TCP/IP components.

H. System Expansion

1. The BAS system shall be scalable and expandable at all levels of the system using the same software interface, and the same TCP/IP level and fieldbus level controllers. Systems that require replacement of either the workstation software or field controllers in order to expand the system shall not be acceptable.
2. Web-based operation shall be supported directly by the NSCs and require no additional software.
3. The system shall be capable of using graphical and/or line application programming language for the Network Server Controllers.

I. Support For Open Systems Protocols

1. All Network Server Controllers must natively support the BACnet IP, BACnet MS/TP, LonWorks FTT-10, Modbus TCP, Modbus RTU (RS-485 and RS-232), and Modbus ASCII protocols.

2.3 OPERATOR WORKSTATION REQUIREMENTS

A. General

1. The operator workstation portion of the BAS shall consist of one or more full-powered configuration and programming workstations, and one or more web-based operator workstations. For this project provide a minimum of 10 concurrent operator users and/or 2 concurrent engineering users within the enterprise server.
2. The programming and configuration workstation software shall allow any user with adequate permission to create and/or modify any or all parts of the NSC and/or Enterprise Server database.
3. Web-based workstations (web stations) shall have a minimum of 10 concurrent operator users.
4. All configuration workstations shall be personal computers operating under the Microsoft Windows operating system. The application software shall be capable of communication to all Network Server Controllers and shall feature high-resolution color graphics, alarming, trend charting. It shall be user configurable for all data collection and data presentation functions.
5. A minimum of 1 physical Workstation shall be allowed on the Ethernet network. In this client/server configuration, any changes or additions made from one workstation will automatically appear on all other workstations since the changes are accomplished to the databases within the NSC. Systems with a central database will not be acceptable.

B. Administration/Programming Workstation, Enterprise Server, and Enterprise Central Requirements

1. The Enterprise Central shall consist of the following:
   a. Processor
      a) Minimum: Intel Core i5 @ 2.0 GHz or equivalent
      b) Recommended: Intel Core i5 @ 3.0 GHz or better
   b. Memory

a) Minimum: 4GB
b) Recommended: 8GB or higher

c. Operating systems
a) Microsoft Windows 7 32-bit (Professional, Enterprise, or Ultimate)
b) Microsoft Windows 7 64-bit (Professional, Enterprise, or Ultimate)
c) Microsoft Windows 8.1 32-bit (Pro, Pro N, Enterprise, or Enterprise N)
d) Microsoft Windows 8.1 64-bit (Pro, Pro N, Enterprise, or Enterprise N)
e) Microsoft Windows 10 64-bit (Pro or Enterprise)
f) Microsoft Windows Server 2008 R2 64-bit (Standard, Enterprise, Datacenter, Web, or Itanium)
g) Microsoft Windows Server 2012 64-bit (Standard, Datacenter, Essentials, or Foundation)
h) Microsoft Windows Server 2012 R2 64-bit (Standard, Datacenter, Essentials, or Foundation)
i) Microsoft Windows Server 2016 R2 64-bit (Standard, Datacenter, Essentials, or Foundation)

d. 10/100MBPS Ethernet NIC
e. 100 GB hard disk (minimum)
f. Required additional software:
a) Microsoft .Net 4.5
g. License agreement for all applicable software

2. The Enterprise Server shall consist of the following:
a. Processor
a) Minimum: Intel Core i5 @ 2.0 GHz or equivalent
b) Recommended: Intel Core i5 @ 3.0 GHz or better
b. Memory
a) Minimum: 4GB
b) Recommended: 8GB or higher
c. Operating systems:
a) Microsoft Windows 7 32-bit (Professional, Enterprise, or Ultimate)
b) Microsoft Windows 7 64-bit (Professional, Enterprise, or Ultimate)
c) Microsoft Windows 8.1 32-bit (Pro, Pro N, Enterprise, or Enterprise N)
d) Microsoft Windows 8.1 64-bit (Pro, Pro N, Enterprise, or Enterprise N)
e) Microsoft Windows 10 64-bit (Pro or Enterprise)
f) Microsoft Windows Server 2008 R2 64-bit (Standard, Enterprise, Datacenter, Web, or Itanium)
g) Microsoft Windows Server 2012 64-bit (Standard, Datacenter, Essentials, or Foundation)
h) Microsoft Windows Server 2012 R2 64-bit (Standard, Datacenter, Essentials, or Foundation)
d. 10/100MBPS Ethernet NIC
e. 100 GB hard disk (minimum)
f. Required additional software:
a) Microsoft .Net 4.5
g. License agreement for all applicable software

3. The workstation shall consist of the following:
a. Processor

a) Minimum: 2.0 GHz
b) Recommended: 3.0 GHz or higher

b. Memory
a) Minimum: 4GB
b) Recommended: 8GB or higher

c. Operating systems:
a) Microsoft Windows 7 32-bit (Professional, Enterprise, or Ultimate)
b) Microsoft Windows 7 64-bit (Professional, Enterprise, or Ultimate)
c) Microsoft Windows 8.1 32-bit (Pro, Pro N, Enterprise, or Enterprise N)
d) Microsoft Windows 8.1 64-bit (Pro, Pro N, Enterprise, or Enterprise N)
e) Microsoft Windows 10 64-bit (Pro or Enterprise)
f) Microsoft Windows Server 2008 R2 64-bit (Standard, Enterprise, Datacenter, Web, or Itanium)
g) Microsoft Windows Server 2012 64-bit (Standard, Datacenter, Essentials, or Foundation)
h) Microsoft Windows Server 2012 R2 64-bit (Standard, Datacenter, Essentials, or Foundation)

d. Serial port, parallel port, USB port
e. 10/100MBPS Ethernet NIC
f. 20 GB hard disk
g. DVD drive
h. High resolution (minimum 1280 x 1024), 17" flat panel display
i. Optical mouse and full function keyboard
j. Audio sound card and speakers
k. Required additional software:
a) Microsoft .Net 4.5
l. License agreement for all applicable software.

C. Web-Based Operator PC Requirements
1. Any user on the network can access the system, using the following software:
a. Internet Explorer 11
b. Mozilla Firefox
c. Google Chrome

D. General Administration and Programming Workstation Software
1. System architecture shall be truly client server in that the Workstation shall operate as the client while the NSCs shall operate as the servers. The client is responsible for the data presentation and validation of inputs while the server is responsible for data gathering and delivery.
2. The workstation functions shall include monitoring and programming of all DDC controllers. Monitoring consists of alarming, reporting, graphic displays, long term data storage, automatic data collection, and operator-initiated control actions such as schedule and setpoint adjustments.
3. Programming of SDCUs shall be capable of being done either off-line or on-line from any operator workstation. All information will be available in graphic or text displays stored at the NSC. Graphic displays will feature animation effects to enhance the presentation of the data, to alert operators of problems, and to facilitate location of information throughout the DDC system. All operator functions shall be selectable through a mouse.

E. User Interface:
1. The BAS workstation software shall allow the creation of a custom, browser-style interface linked to the user when logging into any workstation. Additionally, it shall be possible to create

customized workspaces that can be assigned to user groups. This interface shall support the creation of "hot-spots" that the user may link to view/edit any object in the system or run any object editor or configuration tool contained in the software. Furthermore, this interface must be able to be configured to become a user's "PC Desktop" – with all the links that a user needs to run other applications. This, along with the Windows user security capabilities, will enable a system administrator to setup workstation accounts that not only limit the capabilities of the user within the BAS software, but may also limit what a user can do on the PC and/or LAN/WAN. This might be used to ensure, for example, that the user of an alarm monitoring workstation is unable to shutdown the active alarm viewer and/or unable to load software onto the PC.

2. System shall be able to automatically switch between displayed metric vs. imperial units based on the workstation/webstations localization.
3. The BMS workstation/webstations shall be capable of multiple language display, including English, Spanish, German, French, Japanese, Italian, Finnish, Portuguese, Swedish, Russian, and traditional and simplified Chinese. The multiple languages shall not require additional add on software from the standard workstation installer and shall be selectable within said workstation.
4. Webstations shall have the capability to automatically re-direct to an HTTPS connection to ensure more secure communications.
5. Personalized layouts and panels within workstations shall be extended to webstations to ensure consistent user experiences between the two user interfaces.
6. Servers and clients shall have the ability to be located in different time zones, which are then synchronized via the NTP server.
7. Workstation shall indicate at all times the communication status between it and the server.

F. User Security

1. The software shall be designed so that each user of the software can have a unique username and password. This username/password combination shall be linked to a set of capabilities within the software, set by and editable only by, a system administrator. The sets of capabilities shall range from View only, Acknowledge alarms, Enable/disable and change values, Program, and Administer. The system shall allow the above capabilities to be applied independently to each and every class of object in the system. The system must allow a minimum of 256 users to be configured per workstation. Additionally, the software shall enable the ability to add/remove users based upon Microsoft Windows Security Domains that enable the customer IT department to assist in user access.
2. Additional requirements include mandatory change of passwords:
    a) At first logon with default credentials
    b) Of admin passwords before deploying
3. No general accounts, one account per user
4. Capability to integrate and use Windows Active Directory for user log on credentials
5. Include a timed auto log off feature
6. Use TLS 1.2 encryption or higher
7. Capability to use blacklisted and whitelisted IPs/MAC addresses to gate access
8. All devices and software that support HTTP shall allow disabling the HTTP access and require access via HTTPS.
9. All devices that have web portals for the configuration of IP addresses and other configuration attributes shall have the ability, through commands issued, to disable this service upon completion. A direct connection method with ASCII commands shall enable this service again if changes need to be applied. Loss of power or cycling the device shall not reverse this command. Disabling this web portal eliminates the security risk and the need for updating security patches.

10. All devices shall support SNMP V3 monitoring of network performance and stack statistics for the purpose of managing denial of service attacks
11. The Integrated Control Platform shall support the feature to alarm on a predetermined period of time until the default password for each device is changed from the default factory setting.
12. The Integrated Control Platform shall support encrypted password authentication for all web services whether serving or consuming.

G. Configuration Interface

1. The workstation software shall use a familiar Windows Explorer style interface for an operator or programmer to view and/or edit any object (controller, point, alarm, report, schedule, etc.) in the entire system. In addition, this interface shall present a "network map" of all controllers and their associated points, programs, graphics, alarms, and reports in an easy to understand structure. All object names shall be alphanumeric and use Windows long filename conventions.
2. The configuration interface shall also include support for user defined object types. These object types shall be used as building blocks for the creation of the BAS database. They shall be created form the base object types within the system input, output, string variables, setpoints, etc., alarm algorithms, alarm notification objects, reports, graphics displays, schedules, and programs. Groups of user defined object types shall be able to be set up as a predefined aggregate of subsystems and systems. The configuration interface shall support copying/pasting and exporting/importing portions of the database for additional efficiency. The system shall also maintain a link to all "child" objects created. If a user wishes to make a change to a parent object, the software shall ask the user if he/she wants to update all of the child objects with the change.

H. Color Graphic Displays

1. The system shall allow for the creation of user defined, color graphic displays for the viewing of mechanical and electrical systems, or building schematics. These graphics shall contain point information from the database including any attributes associated with the point (engineering units, etc.). In addition operators shall be able to command equipment or change setpoints from a graphic through the use of the mouse.
2. Requirements of the color graphic subsystem include:
    a. At a minimum, the user shall have the ability to import .gif, .png, .bmp, .jpeg, .tif, and CAD generated picture files as background displays, and layering shall be possible.
    b. The system shall support HTML5 enabled graphics.
    c. It shall be possible for the user to use JavaScript to customize the behavior of each graphic.
    d. The editor shall use Scalable Vector Graphics (SVG) technology.
    e. A built-in library of animated objects such as dampers, fans, pumps, buttons, knobs, gauges, ad graphs which can be "dropped" on a graphic through the use of a software configuration "wizard". These objects shall enable operators to interact with the graphic displays in a manner that mimics their mechanical equivalents found on field installed control panels.
    f. Support for high DPI icons shall be included and automatically chosen if viewing on a high definition display such as Retina or 4K displays.
    g. Using the mouse, operators shall be able to adjust setpoints, start or stop equipment, modify PID loop parameters, or change schedules.
    h. Status changes or alarm conditions must be able to be highlighted by objects changing screen location, size, color, text, blinking or changing from one display to another.
    i. Ability to link graphic displays through user defined objects, alarm testing, or the result of a mathematical expression. Operators must be able to change from one graphic to another by selecting an object with a mouse - no menus will be required.

j. It shall be possible to create and save graphical components and JavaScript code in reusable and transferrable, customized libraries.
k. Graphics should rescale based on whatever monitor or viewing device is being used.
l. Be able to create graphics on varying layers that can be moved and repeated.
m. Be able to create graphics within varying window panes that can be moved and/or re-referenced. For example, creating the graphical menu within a pane and referencing it on every graphics page, therefore not rebuilding thus allowing for a single spot for updates that get pushed to all the pages that reference it.
n. The ability to create re-usable cascading menus.
o. The ability to have multiple instances of a graphic and edit one instance to change all.

3. Additionally, the Graphics Editor portion of the Engineering Software shall provide the following capabilities:
a. Create and save pages.
b. Group and ungroup symbols.
c. Modify an existing symbol.
d. Modify an existing graphic page.
e. Rotate and mirror a symbol.
f. Place a symbol on a page.
g. Place analog dynamic data in decimal format on a page.
h. Place binary dynamic data using state descriptors on a page.
i. Create motion through the use of animated .gif files or JavaScript.
j. Place test mode indication on a page.
k. Place manual mode indication on a page.
l. Place links using a fixed symbol or flyover on a page.
m. Links to other graphics.
n. Links to web sites.
o. Links to notes.
p. Links to time schedules.
q. Links to any .exe file on the operator work station.
r. Links to .doc files.
s. Assign a background color.
t. Assign a foreground color.
u. Place alarm indicators on a page.
v. Change symbol/text/value color as a function of an analog variable.
w. Change a symbol/text/value color as a function of a binary state.
x. Change symbol/text/value as a function of a binary state.
y. All symbols used by Schneider Electric EcoBuilding Business in the creation of graphic pages shall be saved to a library file for use by the owner.

I. Automatic monitoring
1. The software shall allow for the automatic collection of data and reporting from any controller or NSC. The frequency of data collection shall be user-configurable.

J. Alarm Management
1. The software shall be capable of accepting alarms directly from NSCs or controllers, or generating alarms based on evaluation of data in controllers and comparing to limits or conditional equations configured through the software. Any alarm (regardless of its origination) will be integrated into the overall alarm management system and will appear in all standard alarm reports, be available for operator acknowledgment, and have the option for displaying graphics, or reports.
2. Alarm management features shall include:

a. A minimum of 1000 alarm notification levels at the NSC, workstation, and webstation levels. At the Enterprise level the minimum number of active and viewable alarms shall be 10,000. Each notification level will establish a unique set of parameters for controlling alarm display, distribution, acknowledgment, keyboard annunciation, and record keeping.
b. Automatic logging in the database of the alarm message, point name, point value, source device, timestamp of alarm, username and time of acknowledgement, username and time of alarm silence (soft acknowledgement).
c. Playing an audible sound on alarm initiation or return to normal.
d. Sending an email page to anyone specifically listed on the initial occurrence of an alarm. The ability to utilize email paging of alarms shall be a standard feature of the software using Simple Mail Transfer Protocol (SMTP) with support for secure email using Simple Mail Transfer Protocol Secure (SMTPS) No special software interfaces shall be required and no email client software must be running in order for email to be distributed. The email notification shall be able to be sent to an individual user or a user group.
e. Individual alarms shall be able to be re-routed to a user at user-specified times and dates. For example, a critical high temp alarm can be configured to be routed to a Facilities Dept. workstation during normal working hours (7am-6pm, Mon-Fri) and to a Central Alarming workstation at all other times.
f. An active alarm viewer shall be included which can be customized for each user or user type to hide or display any alarm attributes.
g. The active alarm viewer can be configured such that an operator must type in text in an alarm entry and/or pick from a drop-down list of user actions for certain alarms.
h. The active alarm viewer can be configured such that an operator must type in text in an alarm entry and/or pick from a drop-down list of causes for certain alarms. This ensures accountability (audit trail) for the response to critical alarms.
i. The active alarm viewer can be configured such that an operator must confirm that all of the steps in a check list have been accomplished prior to acknowledging the alarm.
j. The active alarm viewer shall, if filtered, show the quantity of visible and total number of alarms that are not equal to 'normal' and the quantity of disabled and hidden alarms.
k. The alarm viewer can be configured to auto hide alarms when triggered.
l. An operator shall have the capability to assign an alarm to another user of the system.
m. Time schedules shall be able to be used to set control notifications to users.
n. An operator shall have the capability to save and apply alarm favorites.
o. Alarm notifications must support multiple distribution methods within one notification.

K. Report Generation

1. The Reports Server shall be able to process large amounts of data and produce meaningful reports to facilitate analysis and optimization of each installation.
2. Reports shall be possible to generate and view from the operator Workstation, and/or Webstation, and/or directly from a reports-only web interface.
3. A library of predefined automatically generated reports that prompt users for input prior to generation shall be available. The properties and configurations made to these reports shall be possible to save as Dashboard reports, so that the configurations are saved for future used.
4. It shall be possible to create reports standard tools, such as Microsoft Report Builder 2.0 or Visual Studio, shall be used for customized reports.
5. Additional reports or sets of reports shall be downloadable, transferrable, and importable
6. All reports shall be able to be set up to automatically run or be generated on demand.

7. Each report shall be capable of being automatically emailed to a recipient in Microsoft Word, Excel, and/or Adobe .pdf format.
8. Reports can be of any length and contain any point attributes from any controller on the network.
9. Image management functionality shall be possible to enable the system administrators to easily upload new logos or images to the system.
10. It shall be possible to run other executable programs whenever a report is initiated.
11. Report Generator activity can be tied to the alarm management system, so that any of the configured reports can be displayed in response to an alarm condition.
12. Minimum supplied reports shall include:
    a. Activities Per Server Report
    b. Activities Per User Report
    c. Alarm Amount by Category Report
    d. Alarm Amount by Type Report
    e. Alarms Per Sever Report
    f. Current Alarm Report
    g. Most Active Alarm Report
    h. System Errors Per Server Report
    i. Top Activities Report
    j. Top Alarms Report
    k. Top System Errors Report
    l. Trend Log Comparison Report
    m. User Logins Report
    n. Users and Groups Reports
    o. Log of User Changes to System
13. Reports Server Hardware Requirements
    a. Processor
        a) Minimum: 2.0 GHz
        b) Recommended: 2.0 GHz or higher
    b. Memory
        a) Minimum: 6 GB
        b) Recommended: 8GB or higher
    c. Hard Disk: 500 GB

15. Reports Server Software Requirements
    a. Operating System:
        a) Microsoft Windows 7 32-bit (Professional)
        b) Microsoft Windows 7 64-bit (Professional)
        c) Microsoft Windows 8.1 32-bit (Pro or Enterprise)
        d) Microsoft Windows 8.1 64-bit (Pro or Enterprise)
        e) Microsoft Windows 10 64-bit (Pro or Enterprise)
        f) Microsoft Windows Server 2008 R2 64-bit (Standard, Enterprise, Datacenter, Web, or Itanium)
        g) Microsoft Windows Server 2012 64-bit (Standard)
        h) Microsoft Windows Server 2012 R2 64-bit (Standard, Datacenter)

b. SQL Versions:

a) Microsoft SQL Server 2008 R2 64-bit SP2 (Standard and Express with Advanced Services)

b) Microsoft SQL Server 2012 64-bit (Standard and Express with Advanced Services)

c. Additional required software"

a) Microsoft .Net 4.5

L. Scheduling

1. From the workstation or webstation, it shall be possible to configure and download schedules for any of the controllers on the network.
2. Time of day schedules shall be in a calendar style and viewable in both a graphical and tabular view.
3. Schedules shall be programmable for a minimum of one year in advance.
4. To change the schedule for a particular day, a user shall simply select the day and make the desired modifications.
5. Additionally, from the operator webstations, each schedule will appear on the screen viewable as the entire year, monthly, week and day. A simple mouse click shall allow switching between views. It shall also be possible to scroll from one month to the next and view or alter any of the schedule times.
6. Schedules will be assigned to specific controllers and stored in their local RAM memory. Any changes made at the workstation will be automatically updated to the corresponding schedule in the controller.
7. It shall be possible to assign a lead schedule such that shadow/local schedules are updated based upon changes in the Lead.
8. It shall be possible to assign a list(s) of exception event days, dates, date ranges to a schedule.
9. It shall be possible to view combined views showing the calendar and all prioritized exemptions on one screen.
10. It should accommodate a minimum of 16 priority levels.
11. Values should be able to be controlled directly from a schedule, without the need for special program logic.

M. Programmer's Environment

1. Programming in the NSC shall be either in graphical block format or line-programming format or both.
2. Programming of the NSC shall be available offline from system prior to deployment into the field. All engineering tasks shall be possible, except, of course, the viewing of live tasks or values.
3. The programmer's environment will include access to a superset of the same programming language supported in the SDCUs.
4. NSC devices will support both script programming language as well as the graphical function block programming language. For both languages, the programmer will be able to configure application software for custom program development, and write global control programs. Both languages will have debugging capabilities in their editors.
5. It shall be possible to save custom programs as libraries for reuse throughout the system. A wizard tool shall be available for loading programs from a library file in the program editor.
6. It shall be possible to view graphical programming live and real-time from the Workstation.

7. The system shall be capable of creating 'binding templates' allowing the user to bind multiple points to multiple objects all at once.
8. Key terms should appear when typing (IntelliType).
9. Applications should be able to be assigned different priorities and cycle times for a prioritized execution of different function.
10. The system shall be able to create objects that allow common objects such as power meters, VFD drives, etc. to be integrated into the system with simple import actions without the need of complicated programming or configuration setups.

N. Saving/Reloading

1. The workstation software shall have an application to save and restore NSC and field controller memory files.
2. For the NSC, this application shall not be limited to saving and reloading an entire controller – it must also be able to save/reload individual objects in the controller. This allows off-line debugging of control programs, for example, and then reloading of just the modified information.

O. Audit Trail

1. The workstation software shall automatically log and timestamp every operation that a user performs at a workstation, from logging on and off a workstation to changing a point value, modifying a program, enabling/disabling an object, viewing a graphic display, running a report, modifying a schedule, etc.
2. It shall be possible to view a history of alarms, user actions, and commands for any system object individually or at least the last 5000 records of all events for the entire system from Workstation.
3. The Enterprise server shall be able to store up to 5 million events.
4. The event view shall support viewing of up to 100,000 events.
5. It shall be possible to save custom filtered views of event information that are viewable and configurable in Workstation.
6. It shall be capable to search and view all forced values within the system.

P. Fault Tolerant Enterprise Server Operation (Top level NSC)

1. A single component failure in the system shall not cause the entire system to fail. All system users shall be informed of any detectable component failure via an alarm event. System users shall not be logged off as a result of a system failure or switchover.

Q. Web-based Operator Software

1. General:
    a. Day-to-day operation of the system shall be accessible through a standard web browser interface, allowing technicians and operators to view any part of the system from anywhere on the network.
    b. The system shall be able to be accessed on site via a mobile device environment with, at a minimum, access to overwrite and view system values.
2. Graphic Displays
    a. The browser-based interface must share the same graphical displays as the Administration and Programming Workstations, presenting dynamic data on site layouts, floor plans, and equipment graphics. The browser's graphics shall support commands to change setpoints, enable/disable equipment and start/stop equipment.
    b. Through the browser interface, operators must be able to navigate through the entire system, and change the value or status of any point in any controller. Changes are effective immediately to the controller, with a record of the change stored in the system database.
3. Alarm Management

a. Systems requiring additional client software to be installed on a PC for viewing the webstation from that PC will not be considered.
b. Through the browser interface, a live alarm viewer identical to the alarm viewer on the Administration and Programming workstation shall be presented, if the user's password allows it. Users must be able to receive alarms, silence alarms, and acknowledge alarms through a browser. If desired, specific operator text must be able to be added to the alarm record before acknowledgement, attachments shall be viewable, and alarm checklists shall be available.

R. Groups and Schedules
1. Through the browser interface, operators must be able to view pre-defined groups of points, with their values updated automatically.
2. Through the browser interface, operators must be able to change schedules – change start and stop times, add new times to a schedule, and modify calendars.

S. User Accounts and Audit Trail
1. The same user accounts shall be used for the browser interface and for the operator workstations. Operators must not be forced to memorize multiple passwords.
2. All commands and user activity through the browser interface shall be recorded in the system's activity log, which can be later searched and retrieved by user, date, or both.

T. Web Services
1. The installed system shall be able to use web services to "consume" information within the Network Server/Controllers (NSCs) with other products and systems. Inability to perform web services within the NSCs will be unacceptable.
a. Shall be able to "consume" data into the system via SOAP and REST web services.

2.4 NETWORK SERVER CONTROLLERS (NSCS)

A. Network Router Controllers shall combine both network routing functions, control functions, and server functions into a single unit.
B. The BACnet NSC shall be classified as a "native" BACnet device, supporting the BACnet Network Server Controller (B-BC) profile. Controllers that support a lesser profile such as B-SA are not acceptable. NSCs shall be tested and certified by the BACnet Testing Laboratory (BTL) as BACnet Network Server Controllers (B-BC).
C. The Network Server Controller shall provide the interface between the LAN or WAN and the field control devices, and provide global supervisory control functions over the control devices connected to the NRS.
D. The NSCs shall be capable of whitelisting IPs to restrict access to a pre-defined list of hosts or devices.
E. Whitelisting of file extensions for documents shall be capable.
F. Encrypted and authenticated communication shall be configurable for non-open protocol communications using TLS 1.2
G. The NSCs shall support Simple Network Management Protocol version 3 (SNMPv3) for monitoring of the NSCs using a Network Management Tool.
H. The NSCs shall support remote system logging for used by System Information and Event Monitoring (SIEM) software.
I. They shall also be responsible for monitoring and controlling their own HVAC equipment such as an AHU or boiler.

J. They shall also contain graphics, trends, trend charts, alarm views, and other similar presentation objects that can be served to workstations or web-based interfaces. A sufficient number of NSCs shall be supplied to fully meet the requirements of this specification and the attached point list.

K. It shall be capable of executing application control programs to provide:
   1. Calendar functions
   2. Scheduling
   3. Trending
   4. Alarm monitoring and routing
   5. Time synchronization by means of an Internet site including automatic synchronization
   6. Native integration of LonWorks controller data and Modbus controller data or BACnet controller data and Modbus controller data
   7. Network Management functions for all LonWorks based devices

L. Hardware Specifications
   1. Memory:
      a. The operating system of the controller, application programs, and all other portions of the configuration database, shall be stored in non-volatile, FLASH memory. Servers/Controllers shall contain enough memory for the current application, plus required history logging, plus a minimum of 20% additional free memory.
   2. Each NRC shall provide the following on-board hardware for communication:
      a. Two 10/100bT Ethernet for communication to Workstations, other NRCs, IP field bus controllers, other SDCUs, and onto the Internet.
         a) The two ethernet ports shall support active switch and BACnet/IP communication protocols.
         b) Support IPv4 addressing
         c) Ethernet port 1 shall support static or DHCP client configuration for communication to Workstation or other NSCs
         d) Ethernet port 2 shall support switch mode or DHCP server to set addressing of DHCP client devices
         e) It shall be possible to disable Ethernet port 2
         f) In DHCP server mode, the Ethernet port 2 shall support 50 BACnet/IP field controllers in daisy chain configuration directly from the port.
         g) Each NSC shall be able to support a total of 250 IP SDCUs in daisy chain configuration (5 sub networks via switch)
         h) If using RSTP (Rapid Spanning Tree Protocol) with a managed switch (with IEEE 802.1W or IEEE 802.1Q-2014 support), Ethernet port 2 shall support up to 39 devices
         i) Each NSC shall be able to support a total of 234 IP SDCUs in RSTP configuration (6 sub networks via managed switch)
         j) Where a switch is needed, use an EtherWAN EX63402-01B, or other equal and approved equivalent.
      b. Two RS-485 ports for communication to BACnet MSTP bus or serial Modbus (software configurable)
      c. One TP/FT port for communication to LonWorks devices.
      d. One device USB port
      e. One host USB port
   3. The NSC shall conform to a small footprint no larger than 100W x 125H x 75D mm (3.94W x 4.92H x 2.95D in).

M. Modular Expandability:

1. The system shall employ a modular I/O design to allow expansion. Input and output capacity is to be provided through plug-in modules of various types. It shall be possible to combine I/O modules as desired to meet the I/O requirements for individual control applications.
2. One shall be able to “hot-change” (hot-swap) the I/O modules preserving the system on-line without any intervention on the software; addressing and configuration shall be automatic.
3. If for any reason the backplane of the modular I/O system were to fail, I/O module addresses will be protected.

N. Hardware Override Switches:

1. All digital outputs shall, optionally, include three position manual override switches to allow selection of the ON, OFF, or AUTO output state. These switches shall be built into the unit and shall provide feedback to the controller so that the position of the override switch can be obtained through software. In addition each analog output shall be equipped with an override potentiometer to allow manual adjustment of the analog output signal over its full range, when the 3 position manual override switch is placed in the ON position.

O. Universal Input Temperatures

1. All universal inputs directly connected to the NSC via modular expansion shall be capable of using the following thermistors for use in the system without any external converters needed.
    a. 10 kohm Type I (Continuum)
    b. 10 kohm Type II (I/NET)
    c. 10 kohm Type III (Satchwell)
    d. 10 kohm Type IV (FD)
    e. Linearized 10 kohm Type V (FD w/11k shunt)
    f. Linearized 10 kohm (Satchwell)
    g. 1.8 kohm (Xenta)
    h. 1 kohm (Balco)
    i. 20 kohm (Honeywell)
    j. 2.2 kohm (Johnson)
2. In addition to the above, the system shall be capable of using the below RTD sensors, however it is not required that all universal inputs be compatible with them.
    a. PT100 (Siemens)
    b. PT1000 (Sauter)
    c. Ni1000 (Danfoss)

P. Local Status Indicator Lamps:

1. The NSC shall provide as a minimum LED indication of CPU status, Ethernet LAN status, and field bus status. For each input or output, provide LED indication of the value of the point (On/Off). The LED indication shall support software configuration to set whether the illumination of the LED corresponds to On or Off or whether the color when illuminated is Red or Green.

Q. Real Time Clock (RTC):

1. Each NSC shall include a real time clock, accurate to 10 seconds per day. The RTC shall provide the following: time of day, day, month, year, and day of week. Each NSC will allow for its own UTC offset, depending upon the time zone. When the time zone is set, the NSC will also store the appropriate times for daylight savings time.
2. The RTC date and time shall also be accurate, up to 30 days, when the NSC is powerless.
3. No batteries may be used to for the backup of the RTC.

R. Power Supply:

1. The 24 VDC power supply for the NSCs shall provide 30 watts of available power for the NSC and associated IO modules. The system shall support the use of more than one power supply if heavily power consuming modules are required.
2. The power supply, NSC, and I/O modules shall connect power wise and communication wise via the separate terminal base allowing for ease of replacement and no separate or loose wiring.

S. Automatic Restart After Power Failure:
1. Upon restoration of power after an outage, the NSC shall automatically and without human intervention update all monitored functions, resume operation based on current, synchronize time and status, and implement special start-up strategies as required.

T. Data Retention:
1. During a power failure, the NSC shall retain all programs, configuration data, historical data, and all other data that is configured to be retained. There shall be no time restriction for this retention and it must not use batteries to achieve it.

U. Software Specifications
1. The operating system of the controller, application programs, and all other portions of the configuration database such as graphics, trends, alarms, views, etc., shall be stored in non-volatile, FLASH memory. There will be no restrictions placed on the type of application programs in the system. Each NSC shall be capable of parallel processing, executing all control programs simultaneously. Any program may affect the operation of any other program. Each program shall have the full access of all I/O facilities of the processor. This execution of control function shall not be interrupted due to normal user communications including interrogation, program entry, printout of the program for storage, etc.
2. Each NSC shall have an available capacity of 4 GB of memory. This shall represent 2 GB for application and historical data and 2 GB dedicated for backup storage.

V. User Programming Language:
1. The application software shall be user programmable. This includes all strategies, sequences of operation, control algorithms, parameters, and setpoints. The source program shall be either a script-based structured text or graphical function block based and fully programmable by the user. The language shall be structured to allow for the configuration of control programs, schedules, alarms, reports, telecommunications, local displays, mathematical calculations, and histories. Users shall be able to place comments anywhere in the body of either script or function block programs.
2. Network Server Controllers that use a “canned” program method will not be accepted.

W. Control Software:
1. The NSC shall have the ability to perform the following pre-tested control algorithms:
   a. Proportional, Integral plus Derivative Control (PID)
   b. Two Position Control
   c. Digital Filter
   d. Ratio Calculator
   e. Equipment Cycling Protection

X. Mathematical Functions:
1. Each controller shall be capable of performing basic mathematical functions (+, -, *, /), squares, square roots, exponential, logarithms, Boolean logic statements, or combinations of both. The controllers shall be capable of performing complex logical statements including operators such as >, <, =, and, or, exclusive or, etc. These must be able to be used in the same equations with the mathematical operators and nested up to five parentheses deep.

Y. NSCs shall have the ability to perform any or all of the following energy management routines:

1. Time of Day Scheduling
2. Calendar Based Scheduling
3. Holiday Scheduling
4. Temporary Schedule Overrides
5. Optimal Start
6. Optimal Stop
7. Night Setback Control
8. Enthalpy Switchover (Economizer)
9. Peak Demand Limiting
10. Temperature Compensated Duty Cycling
11. CFM Tracking
12. Heating/Cooling Interlock
13. Hot/Cold Deck Reset
14. Hot Water Reset
15. Chilled Water Reset
16. Condenser Water Reset
17. Chiller Sequencing

Z. History Logging:

1. Each NSC controller shall be capable of LOCALLY logging any input, output, calculated value or other system variable either over user defined time intervals ranging from 1 second to 1440 minutes or based upon a user configurable change of value. A minimum of 1000 logs, with a minimum of 100,000 records, shall be stored. Each log can record either the instantaneous, average, minimum or maximum value of the point. Logged data shall be downloadable to a higher level NSC long term archiving based upon user-defined time intervals, or manual command.
2. For extended trend logging a minimum of 1500 trends shall be capable, with a minimum number of 600,000 records within.
3. Management of a power meter replacement to ensure meter log data is accurate shall be possible in the NSC.
4. Every hardware input and output point, hosted within the NSC and attached I/O modules, shall be trended automatically without the requirement for manual creation, and each of these logs shall log values based upon a change of value and store at least 500 trend samples before replacing the oldest sample with new data.
5. The presentation of logged data shall be built into the server capabilities of the NSC. Presentation can be in time stamped list formats or in a chart format with fully configurable pen colors, weights, scales and time spans.
6. Tooltips shall be present, magnetic, and visible based on users preference.
7. Comments shall be visible whenever viewing the trend log list.
8. System shall give indication of memory usage and be able to alert the user if too many logs are allocated.

AA. Alarm Management:

1. For each system point, alarms can be created based on high/low limits or in comparison to other point values. All alarms will be tested each scan of the NSC and can result in the display of one or more alarm messages or reports.
2. There is no limit to the number of alarms that can be created for any point
3. Alarms can be configured to be generated based upon a single system condition or multiple system conditions.

4. Alarms will be generated based on an evaluation of the alarm conditions and can be presented to the user in a fully configurable order, by priority, by time, by category, etc. These configurable alarm views will be presented to a user upon logging into the system regardless of whether the log in takes place at a WorkStation or a Webstation.
5. The alarm management system shall support the ability to create and select cause and action notes to be selected and associated with an alarm event. Checklists shall also be possible in order to present to an operator a suggested mode of troubleshooting. When acknowledging an alarm, it shall be possible to assign it to a user of the system such that the user is notified of the assignment and is made responsible for the alarm resolution.
6. Alarms must be capable of being routed to any BACnet workstation that conforms to the B-OWS device profile and uses the BACnet/IP protocol.

BB. Embedded Web Server

1. Each NSC must have the ability to serve out web pages containing the same information that is available from the WorkStation. The development of the screens to accomplish shall not require any additional engineering labor over that required to show them at the WorkStation itself.
2. The NSC shall be configurable to logging all Embedded Web Server access attempts
3. The NSC shall have the option to redirect HTTP based Embedded Web Server connections to secure, HTTPS connections.
4. The NSC shall authenticate and authorize all users connecting to the Embedded Web Server
5. The NSC shall provide to ability to configure an automatic logoff for Embedded Web Server users that have not had any activity for an adjustable time period.

2.5 BACNET IP FIELDBUS CONTROLLERS

A. Controllers – BACnet/IP Protocol
   a. All BACnet/IP Fieldbus controllers shall be BACnet Testing Laboratory listed (v12 or later) as specified BACnet Advanced Application Controller (B-AAC)
   b. All BACnet/IP Fieldbus controllers shall use the following communication specifications and achieve performance as specified herein:
      i. All controllers shall be able to communicate peer-to-peer without the need for a NSC
      ii. Any BACnet/IP Fieldbus controllers on the Ethernet Data Link/Physical layer shall be able to act as a Master to allow for the exchange and sharing of data variables and messages with any other controller connected on the same communication cabling. Slave controllers are not acceptable.

B. The BACnet/IP Fieldbus controllers shall be equipped with 2x 10/100bT Ethernet communication ports with active switch and will support BACnet/IP communication protocols with the following configurations:
   a. Supporting IPv4 addressing
   b. Supporting Static IP setting, DHCP client and Auto-IP address acquisition
   c. It shall be possible to disable Ethernet port 2

C. Topologies
   a. BACnet/IP Fieldbus controllers shall support daisy chain topology of up to 50 controllers. In case of any disruption to the communication, a system alarm shall notify the NSC/BMS of the point disruption has occurred
   b. BACnet/IP Fieldbus Controllers shall support RSTP loop whereby up to 39 controllers are supported.
      i. In case of any disruption there shall be no communication interruption
      ii. In case of any disruption there shall be system alarms that will inform the operator of the disruption

D. Performance

a. Each BACnet/IP Fieldbus Controllers shall have a 32-bit microprocessor operating at 500 MHz and support a BACnet protocol stack in accordance with the ANSI/ASHRAE Standard 135-2008 and the BACnet Device Profile supported.
b. They shall be multi-tasking, real-time digital control processors consisting of communication controllers, controls processing, power supplies with built-in inputs and outputs.

E. Programmability
a. The BACnet/IP Fieldbus controllers shall support both script programming language and graphical that will be consistent with the NSC.
b. The control program will reside within the same enclosure as the input/output circuitry, that reads inputs and controls outputs
c. All control sequences programmed into the BACnet/IP Fieldbus Controllers shall be stored in non-volatile memory, which is not dependent upon the presence of a battery, to be retained.
d. BACnet/IP Fieldbus controllers shall communicate with the Network Server Controller (NSC) via a BACnet/IP connection at a baud rate of not less than 100 Mbps
e. BACnet/IP Fieldbus controllers shall support a dedicated communications port for connecting and supplying power to a matching room temperature and/or humidity sensor and/or CO2 and/or presence detector that does not utilize any of the I/O points of the controller.
f. BACnet/IP Fieldbus controllers (Excluding VAV) shall support an add-on display to supply and provide access in real-time for monitoring inputs and overriding of outputs
g. The override functionality must be supported by a dedicated processor to assure reliable operation (overriding of output)
h. Each BACnet/IP Fieldbus controller shall have sufficient memory, to support its own operating system and databases, including:
    i. Control processes
    ii. Energy management applications
    iii. Alarm management
    iv. Historical/trend data
    v. Maintenance support applications
    vi. Custom processes
    vii. Manual override monitoring
i. Each BACnet/IP Fieldbus controller shall support local trend data up to 2x the built-in I/O and at a minimum be capable of holding 5 days @ 15 min intervals locally
j. The BACnet/IP Fieldbus controller analog or universal input shall use a 16 bit A/D converter.
k. The BACnet/IP Fieldbus controller analog or universal output shall use a 10 bit D/A converter.
l. Built-in I/O: each BACnet/IP Fieldbus controllers shall support:
    i. At minimum 8 and up to 20 configurable IO channels to monitor and to control the following types of inputs and outputs without the addition of equipment inside or outside the DDC Controller cabinet:
        1. Universal Inputs – the following thermistors for use in the system without any external converters needed.
            a. 10 kohm Type I (Continuum)
            b. 10 kohm Type II (I/NET)
            c. 10 kohm Type III (Satchwell)
            d. 10 kohm Type IV (FD)
            e. Linearized 10 kohm Type V (FD w/11k shunt)
            f. Linearized 10 kohm (Satchwell)
            g. 1.8 kohm (Xenta)
            h. 1 kohm (Balco)

i. 20 kohm (Honeywell)
j. 2.2 kohm (Johnson)
k. PT100 (Siemens)
l. PT1000 (Sauter)
m. Ni1000 (Danfoss)

2. Analog inputs:
   a. Current Input - 0-20 mA
   b. Voltage Input 0-10 Vdc
3. Digital inputs from dry contact closure, pulse accumulators, voltage sensing
4. Digital outputs
5. Analog outputs of 4-20 mA and/or 0-10 Vdc.

m. Real Time Clock (RTC):

1. Each BACnet/IP Fieldbus controller shall include a real time clock, accurate to +/-1 minute per month. The RTC shall provide the following: time of day, day, month, year, and day of week.
2. The RTC date and time shall also be accurate, up to 7 days, when the BACnet/IP Fieldbus controller is powerless.
3. No batteries may be used to for the backup of the RTC.

n. The BACnet/IP Fieldbus controller for Variable Air Volume (VAV) applications

1. The BACnet/IP Fieldbus controller for VAV applications shall include a built-in 'flow thru' differential pressure transducer.
2. The VAV differential pressure transducer shall have a measurement range of 0 to 1 in. W.C. and measurement accuracy of ±5% at 0.001 to 1 in. W.C. and a minimum resolution of 0.001 in. W.C., insuring primary air flow conditions shall be controlled and maintained to within ±5% of setpoint at the specified minimum and maximum air flow parameters
3. The BACnet/IP FieldBus controller for VAV applications shall support a dedicated commissioning tool for air flow balancing
4. The BACnet/IP Fieldbus controller for VAV applications shall require no programing for air balancing algorithm
5. All balancing parameters shall be synchronized in NSC

o. Each BACnet/IP Fieldbus controller shall have a minimum of 10% spare capacity for each point type represented on the controller for future point connection

Power Requirements.: 24VDC (21 to 33 VDC) and 24 VAC +/-20% with local transformer power

F. Commissioning Tool - The BACnet/IP Fieldbus controller shall be supported via a dedicate mobile based commissioning tool for configuration, programming, air balancing and I/O checkout

a. The Commissioning Tool shall be supported across: iOS, Android and Windows 10 platforms

b. The Commissioning Tool shall be available for download on App Store, Google Store and Windows Store

c. Commissioning Tool Interface to BACnet/IP Fieldbus controllers shall be via a Bluetooth adapter interface through the Intelligent Space Sensor or via a Wi-Fi access point on the LAN

d. Functionality

i. Device Configuration – the Commissioning Tool shall be able to set or edit all Network configurations associated with the BACnet/IP Fieldbus controller

ii. Programming – The Commissioning Tool shall be able to load offline engineered applications directly in to the controller directly

iii. Air Balancing

1. The Commissioning Tool shall allow the air balancer to manually control the action of the actuator including the following function: open VAV damper, close VAV damper, open all VAV dampers, and close all VAV dampers.

2. The Commissioning Tool shall be able to generate Air Balancing report

iv. IO Checkout

1. The Commissioning Tool shall be able to support overriding of the outputs and reading value of inputs live

2. The Commissioning Tool shall be able to support generation of I/O checkout report

v. There shall be no limit to the number of Commissioning Tools that can be used on a network segment, however, one connection per controller is recommended.

2.6 DDC SENSORS AND POINT HARDWARE

A. Temperature Sensors

1. Acceptable Manufacturers: Veris Industries or equal
2. All temperature devices shall use precision thermistors accurate to +/- 1 degree F over a range of –30 to 230 degrees F. Space temperature sensors shall be accurate to +/- .5 degrees F over a range of 40 to 100 degrees F.
3. Room Sensor: Standard space sensors shall be available in an off white enclosure made of high impact ABS plastic for mounting on a standard electrical box. Basis of Design: Veris TW Series

a. Where manual overrides are required, the sensor housing shall feature both an optional sliding mechanism for adjusting the space temperature setpoint, as well as a push button for selecting after hours operation.
b. Where a local display is specified, the sensor shall incorporate an LCD display for viewing the space temperature, setpoint and other operator selectable parameters. Using built in buttons, operators shall be able to adjust setpoints directly from the sensor.
c. Provide temperature sensors without LCD display in all areas accessible to the public. Provide temperature sensors with LCD display and user adjustable override in all other spaces.

4. Duct Probe Sensor: Sensing element shall be fully encapsulated in potting material within a stainless steel probe. Useable in air handling applications where the coil or duct area is less than 14 square feet. Basis of Design: Veris TD Series

5. Duct Averaging Sensor: Averaging sensors shall be employed in ducts which are larger than 14 square feet. The averaging sensor tube shall contain at least one thermistor for every 3 feet, with a minimum tube length of 6 feet. The averaging sensor shall be constructed of rigid or flexible copper tubing. Basis of Design: Veris TA Series
6. Pipe Immersion Sensor: Immersion sensors shall be employed for measurement of temperature in all chilled and hot water applications as well as refrigerant applications. Provide sensor probe length suitable for application. Provide each sensor with a corresponding pipe-mounted sensor well, unless indicated otherwise. Sensor wells shall be stainless steel for non-corrosive fluids below 250 degrees F and 300 series stainless steel for all other applications. Basis of Design: Veris TI Series
7. Outside Air Sensor: Provide the sensing element on the building's north side. Sensing element shall be fully encapsulated in potting material within a stainless steel probe. Probe shall be encased in PVC solar radiation shield and mounted in a weatherproof enclosure. Operating range -40 to 122 F, Basis of Design: Veris TO Series
8. A pneumatic signal shall not be allowed for sensing temperature.

B. Humidity Wall Transmitter
1. Acceptable Manufacturer: Veris Industries or equal
2. Transmitters shall be accurate to +/- 2 % at full scale.
3. Transmitter shall have replaceable sensing element.
4. Sensor type shall be thin-film capacitive.
5. Sensor element shall contain multipoint calibration on-board in nonvolatile memory
6. Operating range shall be 0 - 100% RH noncondensing, 50 to 95 F
7. Output shall be field selectable 4-20 mA or 0-5/0-10 VDC.
8. Transmitter shall accept 12-30 VDC or 24 VAC supply power.
9. Transmitter shall be available in an off white enclosure made of high impact ABS plastic for mounting on a standard electrical box.
10. Transmitter shall have option of having an LCD display
11. Transmitter shall have option of being NIST certified
12. Transmitter shall have option of an integrated temperature sensor
13. Basis of Design: Veris HWL Series

C. Humidity Duct Transmitter
1. Acceptable Manufacturer: Veris Industries or equal
2. Transmitters shall be accurate to +/- 2 % at full scale.
3. Transmitter shall be fully encapsulated in potting material within a stainless steel probe.
4. Transmitter shall have replaceable sensing element.
5. Sensor type shall be thin-film capacitive.
6. Sensor element shall contain multipoint calibration on-board in nonvolatile memory
7. Operating range shall be 0 - 100% RH noncondensing, -40 to 122 F
8. Output shall be 4-20 mA or 0-5/0-10 VDC.
9. Transmitter shall accept 12-30 VDC or 24 VAC supply power.
10. Transmitter shall have option of being NIST certified
11. Transmitter shall have option of an integrated temperature sensor
12. Basis of Design: Veris HD Series

D. Humidity Outdoor Transmitter
1. Acceptable Manufacturer: Veris Industries or equal
2. Transmitters shall be accurate to +/- 2% at full scale.

3. Transmitter shall be fully encapsulated in potting material within a stainless steel probe. Probe shall be encased in PVC solar radiation shield and mounted in a weatherproof enclosure.
4. Transmitter shall have replaceable sensing element.
5. Sensor type shall be thin-film capacitive.
6. Sensor element shall contain multipoint calibration on-board in nonvolatile memory
7. Operating range shall be 0 - 100% RH noncondensing, -40 to 122 F
8. Output shall be 4-20 mA or 0-5/0-10 VDC.
9. Transmitter shall accept 12-30 VDC or 24 VAC supply power.
10. Transmitter shall have option of being NIST certified
11. Transmitter shall have option of an integrated temperature sensor
12. Basis of Design: Veris HO Series

E. Carbon Dioxide Wall Transmitter:
1. Acceptable Manufacturer: Veris Industries or equal
2. Sensor type shall be Non-dispersive infrared (NDIR).
3. Accuracy shall be ±30 ppm ±2% of measured value with annual drift of ±10 ppm. Minimum five year recommended calibration interval.
4. Repeatability shall be ±20 ppm ±1% of measured value
5. Response Time shall be <60 seconds for 90% step change
6. Outputs shall be field selectable [Analog: 4-20mA or 0-5/0-10VDC] [Protocol: Modbus or BACnet] with [SPDT Relay 1A@30VDC] [temperature setpoint slider]
7. Transmitter shall accept 12-30 VDC or 24 VAC supply power.
8. Temperature Range: [32° to 122°F (CO2 only)] [50° to 95°F (with humidity option)]
9. Output range shall be programmable 0-2000 or 0-5000 ppm
10. Transmitter shall be available in an off white enclosure for mounting on a standard electrical box.
11. Transmitter shall have an option of an LCD display for commissioning and provide additional faceplate to conceal LCD display where occupants may misinterpret CO2 readings.
12. Transmitter shall have option of an integrated temperature sensor and/or humidity sensor
13. Basis of Design: Veris CWL

F. Carbon Dioxide Duct Transmitter:
1. Acceptable Manufacturer: Veris Industries or equal
2. Sensor type shall be Non-dispersive infrared (NDIR).
3. Accuracy shall be ±30 ppm ±2% of measured value with annual drift of ±10 ppm. Minimum five year recommended calibration interval.
4. Repeatability shall be ±20 ppm ±1% of measured value
5. Response Time shall be <60 seconds for 90% step change
6. Outputs shall be field selectable Analog: 4-20mA or 0-5/0-10VDC with SPDT Relay 1A@30VDC
7. Transmitter shall accept 12-30 VDC or 24 VAC supply power.
8. Temperature Range: 32° to 122°F
9. Output range shall be programmable 0-2000 or 0-5000 ppm
10. Enclosure shall not require remote pickup tubes and make use of integrated H-beam probe to channel air flow to sensor.
11. Enclosure lid shall require no screws and make use of snap on features for attachment
12. Enclosure shall be made of high impact ABS plastic
13. Transmitter shall have option of an LCD display
14. Transmitter shall have option of an integrated temperature sensor and/or humidity sensor
15. Basis of Design: Veris CDL

G. Air Pressure Transmitters.

1. Acceptable Manufacturers: Veris Industries or equal
2. Sensor shall be microprocessor profiled ceramic capacitive sensing element
3. Transmitter shall have 14 selectable ranges from 0.1 – 10" WC
4. Transmitter shall be +/- 1% accurate in each selected range including linearity, repeatability, hysteresis, stability, and temperature compensation.
5. Transmitter shall be field configurable to mount on wall or duct with static probe
6. Transmitter shall be field selectable for Unidirectional or Bidirectional
7. Maximum operating pressure shall be 200% of design pressure.
8. Output shall be field selectable 4-20 mA or 0-5/0-10 VDC linear.
9. Transmitter shall accept 12-30 VDC or 24 VAC supply power
10. Response time shall be field selectable T95 in 20 sec or T95 in 2 sec
11. Transmitter shall have an LCD display
12. Units shall be field selectable for WC or PA
13. Transmitter shall have provision for zeroing by pushbutton or digital input.
14. Transmitter shall be available with a certification of NIST calibration
15. Basis of Design: Veris model PXU.

H. Liquid Differential Pressure Transmitters:

1. Acceptable Manufacturer: Veris Industries or equal
2. Transmitter shall be microprocessor based
3. Transmitter shall use two independent gauge pressure sensors to measure and calculate differential pressure
4. Transmitter shall have 4 switch selectable ranges
5. Transmitter shall have test mode to produce full-scale output automatically.
6. Transmitter shall have provision for zeroing by pushbutton or digital input.
7. Transmitter shall have field selectable outputs of 0-5V, 0-10V, and 4-20mA.
8. Transmitter shall have field selectable electronic surge damping
9. Transmitter shall have an electronic port swap feature
10. Transmitter shall accept 12-30 VDC or 24 VAC supply power
11. Sensor shall be 17-4 PH stainless steel where it contacts the working fluid.
12. Performance:

a. Accuracy shall be ±1% F.S. and ±2% F.S. for lowest selectable range
b. Long term stability shall be ±0.25%
c. Sensor temperature operating range shall be -4° to 185°F
d. Operating environment shall be 14° to 131°F; 10-90% RH noncondensing
e. Proof pressure shall be 2x max. F.S. range
f. Burst pressure shall be 5x max. F.S. range

13. Transmitter shall be encased in a NEMA 4 enclosure
14. Enclosure shall be white powder-coated aluminum
15. Transmitter shall be available with a certification of NIST calibration
16. [Transmitter shall be preinstalled on a bypass valve manifold]
17. Basis of Design: Veris PW

I. Current Sensors

1. Current status switches shall be used to monitor fans, pumps, motors and electrical loads. Current switches shall be available in split core models, and offer either a digital or an analog signal to the automation system. Acceptable manufacturer is Veris Industriesor equal

J. Current Status Switches for Constant Load Devices
    1. Acceptable Manufacturer: Veris Industries or equal
    2. General: Factory programmed current sensor to detect motor undercurrent situations such as belt or coupling loss on constant loads. Sensor shall store motor current as operating parameter in non-volatile memory. Push-button to clear memory.
    3. Visual LED indicator for status.
    4. Split core sensor, induced powered from monitored load and isolated to 600 VAC rms. Sensor shall indicate status from 0.5 A to 175 A.
    5. Normally open current sensor output. 0.1A at 30 VAC/DC.
    6. Basis of Design: Veris Model H608.

K. Current Status Switches for Constant Load Devices (Auto Calibration)
    1. Acceptable Manufacturer: Veris Industries or equal
    2. General: Microprocessor based, self-learning, self-calibrating current switch. Calibration-free status for both under and overcurrent, LCD display, and slide-switch selectable trip point limits. At initial power-up automatically learns average current on the line with no action required by the installer
    3. Split core sensor, induced powered from monitored load and isolated to 600 VAC rms. Sensor shall indicate status from 2.5 A to 200 A.
    4. Display: Backlit LCD; illuminates when monitored current exceeds 4.5A
    5. Nominal Trip Point: ±40%, ±60%, or on/off (user selectable)
    6. Normally open current sensor output. 0.1A at 30 VAC/DC.
    7. Basis of Design: Veris Model H11D.

L. Current Status Switches for Variable Frequency Drive Application
    1. Acceptable Manufacturer: Veris Industries or equal
    2. General: Microprocessor controlled, self-learning, self-calibrating current sensor to detect motor undercurrent and overcurrent situations such as belt loss, coupling shear, and mechanical failure on variable loads. Sensor shall store motor current as operating parameter in non-volatile memory. Push-button to clear memory and relearn.
    3. Visual LED indicator for status.
    4. Alarm Limits: ±20% of learned current in every 5 Hz freq. band
    5. Split core sensor, induced powered from monitored load and isolated to 600 VAC rms. Sensor shall indicate status from 1.5 A to 150 A and from 12 to 115 Hz.
    6. Normally open current sensor output. 0.1A at 30 VAC/DC.
    7. Basis of Design: Veris Model H614.

M. Liquid Flow, Insertion Type Turbine Flowmeter:
    1. Acceptable Manufacturer: Veris Industries or equal
    2. General: Turbine-type insertion flow meter designed for use in pipe sizes 1 1/2" and greater. Available in hot tap configuration with isolation valves and mounting hardware to install or remove the sensor from pipeline that is difficult to shut down or drain
    3. Performance:
        a. Accuracy ±1% of rate over optimum flow range; ≥10 upstream and ≥5 downstream straight pipe diameters, uninterrupted flow
        b. Repeatability ±0.5%
        c. Velocity Range: 0.3 to 20 FPS
        d. Pressure Drop 0.5 psi or less @ 10 ft/sec for all pipe sizes 1.5" dia and up
        e. Pressure Rating: 1000 psi @ 70°F
    4. Maximum Temperature Rating: 300°F

5. Materials: Stainless Steel or Brass body; Stainless steel impeller
6. Transmitter:
    a. Power Supply: 12 - 30VAC or 8 - 35VDC.
        a) Output: [Frequency] [4-20 mA] [Scaled Pulse]
    b. Temperature Range: 14° to 150°F
    c. Display: 8 character 3/8" LCD (Optional)
    d. Enclosure: NEMA 4, Polypropylene with Viton® sealed acrylic cover
7. Basis of Design: Veris SDI series

N. Liquid Flow/Energy Transmitter, Non-invasive Ultrasonic (Clamp-on):

1. Acceptable Manufacturer: Veris Industries
2. General: Clamp-on digital correlation transit-time ultrasonic flow meter designed for clean liquids or liquids containing small amounts of suspended solids or aeration. Optional temperature sensors for BTU calculations.
3. Liquid: water, brine, raw sewage, ethylene, glycol, glycerin, others. Contact manufacturer for other fluid compatibility
4. Pipe Surface Temperature: Pipe dia 1/2" to 2":-40-185°F; Pipe dia > 2": -40-250°F
5. Performance:
    a. Flow Accuracy:
        a) Pipe dia 1/2" to 3/4" 1% of full scale
        b) Pipe dia 1" to 2"1% of reading from 4-40 FPS
        c) Pipe dia 2" to 100" 1% of reading from 1-40 FPS
    b. Flow Repeatability ±0.01% of reading
    c. Velocity Range: (Bidirectional flow)
        a) Pipe dia 1/2" to 2" 2 to 40 FPS
        b) Pipe dia 2" to 100" 1 to 40 FPS
    d. Flow Sensitivity 0.001 FPS
    e. Temperature Accuracy (energy): 32-212°F; Absolute 0.45°F; Difference 0.18°F
    f. Temperature Sensitivity: 0.05°F
    g. Temperature Repeatability: ±0.05% of reading
6. Transmitter:
    a. Power Supply: 95 to 264 VAC, 47 to 63 Hz or 10 to 28 VDC.
    b. Output: [RJ45] [Modbus TCP/IP] [Ethernet/IP] [BACnet/IP] [Pulse] [4-20 mA] [RS-485 Modbus RTU}
    c. Temperature Range: -40 to +185°F
    d. Display: 2 line backlit LCD with keypad
    e. Enclosure: NEMA 4, (IP65), Powder-coated aluminum, polycarbonate
7. Agency Rating: UL 1604, EN 60079-0/15, CSA C22.2, CSA Class 1 (Pipe > 2")
8. Basis of Design: Veris FST & FSR series

O. Pressure Independent Control Valves

1. NPS 2 and Smaller: PN 16, stainless steel components.
2. NPS 2½ through 10: Class 125 cast iron body per ASME B16.1-2010, Material class B per ASTM A 126-04 (2014), stainless steel components.
3. Accuracy NPS ¾" and Smaller: The control valves shall accurately control the flow from 0…100% rated flow with a differential pressure range of 2.32…58 psi for low and standard flow units, 5…58 psi for high flow units within 5% of set flow value.

4. Accuracy NPS 1 through 1¼: The control valves shall accurately control the flow from 0…100% rated flow with a differential pressure range of 2.9…58 psi for standard flow units, 5…58 psi for high flow units within 5% of set flow value.
5. Accuracy NPS 1½ through 4: The control valves shall accurately control the flow from 0…100% rated flow with a differential pressure range of 4.35…58 psi within 5% of set flow value.
6. Accuracy NPS 5 through 10: The control valves shall accurately control the flow from 0…100% rated flow with a differential pressure range of 5.8…58 psi for standard flow units, 8.7…58 psi for high flow units within 5% of set flow value.
7. Flow Characteristics: Linear Control, selectable to equal percentage at the proportional valve actuator.
8. Field adjustable flow by means of a percentage of rated valve flow.
9. Position feedback output signal integrated into all proportional actuators.
10. 100% authority with modulating below 1% regardless of flow settings.
11. No cartridges requiring replacement or maintenance.
12. Basis of Design: Schneider Electric SmartX PICV, or approved equal.

P. Control Valve Actuators

1. ½" to ¾" Ball Valve Actuators
   a. Size for torque required for valve close-off pressure for system design.
   b. Coupling: Direct coupled to valve body without use of external devices/tools
   c. Auxiliary End Switch (optional) to be SPST 24 Vac/Vdc,101 mA to 5 mA maximum on selected two-position models.
   d. Controller Signal Two-position, Floating or Proportional (0…5 Vdc, 0…10 Vdc, 5…10 Vdc, or 4…20 mA dc). Design allows for change via DIP switches without removal of cover.
   e. Manual operating lever and position indicator must be standard.
   f. Power Requirements: 24 Vac for floating, proportional, and 110…230 Vac for two position multi-voltage types
   g. Actuators must be available with either Spring Return (SR) or Non-Spring Return (NSR) models.
   h. Wiring (depending on model) Removable Terminal Block, 10 ft. (3.05 m) Plenum Cable, 18 in. (45 cm) Appliance Wire
   i. Locations must be rated NEMA 2, IEC IP31. (Indoor Use Only.) Actuators with terminal block or plenum cable leads are plenum rated per UL file number E9429.
   j. Agency Listings: ISO 9001, cULus, and CE.
   k. Basis of Design: Schneider Electric VBB/VBS, or approved equal.

b. ½" to 3" 2-way and ½" to 2" 3-way Ball Valves Actuators
   a. Size for torque required for valve close-off pressure for system design.
   b. Actuators are to be available in spring return (SR) and non-spring return (NSR) models. Spring Return (SR) actuators are to provide a choice to return direction.
   c. Actuators are to be available in models for two-position, floating and proportional control.
   d. All actuator models are to be equipped with pigtail leads, manual override, and auxiliary switch(es)
   e. Operating temperatures' Floating Non-Spring Return (NSR) with 33 lb.-in. of torque must be -25 to 130 °F (-32 to 55°C). All other actuators are to -22 to 140 °F (-30 to 60 °C)
   f. Actuators must be NEMA 2 rated.
   g. Agency Listings: ISO 9001, cULus, and CE.
   h. Basis of Design: Schneider Electric VB-2000, or approved equal.

c. ½" to 2" Bronze, Linear Globe Valve Actuators/67 or 78 lbs. force

a. Actuator must have bi-color LED status indication for motion indication, auto calibration and alarm notification.
b. When the actuator is properly mounted must have a minimum of a NEMA 2 (IP53) rating.
c. Actuators are to be non-spring return.
d. Actuators are to be floating (used for two-position) or proportional models.
e. Proportional models will have optional models with a position output signal with field selectable 2…10 Vdc and 0…10 Vdc input signals and selectable input signal direct or reverse acting.
f. Actuator must have auto calibration which provides precise control by scaling the input signal to match the exact travel of the valve stem
g. Actuators must come in models with Pulse Width Modulated (PWM) with field selectable 0.59 to 2.93 sec and 0.1 to 25.5 sec input signal ranges with a position output signal
h. Actuators must have manual override with automatic release.
i. Models with position feedback output signal include field selectable 2…10 Vdc or 0…5 Vdc output signal
j. Removable wiring screw terminal with ½" conduit opening.
k. Actuator agency Listings: cUL-us LISTED mark, NEMA 2, NEC class 2 FCC part-15 class B, Canadian ICES-003, ESA registered, Plenum rated per UL 20430
l. Basis of Design: Schneider Electric MG350V, or approved equal.

d. ½" to 2" Bronze, Linear Globe Valve Actuators/105 lbs. force
a. Actuators must have Two- Position, Floating, and Proportional models.
b. Proportional models will a controller input signal of either a 0…10 Vdc, 2…10 Vdc, 4…20 mAdc, 0…3 Vdc, or 6…9 Vdc. Control function direct/reverse action is switch selectable on most models.
c. Actuator force is to be 105 lb. (467 newton) with ½" (13 mm) nominal linear stroke
d. Power requirements 24 Vac, 120 Vac or 230 Vac depending on model.
e. Actuator housings rated for up to NEMA 2/ IP54.
f. Actuator is to have overload protection throughout stroke.
g. Actuator must automatically set input span to match valve travel.
h. Actuator must have manual override to allow positioning of valve and preload.
i. Actuator is to be spring return.
j. Actuator is to mount directly to valves without separate linkage.
k. Actuator agency Listings: UL 873, CUL: UL
l. Basis of Design: Schneider Electric SmartX Mx51-7103, or approved equal

e. ½" to 2" Bronze, Linear Globe Valve Actuators/220 lbs. force
a. Actuators must have Two- Position for a SPST controller, Floating for a SPST controller, and Proportional models will a controller input signal of either a 0…10 Vdc, 2…10 Vdc, 4…20 mAdc, or 6…9 Vdc. Control function direct/reverse action is jumper selectable
b. Actuator is to be spring return.
c. Actuator will have 220 lb. force (979 newton) with ½" (13 mm) or 1" (25 mm) nominal linear stroke
d. Feedback on proportional model with 2…10 Vdc (max. 0.5 mA) output signal or to operate up to four like additional slave actuators.
e. Actuator must automatically set input span to match valve travel
f. Actuator is to have a 24 Vac power supply on Two-position and Proportional models and 120 Vac on Two-position models.
g. Actuator housings rated for up to NEMA 2/ IP54
h. Actuator must have manual override to allow positioning of valve and preload

i. Actuator is to mount directly to vales without separate linkage.
j. Actuator agency Listings: UL 873, CUL: UL
k. Basis of Design: Schneider Electric SmartX Mx51-720x, or approved equal.

f. ½" to 2" Bronze, Linear Globe Valve Actuators with linkage SR
   a. Actuators with 35, 60, 133, or 150 lb.-in of force depending on model.
   b. Actuator housings rated for up to NEMA 2/ IP54 with a 150 lb.-in. rated a NEMA 4.
   c. Actuators are to be spring return.
   d. Actuators are to have Two-position, Floating and Proportional models.
   e. Actuators must have overload protection throughout rotation.
   f. Actuator have an optional built-in auxiliary switch to provide for interfacing or signaling on selected models.
   g. Actuator agency listings: UL-873, C22-2 No.24-83, CUL0
   h. Basis of Design: Schneider Electric SmartX, or approved equal.

g. ½" to 2" Bronze Body, Linear Globe Valve Actuators with linkage SR & NSR
   a. Actuators are to be either floating SPDT control or proportional control 0…10, 2…10 Vdc or 4…20 mA with a 500-ohm resistor included.
   b. Actuators are to be direct/reverse with selectable DIP switches.
   c. Actuators are to have 90 lb. (400N), 180 lb. (800N), or 337 lb. (1500N) of force on Non-Spring Return (NSR) 157 lb. of force on the Spring Return model. Note: Not every actuator is for every valve.
   d. Actuators are to be powered with 24 Vac or 24 Vdc.
   e. All Non-Spring Return (NSR) actuators are to be NEMA 2, vertical mount only. Spring Return (SR) actuators are to have NEMA 4 models.
   f. Actuators must have manual override to allow positioning of the valve.
   g. Actuators must have selectable valve sequencing and flow curves of either equal percentage or linear.
   h. Actuators must have feedback.
   i. Actuators must have internal torque protection throughout stroke.
   j. 90°F (32°C) ambient at 366°F (186°C) fluid temperature
   k. Actuator agency listings (North America) UL873, cULus, RCM, CE
   l. Basis of Design: Schneider Electric Forta M400A-VB, M800A-VB, M900A and M1500x-VB screw mounted on Venta VB7000s, or approved equal.

h. 2 ½" to 6" Cast Iron Flanged Globe Valve Linear Actuators with linkage
   a. Actuators are to be either floating SPDT control or proportional control 0…10, 2…10 Vdc or 4…20 mA with a 500-ohm resistor included.
   b. Actuators are to direct/reverse acting with selectable DIP switch.
   c. Actuators are to have 180 lb. (800N) or 337 lb. (1500N) of force.
   d. Actuators will need a 24 Vac or Vdc power supply.
   e. Actuators are to be rated NEMA 2, vertical mount only.
   f. Actuators must have manual override to allow positioning of the valve.
   g. Actuators must have selectable valve sequencing and flow curves of either equal percentage to linear. A 2…10 Vac feedback.
   h. Actuators must have Internal torque protection throughout stroke.
   i. 90°F (32°C) ambient at 366°F (186°C) fluid temperature
   j. Actuator agency listings (North America) UL873, cULus, RCM, CE
   k. Basis of Design: Schneider Electric Forta M800A and M1500A, or approved equal.

i. 2" to 18" 2-Way and 2" to 16" 3-Way Linear Butterfly Valve Actuator with linkage NSR

a. The butterfly valve actuators are to be Non-Spring Return (NSR) two-position and proportional taking 0…10 Vdc or 4…20 mA models. All Actuators are to be NEMA 4, manual override (hand wheel) two auxiliary switches, and built-in heater.
b. Actuator close-offs and CVs must be appropriate for the valve size in a typical HVAC application.
c. Actuators must be available in 24 Vac and 120 Vac models.
d. Actuators must have Internal wiring isolation for parallel wiring multiple units that eliminates the risk of feedback from one actuator to another.
e. Proportional models must have feedback of 0…10 Vdc or 4…20 mA.
f. Actuator operating temperature shall be -40…150°F (-40…60°C).
g. Actuator agency listings (North America) UL, CSA and CE
h. Basis of Design: Schneider Electric S70, or approved equal.

j. 2" to 4" 2-Way and 3-Way Butterfly Valve Actuators SR
a. The butterfly valve actuators are to be Spring Return (SR) two-position and proportional taking 2…10 Vdc or 4…20 mA models. All Actuators are to be NEMA
b. 2.
c. Actuator close-offs and CVs must be appropriate for the valve size in a typical HVAC application.
d. Actuators must be available in 24 Vac models.
e. Actuators shall have two SPDT auxiliary switch models.
f. Actuators must have [Internal wiring isolation for parallel wiring multiple units that eliminates the risk of feedback from one actuator to another.
g. Proportional models must have feedback of 2…10 Vdc or 4…20 mA.
h. Actuator agency listings (North America) UL, CSA and CE
i. Basis of Design: Schneider Electric SmartX Mx-41-7153, or approved equal.

k. 2" to 6" 2-Way and 3-Way Butterfly Valve Actuators NSR
a. The butterfly valve actuators are to be Non-Spring Return (NSR) two-position and proportional taking 0…10 Vdc or 4…20 mA models. All Actuators are to be NEMA 2.
b. Actuator close-offs and CVs must be appropriate for the valve size in a typical HVAC application.
c. Actuators must be available in 24 Vac models.
d. Actuators shall have two SPDT auxiliary switch models.
e. Actuators must have [Internal wiring isolation for parallel wiring multiple units that eliminates the risk of feedback from one actuator to another.
f. Proportional models must have feedback of 2…10 Vdc or 4…20 mA.
g. Actuator agency listings (North America) UL, CSA and CE
h. Basis of Design: Schneider Electric SmartX NR-22xx-5xx, or approved equal.

Q. Dampers

1. Automatic dampers, furnished by the Building Automation Contractor shall be single or multiple blade as required. Dampers are to be installed by the HVAC Contractor under the supervision of the BAS Contractor. All blank-off plates and conversions necessary to install smaller than duct size dampers are the responsibility of the Sheet Metal Contractor.
2. Damper frames are to be constructed of 13 gauge galvanized sheet steel mechanically joined with linkage concealed in the side channel to eliminate noise as friction. Compressible spring stainless steel side seals and acetyl or bronze bearings shall also be provided.
3. Damper blade width shall not exceed eight inches. Seals and 3/8 inch square steel zinc plated pins are required. Blade rotation is to be parallel or opposed as shown on the schedules.

4. For high performance applications, control dampers will meet or exceed the UL Class I leakage rating.
5. Control and smoke dampers shall be Ruskin, or approved equal.
6. Provide opposed blade dampers for modulating applications and parallel blade for two position control.

R. Damper Actuators

1. Direct-coupled type non-hydraulic designed for minimum 100,000 full-stroke cycles at rated torque.
2. Direct-coupled damper actuators must have a five-year warrantee.
3. Size for torque required for damper seal at maximum design conditions and valve close-off pressure for system design.
4. Overload protected electronically throughout rotation except for selected Floating actuators the have a mechanical clutch.
5. Spring Return Actuators: Mechanical fail safe shall incorporate a spring-return mechanism.
6. Non-Spring Return Actuators shall stay in the position last commended by the controller with an external manual gear release to allow positioning when not powered.
7. Power Requirements: 24Vac/dc [120Vac] [230Vac]
8. Proportional Actuators controller input range from 0…10 Vdc, 2…10 Vdc or 4…20 mA models.
9. Housing: Minimum requirement NEMA type 2
10. Actuators with a microprocessor should not be able to be modified by an outside source (cracked or hacked).
11. Actuators of 133 and 270 lb.-in. of torque or more should be able to be tandem mount or “gang” mount.
12. Agency Listings: ISO 9001, cULus, CE and CSA
13. Basis of Design: Schneider Electric SmartX Actuators, or approved equal.

S. Smoke Detectors

1. Air duct smoke detectors shall be by Air Products & Controls or approved equal. The detectors shall operate at air velocities from 300 feet per minute to 4000 feet per minute.
2. The smoke detector shall utilize a photoelectric detector head.
3. The housing shall permit mechanical installation without removal of the detector cover.
4. The detectors shall be listed by Underwriters Laboratories and meet the requirements of UL 268A.

T. Airflow Measuring Stations

1. Provide a thermal anemometer using instrument grade self heated thermistor sensors with thermistor temperature sensors.
2. The flow station shall operate over a range of 0 to 5,000 feet/min with an accuracy of +/- 2% over 500 feet/min and +/- 10 ft/min for reading less than 500 feet/min.

PART 3 - EXECUTION

3.1 CONTRACTOR RESPONSIBILITIES

A. General

1. Installation of the building automation system shall be performed by the Contractor or a subcontractor. However, all installation shall be under the personal supervision of the Contractor. The Contractor shall certify all work as proper and complete. Under no circumstances shall the

design, scheduling, coordination, programming, training, and warranty requirements for the project be delegated to a subcontractor.

B. Access to Site

1. Unless notified otherwise, entrance to building is restricted. No one will be permitted to enter the building unless their names have been cleared with the Owner or the Owner's Representative.

C. Code Compliance

1. All wiring shall be installed in accordance with all applicable electrical codes and will comply with equipment manufacturer's recommendations. Should any discrepancy be found between wiring specifications in Division 17 and Division 16, wiring requirements of Division 17 will prevail for work specified in Division 17.

D. Cleanup

1. At the completion of the work, all equipment pertinent to this contract shall be checked and thoroughly cleaned, and all other areas shall be cleaned around equipment provided under this contract.

3.2 WIRING, CONDUIT, AND CABLE

A. All wire will be copper and meet the minimum wire size and insulation class listed below:

Wire Class	Wire Size	Isolation Class
Power	12 Gauge	600 Volt
Class One	14 Gauge Std.	600 Volt
Class Two	18 Gauge Std.	300 Volt
Class Three	18 Gauge Std.	300 Volt
Communications	Per Mfr.	Per Mfr.

B. Power and Class One wiring may be run in the same conduit. Class Two and Three wiring and communications wiring may be run in the same conduit.

C. Where different wiring classes terminate within the same enclosure, maintain clearances and install barriers per the National Electric Code.

D. Where wiring is required to be installed in conduit, EMT shall be used. Conduit shall be minimum 1/2 inch galvanized EMT. Set screw fittings are acceptable for dry interior locations. Watertight compression fittings shall be used for exterior locations and interior locations subject to moisture. Provide conduit seal-off fitting where exterior conduits enter the building or between areas of high temperature/moisture differential.

E. Flexible metallic conduit (max. 3 feet) shall be used for connections to motors, actuators, controllers, and sensors mounted on vibration producing equipment. Liquid-tight flexible conduit shall be use in exterior locations and interior locations subject to moisture.

F. Junction boxes shall be provided at all cable splices, equipment termination, and transitions from EMT to flexible conduit. Interior dry location J-boxes shall be galvanized pressed steel, nominal four-inch square with blank cover. Exterior and damp location JH-boxes shall be cast alloy FS boxes with threaded hubs and gasketed covers.

G. Where the space above the ceiling is a supply or return air plenum, the wiring shall be plenum rated. Teflon wiring can be run without conduit above suspended ceilings. EXCEPTION: Any wire run in suspended ceilings that is used to control outside air dampers or to connect the system to the fire management system shall be in conduit.

H. Fiber optic cable shall include the following sizes; 50/125, 62.5/125 or 100/140.

I. Only glass fiber is acceptable, no plastic.

J. Fiber optic cable shall only be installed and terminated by an experienced contractor. The BAS contractor shall submit to the Engineer the name of the intended contractor of the fiber optic cable with his submittal documents.

3.3 HARDWARE INSTALLATION PRACTICES FOR WIRING

A. All controllers are to be mounted vertically and per the manufacturer's installation documentation.
B. The 120VAC power wiring to each Ethernet or Remote Site controller shall be a dedicated run, with a separate breaker. Each run will include a separate hot, neutral and ground wire. The ground wire will terminate at the breaker panel ground. This circuit will not feed any other circuit or device.
C. A true earth ground must be available in the building. Do not use a corroded or galvanized pipe, or structural steel.
D. Wires are to be attached to the building proper at regular intervals such that wiring does not droop. Wires are not to be affixed to or supported by pipes, conduit, etc.
E. Conduit in finished areas will be concealed in ceiling cavity spaces, plenums, furred spaces and wall construction. Exception; metallic surface raceway may be used in finished areas on masonry walls. All surface raceway in finished areas must be color matched to the existing finish within the limitations of standard manufactured colors.
F. Conduit, in non-finished areas where possible, will be concealed in ceiling cavity spaces, plenums, furred spaces, and wall construction. Exposed conduit will run parallel to or at right angles to the building structure.
G. Wires are to be kept a minimum of three (3) inches from hot water, steam, or condensate piping.
H. Where sensor wires leave the conduit system, they are to be protected by a plastic insert.
I. Wire will not be allowed to run across telephone equipment areas.
J. Provide fire caulking at all rated penetrations.

3.4 INSTALLATION PRACTICES FOR FIELD DEVICES

A. Well-mounted sensors will include thermal conducting compound within the well to insure good heat transfer to the sensor.
B. Actuators will be firmly mounted to give positive movement and linkage will be adjusted to give smooth continuous movement throughout 100 percent of the stroke.
C. Relay outputs will include transient suppression across all coils. Suppression devices shall limit transients to 150% of the rated coil voltage.
D. Water line mounted sensors shall be removable without shutting down the system in which they are installed.
E. For duct static pressure sensors, the high pressure port shall be connected to a metal static pressure probe inserted into the duct pointing upstream. The low pressure port shall be left open to the plenum area at the point that the high pressure port is tapped into the ductwork.
F. For building static pressure sensors, the high pressure port shall be inserted into the space via a metal tube. Pipe the low pressure port to the outside of the building.

3.5 ENCLOSURES

A. For all I/O requiring field interface devices, these devices where practical will be mounted in a field interface panel (FIP). The Contractor shall provide an enclosure which protects the device(s) from dust, moisture, conceals integral wiring and moving parts.
B. FIPs shall contain power supplies for sensors, interface relays and contactors, and safety circuits.
C. The FIP enclosure shall be of steel construction with baked enamel finish; NEMA 1 rated with a hinged door and keyed lock. The enclosure will be sized for twenty percent spare mounting space. All locks will be keyed identically.

D. All wiring to and from the FIP will be to screw type terminals. Analog or communications wiring may use the FIP as a raceway without terminating. The use of wire nuts within the FIP is prohibited.
E. All outside mounted enclosures shall meet the NEMA-4 rating.
F. The wiring within all enclosures shall be run in plastic track. Wiring within controllers shall be wrapped and secured.

3.6 IDENTIFICATION

A. Identify all control wires with labeling tape or sleeves using words, letters, or numbers that can be exactly cross-referenced with as-built drawings.
B. All field enclosures, other than controllers, shall be identified with a Bakelite nameplate. The lettering shall be in white against a black or blue background.
C. Junction box covers will be marked to indicate that they are a part of the BAS system.
D. All I/O field devices (except space sensors) that are not mounted within FIP's shall be identified with name plates.
E. All I/O field devices inside FIP's shall be labeled.

3.7 LOCATION

A. The location of sensors is per mechanical and architectural drawings.
B. Space humidity or temperature sensors will be mounted away from machinery generating heat, direct light and diffuser air streams.
C. Outdoor air sensors will be mounted on the north building face directly in the outside air. Install these sensors such that the effects of heat radiated from the building or sunlight is minimized.
D. Field enclosures shall be located immediately adjacent to the controller panel(s) to which it is being interfaced.

3.8 SOFTWARE INSTALLATION

A. General.
    1. The Contractor shall provide all labor necessary to install, initialize, start-up and debug all system software as described in this section. This includes any operating system software or other third party software necessary for successful operation of the system.

3.9 DATABASE CONFIGURATION.

A. The Contractor will provide all labor to configure those portions of the database that are required by the points list and sequence of operation.

3.10 COLOR GRAPHIC DISPLAYS.

A. Unless otherwise directed by the owner, the Contractor will provide color graphic displays as depicted in the mechanical drawings for each system and floor plan. For each system or floor plan, the display shall contain the associated points identified in the point list and allow for setpoint changes as required by the owner.

3.11 REPORTS.

A. The Contractor will configure a minimum of 4 reports for the owner. These reports shall, at a minimum, be able to provide:
    1. Trend comparison data
    2. Alarm status and prevalence information
    3. Energy Consumption data

4. System user data

3.12 DOCUMENTATION

A. As built software documentation will include the following:
   1. Descriptive point lists
   2. Application program listing
   3. Application programs with comments.
   4. Printouts of all reports.
   5. Alarm list.
   6. Printouts of all graphics
   7. Commissioning and System Startup
   8. An electronic copy of all databases, configuration files, or any type of files created specifically for each system.

3.13 POINT TO POINT CHECKOUT.

A. Each I/O device (both field mounted as well as those located in FIPs) shall be inspected and verified for proper installation and functionality. A checkout sheet itemizing each device shall be filled out, dated and approved by the Project Manager for submission to the owner or owner's representative.

3.14 CONTROLLER AND WORKSTATION CHECKOUT.

A. A field checkout of all controllers and front end equipment (computers, printers, modems, etc.) shall be conducted to verify proper operation of both hardware and software. A checkout sheet itemizing each device and a description of the associated tests shall be prepared and submitted to the owner or owner's representative by the completion of the project.

3.15 SYSTEM ACCEPTANCE TESTING

A. All application software will be verified and compared against the sequences of operation.
B. Control loops will be exercised by inducing a setpoint shift of at least 10% and observing whether the system successfully returns the process variable to setpoint. Record all test results and attach to the Test Results Sheet.
C. Test each alarm in the system and validate that the system generates the appropriate alarm message, that the message appears at all prescribed destinations (workstations or printers), and that any other related actions occur as defined (i.e. graphic panels are invoked, reports are generated, etc.). Submit a Test Results Sheet to the owner.

D. Perform an operational test of each unique graphic display and report to verify that the item exists, that the appearance and content are correct, and that any special features work as intended. Submit a Test Results Sheet to the owner.

E. Perform an operational test of each third party interface that has been included as part of the automation system. Verify that all points are properly polled, that alarms have been configured, and that any associated graphics and reports have been completed. If the interface involves a file transfer over Ethernet, test any logic that controls the transmission of the file, and verify the content of the specified information.

END OF SECTION 23 0900

SECTION 23 0993

POINTS LIST AND 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

1. This Section includes control sequences for HVAC systems, subsystems, and equipment.

B. Related Sections include the following:

1. Division 23 Section "Instrumentation and Control for HVAC" for control equipment and devices and for submittal requirements.

1.3 DEFINITIONS

A. BAS: Building Automation System.

B. DDC: Direct digital control.

1.4 POINTS LIST

A. CHILLER PLANT

CHILLER PLANT INPUT/OUTPUT POINTS LIST						
POINT DESCRIPTION	POINT TYPE	HARDWIRED OR COMM	DISPLAY ON GRAPHIC	ALARM	TREND	REMARKS
SYSTEM GRAPHIC			X			
CH-1 ENABLE/DISABLE	DO	HW	X		X	
CH-1 ON/OFF STATUS	DI	HW	X		X	
CH-1 REMOTE CHILLED WATER SUPPLY TEMPERATURE SETPOINT ADJUSTMENT	AO	HW	X		X	
CH-1 ACTIVE CHILLED WATER SUPPLY TEMPERATURE SETPOINT	AI	COMM	X		X	
CH-1 SUPPLY TEMPERATURE	AI	HW	X	X	X	
CH-1 RETURN TEMPERATURE	AI	HW	X		X	
CH-1 CHILLED WATER FLOW (GPM)	AI	HW	X		X	
CH-1 ACTUAL RUNNING CAPACITY (%)	AI	COMM	X		X	
CH-1 KW	DO	COMM	X		X	
CH-1 COMPRESSOR 1 ON/OFF STATUS	DI	COMM	X		X	
CH-1 COMPRESSOR 2 ON/OFF STATUS	DI	COMM	X		X	
CH-1 COMPRESSOR 3 ON/OFF STATUS	DI	COMM	X		X	
CH-1 COMPRESSOR 4 ON/OFF STATUS	DI	COMM	X		X	
CH-1 FAULT	DI	HW	X	X	X	
CH-1 GENERAL ALARM	DI	HW	X	X	X	
CH-1 GENERAL ALARM RESET	DO	HW	X		X	
ACTIVE CURRENT LIMIT SETPOINT (%)	AI	COMM	X			
ACTIVE DEMAND LIMIT SETPOINT (%)	AI	COMM	X			
ACTUAL OPERATING CAPACITY (%)	AI	COMM	X			
CHILLER POWER CONSUMPTION (%)	AI	COMM	X			
EVAPORATOR ENTERING WATER TEMPERATURE	AI	COMM	X			
EVAPORATOR LEAVING WATER TEMPERATURE	AI	COMM	X			
OUTDOOR AIR TEMPERATURE	AI	COMM	X			
CHILLER RUN STATUS (STANDBY/RUNNING)	DI	COMM	X			
CHILLER CAPACITY LIMITED STATUS	DI	COMM	X			
CHILLER RUN STATUS (OFF/RUNNING)	DI	COMM	X			
CHILLER MAXIMUM CAPACITY STATUS	DI	COMM	X			
EVAPORATOR CHW FLOW STATUS	DI	COMM	X			
CHILLED WATER BYPASS VALVE POSITION COMMAND	AO	HW	X		X	
CHILLED WATER BYPASS VALVE POSITION FEEDBACK	AI	HW	X		X	
SYSTEM DIFFERENTIAL SYSTEM PRESSURE SENSOR	AI	HW	X	X	X	
CHP-1 STATUS	DI	HW	X	X	X	DIFFERENTIAL PRESSURE SWITCH
CHP-1 VFD STATUS	DI	HW	X	X	X	
CHP-1 VFD SPEED COMMAND	AO	HW	X		X	
CHP-1 VFD REFERENCE SPEED	AI	HW	X		X	
CHP-1 VFD KW	AI	COMM	X		X	
CHP-1 VFD KWH COUNTER	AI	COMM	X		X	
CHP-1 VFD GENERAL ALARM	DI	HW	X	X	X	
CHP-2 STATUS	DI	HW	X	X	X	DIFFERENTIAL PRESSURE SWITCH
CHP-2 VFD STATUS	DI	HW	X	X	X	
CHP-2 VFD SPEED COMMAND	AO	HW	X		X	
CHP-2 VFD REFERENCE SPEED	AI	HW	X		X	
CHP-2 VFD KW	AI	COMM	X		X	
CHP-2 VFD KWH COUNTER	AI	COMM	X		X	
CHP-2 VFD GENERAL ALARM	DI	HW	X	X	X	
NOTE(S)						
1. DO=DIGITAL OUTPUT, DI=DIGITAL INPUT, AO=ANALOG INPUT, HW=HARDWIRED, COMM=COMMUNCIATION CABLE.						

B. Air Handling Units

TYPICAL AHU INPUT/OUTPUT POINTS LIST						
POINT DESCRIPTION	POINT TYPE	HARDWIRED OR COMM	DISPLAY ON GRAPHIC	ALARM	TREND	REMARKS
SYSTEM GRAPHIC			X			
SUPPLY FAN VFD STATUS	AI	HW	X			
SUPPLY FAN VFD SPEED COMMAND	AO	HW	X			
SUPPLY FAN VFD REFERENCE SPEED	AI	HW	X	X		
SUPPLY FAN VFD GENERAL ALARM	DI	HW	X	X		
SUPPLY FAN VFD KW	AI	COMM	X			
SUPPLY FAN VFD KWH COUNTER	AI	COMM	X			
SUPPLY FAN VFD KWH COUNTER RESET	AI	COMM	X			
SMOKE DETECTOR	DI	HW	X	X		
RETURN AIR DAMPER POSITION	AO	HW	X			
RETURN AIR DAMPER FEEDBACK POSITION	AI	HW	X	X		
OUTSIDE AIR DAMPER POSITION	AO	HW	X			
OUTSIDE AIR DAMPER FEEDBACK POSITION	AI	HW	X	X		
MIXED AIR TEMPERATURE	AI	HW	X			
FILTER DIFFERENTIAL PRESSURE	DI	HW	X	X		
FREEZE STAT	DI	HW	X	X		
CHILLED WATER VALVE POSITION	AO	HW	X			
CHILLED WATER FEEDBACK POSITION	AI	HW	X	X		
HIGH STATIC PRESSURE SWITCH	DI	HW	X	X		
SUPPLY AIR TEMPERATURE	AI	HW	X	X		
DUCT STATIC PRESSURE	AI	HW	X			
NOTE(S)						
1. DO=DIGITAL OUTPUT, DI=DIGITAL INPUT, AO=ANALOG INPUT, HW=HARDWIRED, COMM=COMMUNCIATION CABLE.						

C. VAV Boxes

TYPICAL VAV TERMINAL BOX INPUT/OUTPUT POINTS LIST						
POINT DESCRIPTION	POINT TYPE	HARDWIRED OR COMM	DISPLAY ON GRAPHIC	ALARM	TREND	REMARKS
SYSTEM GRAPHIC			X			
DAMPER POSITION COMMAND (%)	DO	HW	X			
DAMPER POSITION REFERENCE (%)	DI	HW	X	X		
OUTLET TEMPERATURE (°F)	DI	HW	X			
ELECTRIC HEATER (%)	DO	HW	X			
SPACE TEMPERATURE SETPOINT (°F)	AO	HW	X			
SPACE TEMPERATURE (°F)	AI	HW	X	X		
SPACE RELATIVE HUMIDITY (% RH)	AI	HW	X			
NOTE(S)						
1. DO=DIGITAL OUTPUT, DI=DIGITAL INPUT, AO=ANALOG INPUT, HW=HARDWIRED, COMM=COMMUNCIATION CABLE.						

D. Exhaust Fans

TYPICAL BATHROOM EXHAUST FAN INPUT/OUTPUT POINTS LIST						
POINT DESCRIPTION	POINT TYPE	HARDWIRED OR COMM	DISPLAY ON GRAPHIC	ALARM	TREND	REMARKS
SYSTEM GRAPHIC			X			
ON/OFF COMMAND	DO	HW	X			
ON/OFF STATUS	DI	HW	X	X		DIFFERENTIAL PRESSURE SWITCH
NOTE(S)						
1. DO=DIGITAL OUTPUT, DI=DIGITAL INPUT, AO=ANALOG INPUT, HW=HARDWIRED, COMM=COMMUNCIATION CABLE.						

E. Smoke Removal Fan

SMOKE REMOVAL FAN INPUT/OUTPUT POINTS LIST						
POINT DESCRIPTION	POINT TYPE	HARDWIRED OR COMM	DISPLAY ON GRAPHIC	ALARM	TREND	REMARKS
SYSTEM GRAPHIC			X			
ON/OFF COMMAND	DO	HW	X			
ON/OFF STATUS	DI	HW	X	X		DIFFERENTIAL PRESSURE SWITCH
NOTE(S)						
1. DO=DIGITAL OUTPUT, DI=DIGITAL INPUT, AO=ANALOG INPUT, HW=HARDWIRED, COMM=COMMUNCIATION CABLE.						

F. SEWAGE SUMP PUMP

SEWAGE SUMP PUMP INPUT/OUTPUT POINTS LIST						
POINT DESCRIPTION	POINT TYPE	HARDWIRED OR COMM	DISPLAY ON GRAPHIC	ALARM	TREND	REMARKS
SYSTEM GRAPHIC			X			
PUMP #1 STATUS	DI	HW	X			
PUMP #2 STATUS	DI	HW	X			
ALARM	DI	HW	X	X		
NOTE(S)						
1. DO=DIGITAL OUTPUT, DI=DIGITAL INPUT, AO=ANALOG INPUT, HW=HARDWIRED, COMM=COMMUNCIATION CABLE.						

G. AREA WAY SUMP PUMP

AREA WAY SUMP PUMP INPUT/OUTPUT POINTS LIST						
POINT DESCRIPTION	POINT TYPE	HARDWIRED OR COMM	DISPLAY ON GRAPHIC	ALARM	TREND	REMARKS
SYSTEM GRAPHIC			X			
PUMP STATUS (ON/OFF)	DI	HW	X			
ALARM	DI	HW	X	X		
NOTE(S)						
1. DO=DIGITAL OUTPUT, DI=DIGITAL INPUT, AO=ANALOG INPUT, HW=HARDWIRED, COMM=COMMUNCIATION CABLE.						

1.5 SEQUENCE OF OPERATIONS FOR CHILLER PLANT

A. GENERAL DESCRIPTION: The chilled water plant is configured as a variable primary flow system and consist of one air-cooled chillers and two variable flow chilled water pumps. The chilled water pumps are in a lead-standby arrangement.

B. SETPOINTS: Setpoints for the system shall be determined as follows:

1. The chilled water supply temperature setpoint shall be set initially at 42 deg F (adj):
2. The chilled water loop differential pressure setpoint shall be set initially at 10 psig (adj.). The final chilled water loop differential pressure setpoints shall be established by the Test and Balance Contractor.
3. The design minimum chilled water flow setpoint for the chiller shall be 20% (adj.) greater than the recommended minimum chilled water flow established by the chiller manufacturer.

C. SYSTEM OFF: When the system is off:
1. The chilled water pumps shall be disabled.
2. The chiller shall be disabled.
3. All control loops for the chilled water plant shall be disabled.

D. INITIATION OF SYSTEM STARTUP: The system shall be started either of the followings:
1. Manually by an operator entered command.
2. Automatically by the building automation system.

E. CHILLER START SEQUENCE:
1. The chilled water pump shall start.
2. The BAS shall enable the chiller.

F. CHILLER STOP SEQUENCE:
1. The chilled water pump shall stop and be disabled.
2. The BAS shall disable the chiller.

G. CHILLED WATER PUMP ROTATION: Chillers CH-1 and CH-2 shall be operated in a lead-standby arrangement. The lead-standby status of each chilled water pump shall be alternated by any of the following methods:
1. Manually by an operator entered command at the BAS.
2. Automatically based on a user defined time period (daily, weekly, monthly, etc.).
3. Automatically by the BAS in response to a chilled water pump failure.

H. CHILLER OPERATION: When enabled, the chiller shall operate in response to its onboard controls and safeties to maintain its chilled water supply temperature setpoint.

I. CHILLED WATER PUMP OPERATION:
1. The chilled water loop differential pressure shall be measured by a chilled water differential pressure transmitter located two-thirds the distance to the most remote air handling unit.
2. The BAS shall modulate the speed of the lead chilled water pump's variable frequency drive to maintain the chilled water loop differential pressure setpoint. However, the speed of the variable frequency drives shall not be reduced to a point such that the chilled water flow through the chiller falls below its design minimum flow. The speed of the variable frequency drive for the chilled water pump shall remain fixed when the chilled water bypass valve is open.
3. If the lead chilled water pump fails to start as commanded or fails while in service:
    a. The BAS shall initiate the start sequence for the standby pump and designate it as "Lead".
    b. The BAS shall initiate the stop sequence for the failed chilled water pump and designate it as "Out of Service".

J. CHILLED WATER SYSTEM BYPASS VALVE OPERATION: The chilled water bypass valve shall operate as follows:
1. If the chilled water flow rate through the chiller is above its design minimum flow, the chilled water bypass valve shall be closed.

2. If the chilled water flow rate through the chiller is at the design minimum flow and the chilled water loop differential pressure rises above setpoint, the BAS shall modulate the chilled water bypass valve open to maintain chilled water loop differential setpoint.
3. If the chilled water flow rate through the chiller is at the design minimum flow and the chilled water loop differential pressure falls below setpoint, the BAS shall modulate the chilled water bypass valve closed to maintain chilled water loop differential setpoint.

K. INITIATION OF SYSTEM SHUTDOWN: The chilled water system shutdown shall be initiated either of the following:
1. Manually by an operator entered command at the BAS.
2. Automatically by the BAS.

L. SYSTEM SHUT DOWN PROCEDURE:
1. The BAS shall initiate the stop sequence for the chiller.

M. POWER FAILURE: When a power failure or BAS component failure occurs:
1. The operating chilled water pump shall remain at the last commanded state.
2. Chiller shall remain at the last commanded state.
3. Control valves shall remain at the last commanded state.
4. Operating chillers, pumps, and control valves shall resume operations at the last commanded state when power is restored.

N. LOSS OF COMMUNICATION: When a communications loss occurs:
1. If a local field controller loses communication with the BAS network, an alarm shall be generated at the operator workstation indicating a loss of communication with the field controller.
2. If the operating chilled water pump variable frequency drive loses communication with the local field controller (enable/disable, reference speed, speed command, or status), configure control logic such that a loss of control signal to the variable frequency drive will cause the pump to operate at full speed (rpm).
3. If the chiller controller loses communication with a local field controller, an alarm shall be generate at the operator workstation indicating a loss of communication.

O. BAS ALARMS: The BAS shall generate an alarm for the following conditions:
1. If the chiller fails.
2. If the chilled water pump fails.
3. If the chilled water supply temperature is outside of the operator established high or low limit for a time period of 30 minutes (adj.). These limits shall be set initially at the setpoint plus or minus 2°F (adj.).
4. If a field controller loses communication with the BAS network.
5. If a chilled water pump variable frequency drive loses communication with the BAS network.

1.6 TYPICAL SEQUENCE OF OPERATION FOR AIR HANDLING UNITS

A. GENERAL DESCRIPTION: THIS IS VARIABLE AIR VOLUME AIR HANDLING UNIT WITH RETURN AIR DAMPER, OUTSIDE AIR DAMPER, FILTER SECTION, CHILLED WATER COIL, SUPPLY FAN, and OUTSIDE AIR FAN.

B. SETPOINTS: Setpoints for the system shall be determined as follows:
1. The supply air temperature setpoint shall be set initially at 55 deg F (adj.). The supply air temperature setpoint shall be reset to 52 deg F (adj. but not less than 50 deg F) when the return air relative humidity is greater than 60% RH (adj.)
2. The duct static pressure setpoint shall be set initially to 1.0” W.C. (adj.).
3. The freeze stat shall be initiated at 35 deg F (adj.).
4. The high static pressure switch shall initially be set to 4” W.G. (adj.).

C. SYSTEM OFF: When the system is off:
1. Outdoor air damper shall be closed.

2. Return air damper shall be closed.
3. Chilled water valve shall be closed (0% open)
4. Supply shall be turned off.
5. Outside air fan shall be off.

D. INITIATION OF SYSTEM STARTUP: The system shall be started either of the following
   1. Manually by an operator entered command.
   2. Automatically by the building automation system.

E. AIR HANDLING UNIT START SEQUENCE: The system shall be started either of the following:
   1. Open return air damper.
   2. Open outside air damper.
   3. Simultaneously start supply air fan and outside air fan.
   4. Open chilled water valve.

F. AIR HANDLING UNIT STOP SEQUENCE:
   1. Close chilled water valve.
   2. Stop supply air fan and outside air fan simultaneously.
   3. Close outside air damper.
   4. Close return air damper.

G. AIR HANDLING UNIT OPERATION:
   1. SUPPLY FAN: The supply fan shall modulate to maintain duct static pressure setpoint.
   2. OUTSIDE AIR FAN: The outside air fan shall run at constant speed while supply fan is on and turn off when supply fan is off.
   3. CHILLED WATER COIL: The chilled water valve shall modulate to maintain supply air temperature setpoint.
   4. OUTSIDE AIR DAMPER: The outside air damper shall remain 100% open when outside air fan is on and close to 0% open when outside air fan is off.
   5. RETURN AIR DAMPER: The outside air damper shall remain 100% open when supply fan is on and close to 0% open when supply air fan is off.
   6. SMOKE DETECTOR: When the smoke detector is initiated the supply fan and outside air fan shall turned off and the outside and return air dampers shall close to 0% open.
   7. FREEZE STAT: When the freeze stat is initiated the supply air fan and outside air fan shall turn off and the outside air and return air damper shall close to 0% open.
   8. HIGH STATIC PRESSURE SWITCH: When the high static pressure switch is initiated the supply air fan and outside air fan shall turn off and the outside air and return air damper shall close to 0% open.

H. INITIATION FOR SYSTEM SHUTDOWN: The air handling unit shutdown shall be initiated by either of the following:
   1. Manually by an operator entered command at BAS.
   2. Automatically by the BAS.

I. SYSTEM SHUT DOWN PROCEDURE:
   1. The BAS shall start the stop sequence for the air handler.

J. POWER FAILURE: When a power failure or BAS component failure occurs:
   1. The supply air fan shall remain at the last commanded state.
   2. The outside air fan shall remain at the last commanded state.
   3. The chilled water valve shall remain at the last commanded state.
   4. The outside air and return air damper shall remain at the last commanded state.

K. LOSS OF COMMUNICATION: When a communications loss occurs:
    1. If a local field controller loses communication with the BAS network, an alarm shall be generated at the operator workstation indicating a loss of communication with the field controller.

L. BAS ALARMS: The BAS shall generate an alarm for the following conditions:
    1. If the smoke detector is tripped.
    2. If the freeze stat is tripped.
    3. If the high duct static pressure switch is tripped.
    4. If supply air temperature setpoint has not been satisfied for 30 mins (adj.).
    5. If a field controller loses communication with the BAS network.

1.7 TYPICAL CONTROL SEQUENCE FOR VAV TERMINAL BOXES

A. GENERAL DESCRIPTION: This is a variable air volume (VAV) terminal box with motorized damper and air flow sensor.

B. SETPOINTS: Setpoints for the terminal box shall be determined as follows:
    1. The cooling temperature setpoint shall be initially set to 75 deg F (adj.) during occupied hours and 78 deg F (adj.) during unoccupied hours.
    2. The heating temperature setpoint shall be initially set to 70 deg F (adj.) during occupied hours and 68 de F (adj.) during occupied hours.

C. VAV TERMINAL BOX OPERATION:
    1. COOLING MODE: When the space temperature is 2 deg F (adj.) above cooling temperature setpoint, cooling mode shall be initiated. The damper shall modulate to maintain the space temperature setpoint. If the space temperature is below setpoint, the damper is at its minimum position, and the space relative humidity is above 55% RH the electric reheat coil shall turn on and modulate to maintain cooling temperature setpoint.
    2. HEATING MODE: When the space temperature is 2 deg F (adj.) below the heating temperature setpoint, heating mode shall be initiated. The damper shall modulate to maintain the space temperature setpoint. If the damper is at the minimum position and below the space temperature setpoint the electric reheat coil shall turn on and modulate to maintain space temperature setpoint.

D. POWER FAILURE: When a power failure or BAS component failure occurs:
    1. The motorized damper shall remain at the last commanded state.
    2. The electric heating coil shall remain at the last commanded state.

E. LOSS OF COMMUNICATION: When a loss of communication occurs:
    1. If a local field controller loses communication with the BAS network, an alarm shall be generated at the operator workstation indicating a loss of communication with the field controller.

F. BAS ALARMS: The BAS shall generate an alarm for the following conditions:
    1. If the space temperature cannot be reach for 30 minutes (adj.).

1.8 SMOKE REMOVAL EXHAUST FAN

A. Smoke removal exhaust fan shall be initiated through BAS workstation.

1.9 WALL MOUNTED AND DUCTLESS DX FAN COIL UNITS

A. Wall mounted and ductless DX fan coil units shall be control by room thermostats. Connection to BAS not required.

1.10 BATHROOM EXHAUST FAN

A. Bathroom exhaust fans shall run continuously during occupied hours.

1.11 CRAWL SPACE EXHAUST FAN

A. Crawl space exhaust fan shall be control by humidistat. Connection to BAS not required.

1.11 OCCUPIED/UNOCCUPIED HOURS SCHEDULE

A. Initial set occupancy schedule show below. Consult with building owner to confirm schedule.
    1. Occupied: Mon.-Fri. 6am-7pm
    2. Unoccupied: Mon.-Fri 12am-6am and 7pm-11:59pm, Sat-Sun 12am-11:59pm

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 23 0993

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SECTION 23 2113

HYDRONIC 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 pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
   1. Chilled-water piping.
   2. Makeup-water piping.
   3. Condensate-drain piping.
   4. Air-vent piping.
   5. Safety-valve-inlet and -outlet piping.

B. Related Sections include the following:

   1. Division 23 Section "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.

1.3 DEFINITIONS

A. PTFE: Polytetrafluoroethylene.

B. RTRF: Reinforced thermosetting resin (fiberglass) fittings.

C. RTRP: Reinforced thermosetting resin (fiberglass) pipe.

1.4 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:
   1. Chilled Water Piping: 150 psi at 50 deg F.
   2. Condensate-Drain Piping: 150 deg F
   3. Air-Vent Piping: 200 deg F.
   4. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

1.5 SUBMITTALS

A. Product Data: For each type of the following:
   1. Pressure-seal fittings.

2. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
3. Air control devices.
4. Chemical treatment.
5. Hydronic specialties.

B. Shop Drawings: Detail, at 1/4 scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops. For plan views, use minimum scale of 1/8"=1'-0".

C. Welding certificates.

D. Qualification Data: For Installer.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

G. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

B. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01.

1.7 EXTRA MATERIALS

A. Water-Treatment Chemicals: Furnish enough chemicals for initial system startup and for preventive maintenance for one year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L

B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.

C. DWV Copper Tubing: ASTM B 306, Type DWV.

D. Wrought-Copper Fittings: ASME B16.22.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Anvil International, Inc.
      b. S. P. Fittings; a division of Star Pipe Products.
      c. Victaulic Company of America.
   2. Grooved-End Copper Fittings: ASTM B 75 copper tube or ASTM B 584, bronze casting.
   3. Grooved-End-Tube Couplings: Rigid pattern, unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching pipe and fitting grooves, prelubricated EPDM gasket rated for minimum 230 deg F for use with housing, and steel bolts and nuts.

E. Copper or Bronze Pressure-Seal Fittings:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Stadler-Viega.
   2. Housing: Copper.
   3. O-Rings and Pipe Stops: EPDM.
   4. Tools: Manufacturer's special tools.
   5. Minimum 200-psig working-pressure rating at 250 deg F.

F. Wrought-Copper Unions: ASME B16.22.

2.2 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel with grooved ends; type, grade, and wall thickness as indicated in Part 3 "Piping Applications" Article.

B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in Part 3 "Piping Applications" Article.

C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in Part 3 "Piping Applications" Article.

D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 "Piping Applications" Article.

E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in Part 3 "Piping Applications" Article.

F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
   1. Material Group: 1.1.
   2. End Connections: Butt welding.
   3. Facings: Raised face.

H. Grooved Mechanical-Joint Fittings and Couplings:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Anvil International, Inc.
b. Central Sprinkler Company; a division of Tyco Fire & Building Products.
c. National Fittings, Inc.
d. S. P. Fittings; a division of Star Pipe Products.
e. Victaulic Company of America.

2. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
3. Couplings: Ductile- or malleable-iron housing and synthetic rubber gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

I. Steel Pressure-Seal Fittings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Victaulic Company of America.

2. Housing: Steel.
3. O-Rings and Pipe Stop: EPDM.
4. Tools: Manufacturer's special tool.
5. Minimum 300-psig working-pressure rating at 230 deg F.

J. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.3 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

E. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

F. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.4 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper-alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Capitol Manufacturing Company.
b. Central Plastics Company.
c. Hart Industries International, Inc.
d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
e. Zurn Plumbing Products Group; AquaSpec Commercial Products Division.

2. Factory-fabricated union assembly, for 250-psig minimum working pressure at 180 deg F.

D. Dielectric Flanges:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Capitol Manufacturing Company.
b. Central Plastics Company.
c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Factory-fabricated companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

E. Dielectric-Flange Kits:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.

2. Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
3. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

F. Dielectric Couplings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Calpico, Inc.
b. Lochinvar Corporation.

2. Galvanized-steel coupling with inert and noncorrosive thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

G. Dielectric Nipples:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Perfection Corporation; a subsidiary of American Meter Company.
b. Precision Plumbing Products, Inc.
c. Sioux Chief Manufacturing Company, Inc.
d. Victaulic Company of America.

2. Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.5 VALVES

A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC Piping."

B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 23 Section "Instrumentation and Control for HVAC."

C. Bronze, Calibrated-Orifice, Balancing Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Armstrong Pumps, Inc.
    b. Bell & Gossett Domestic Pump; a division of ITT Industries.
    c. Flow Design Inc.
    d. Gerand Engineering Co.
    e. Griswold Controls.
    f. Taco.
2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
4. Plug: Resin.
5. Seat: PTFE.
6. End Connections: Threaded or socket.
7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
8. Handle Style: Lever, with memory stop to retain set position.
9. CWP Rating: Minimum 125 psig.
10. Maximum Operating Temperature: 250 deg F.

D. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Armstrong Pumps, Inc.
    b. Bell & Gossett Domestic Pump; a division of ITT Industries.
    c. Flow Design Inc.
    d. Gerand Engineering Co.
    e. Griswold Controls.
    f. Taco.
    g. Tour & Andersson; available through Victaulic Company of America.
2. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
4. Stem Seals: EPDM O-rings.
5. Disc: Glass and carbon-filled PTFE.
6. Seat: PTFE.
7. End Connections: Flanged or grooved.
8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
9. Handle Style: Lever, with memory stop to retain set position.
10. CWP Rating: Minimum 125 psig.
11. Maximum Operating Temperature: 250 deg F.

E. Diaphragm-Operated Safety Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Amtrol, Inc.
    b. Armstrong Pumps, Inc.
    c. Bell & Gossett Domestic Pump; a division of ITT Industries.
    d. Conbraco Industries, Inc.
    e. Spence Engineering Company, Inc.
    f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Wetted, Internal Work Parts: Brass and rubber.
8. Inlet Strainer: Stainless Steel, removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.
10. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

F. Diaphragm-Operated, Pressure-Reducing Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

    a. Amtrol, Inc.
    b. Armstrong Pumps, Inc.
    c. Bell & Gossett Domestic Pump; a division of ITT Industries.
    d. Conbraco Industries, Inc.
    e. Spence Engineering Company, Inc.
    f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

4. Body: Bronze or brass.
5. Disc: Glass and carbon-filled PTFE.
6. Seat: Brass.
7. Stem Seals: EPDM O-rings.
8. Diaphragm: EPT.
9. Low inlet-pressure check valve.
10. Inlet Strainer: Stainless steel, removable without system shutdown.
11. Valve Seat and Stem: Noncorrosive.
12. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

2.6 AIR CONTROL DEVICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amtrol, Inc.
2. Armstrong Pumps, Inc.
3. Bell & Gossett Domestic Pump; a division of ITT Industries.
4. Taco.

C. Manual Air Vents:

1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Operator: Screwdriver or thumbscrew.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: NPS 1/8.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 225 deg F.

D. Automatic Air Vents:

1. Body: Bronze or cast iron.
2. Internal Parts: Nonferrous.
3. Operator: Noncorrosive metal float.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: NPS 1/4.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 240 deg F.

E. Bladder-Type Expansion Tanks:

1. Tank: Welded steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature. Factory test with taps fabricated and supports installed and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
2. Bladder: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
3. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.

F. Tangential-Type Air Separators:

1. Tank: Welded steel; ASME constructed and labeled for 125-psig minimum working pressure and 375 deg F maximum operating temperature.
2. Air Collector Tube: Perforated stainless steel, constructed to direct released air into expansion tank.
3. Tangential Inlet and Outlet Connections: Threaded for NPS 2 and smaller; flanged connections for NPS 2-1/2 and larger.
4. Blowdown Connection: Threaded.
5. Size: Match system flow capacity.

G. Air Purgers:

1. Body: Cast iron with internal baffles that slow the water velocity to separate the air from solution and divert it to the vent for quick removal.
2. Maximum Working Pressure: 150 psig.
3. Maximum Operating Temperature: 250 deg F.

2.7 CHEMICAL TREATMENT

A. Bypass Chemical Feeder: Welded steel construction; 125-psig working pressure; 5-gal. capacity; with fill funnel and inlet, outlet, and drain valves.

1. Chemicals: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment.

2.8 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

B. Expansion fittings are specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Chilled-water piping, aboveground, NPS 3-1/3 and smaller, shall be any of the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and brazed joints.

B. Chilled-water piping, aboveground, NPS 4 and larger, shall be any of the following:

1. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.

C. Makeup-water piping installed aboveground shall be either of the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and brazed joints.

D. Condensate-Drain Piping: Type M, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

E. Air-Vent Piping:

1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.
2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.

F. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed.

3.2 VALVE APPLICATIONS

A. Install shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.

B. Install calibrated-orifice, balancing valves at each branch connection to return main near equipment served.

C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.

D. Install check valves at each pump discharge and elsewhere as required to control flow direction.

E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; and pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01, for installation requirements.

F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.3 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such 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 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. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS 1 ball valve, and short NPS 1 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

N. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

O. Install valves according to Division 23 Section "General-Duty Valves for HVAC Piping."

P. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

Q. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

R. Install strainers on inlet side of each pump, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.

S. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."

T. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.4 HANGERS AND SUPPORTS

A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet (6 m) long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet (6 m) or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.

C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 7 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
6. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
7. NPS 4: Maximum span, 14 feet; minimum rod size, 1/2 inch.
8. NPS 6: Maximum span, 17 feet; minimum rod size, 1/2 inch.
9. NPS 8: Maximum span, 19 feet; minimum rod size, 5/8 inch.
10. NPS 10: Maximum span, 20 feet; minimum rod size, 3/4 inch.
11. NPS 12: Maximum span, 23 feet; minimum rod size, 7/8 inch.
12. NPS 14: Maximum span, 25 feet; minimum rod size, 1 inch.
13. NPS 16: Maximum span, 27 feet; minimum rod size, 1 inch.
14. NPS 18: Maximum span, 28 feet; minimum rod size, 1-1/4 inches.
15. NPS 20: Maximum span, 30 feet; minimum rod size, 1-1/4 inches.

D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
4. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
6. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.

E. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.5 PIPE JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

E. 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 unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

F. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

H. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.

I. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.

J. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.

3.6 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Manual vents at heat-transfer coils and elsewhere as required for air venting.

C. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.

D. Install in-line air separators in pump suction. Install drain valve on air separators NPS 2 and larger.

E. Install tangential air separator in pump suction. Install blowdown piping with gate or full-port ball valve; extend full size to nearest floor drain.

F. Install bypass chemical feeders in each hydronic system where indicated, in upright position with top of funnel not more than 48 inches above the floor. Install feeder in minimum NPS 3/4 bypass line, from main with full-size, full-port, ball valve in the main between bypass connections. Install NPS 3/4 pipe from chemical feeder drain, to nearest equipment drain and include a full-size, full-port, ball valve.

G. Install expansion tanks above the air separator. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.

1. Install tank fittings that are shipped loose.
2. Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, fittings, plus tank full of water. Do not overload building components and structural members.

H. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system Project requirements.

3.7 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Division 23 Section "Meters and Gages for HVAC Piping."

3.8 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

C. Perform the following before operating the system:

1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION 23 21 13

SECTION 23 2123

HYDRONIC 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. This Section includes the following:

1. End-suction pumps.
2. Automatic condensate pump units.

B. Related Sections include the following:

1. Division 23 Section “Motors” for general motor requirements.
2. Division 23 for inertia pads, isolation pads, spring supports, and spring hangers.

1.3 DEFINITIONS

A. Buna-N: Nitrile rubber.

B. EPT: Ethylene propylene terpolymer.

1.4 SUBMITTALS

A. Product Data: Include certified performance curves and rated capacities, shipping, installed, and operating weights, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.

B. Shop Drawings: Show pump layout and connections. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.

1. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.

C. Maintenance Data: For pumps to include in maintenance manuals specified in Division 1.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain hydronic pumps through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of hydronic pumps and are based on the specific system indicated. Subject to these specification requirements, other manufacturers' pumps with equal performance characteristics may be considered. Any additional cost required due to the contractors use of an alternate manufacturer shall be the contractor's responsibility and there shall be no additional cost to the owner.

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. UL Compliance: Comply with UL 778 for motor-operated water pumps.

E. Note: In all cases, base mounted pumps handling chilled water shall have an epoxy coating, minimum of 0.25" thick on base to prevent corrosion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.

B. Store pumps in dry location.

C. Retain protective covers for flanges and protective coatings during storage.

D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.

E. Comply with pump manufacturer's written rigging instructions.

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 Division 03.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Mechanical Seals: One mechanical seal(s) for each pump.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. End-Suction Pumps:

a. Bell & Gossett
b. Grundfos/PACO
c. Peerless

2. Automatic Condensate Pumps:
a. Bell & Gossett
b. Grundfos/PACO
c. Peerless
d. Little Giant

2.2 GENERAL PUMP REQUIREMENTS

A. Pump Units: Factory assembled and tested.

B. Motors: Include built-in, thermal-overload protection and grease-lubricated ball bearings. Select each motor to be nonoverloading over full range of pump performance curve.

1. Minimum efficiency as indicated according to IEEE 112, Test Method B. Include motors with higher efficiency than "average standard industry motors" according to IEEE 112, Test Method B.

2.3 CLOSE-COUPLED, END-SUCTION PUMPS

A. Description: Centrifugal, close-coupled, end-suction, single-stage, bronze-fitted, back-pull-out, radially split case design; rated for 175-psig minimum working pressure and a continuous water temperature of 225 deg F.
1. Casing: Cast iron, with flanged piping connections, drain plug at low point of volute, and threaded gage tappings at inlet and outlet connections.
a. Connection Option: Unions at connections for casings that are not available with threaded companion flanges.
2. Impeller: ASTM B 584, cast bronze, statically and dynamically balanced, closed, overhung, single suction, keyed to shaft, and secured by locking cap screw.
3. Wear Rings: Replaceable, bronze casing ring.
4. Shaft and Sleeve: Steel shaft extension with bronze sleeve and neoprene slinger.
5. Shaft: Stainless-steel shaft close coupled to motor shaft.
6. Seals: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and flexible bellows and gasket.
7. Motor: Directly mounted to pump casing and with supporting legs as integral Part of motor enclosure.

2.4 FLEXIBLE-COUPLED, END-SUCTION PUMPS

A. Description: Base-mounted, centrifugal, flexible-coupled, end-suction, single-stage, bronze- fitted, back-pull-out, radially split case design; rated for 175-psig minimum working pressure and a continuous water temperature of 225 deg F.

1. Casing: Cast iron, with flanged piping connections, drain plug at low point of volute, and threaded gage tappings at inlet and outlet connections.
2. Casing: Cast iron, with flanged piping connections, drain plug at low point of volute, threaded gage tappings at inlet and outlet connections, and integral feet or other means on volute to support weight of casing and attached piping. Casing shall allow removal and replacement of impeller without disconnecting piping.
3. Impeller: ASTM B 584, cast bronze, statically and dynamically balanced, closed, overhung, single suction, keyed to shaft, and secured by locking cap screw.

4. Wear Rings: Replaceable, bronze casing ring.
5. Shaft and Sleeve: Steel shaft with bronze sleeve.
6. Seals: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and flexible bellows and gasket.
7. Seals: Stuffing box, with at least four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.
8. Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment.
9. Coupling: Flexible-spacer type, capable of absorbing torsional vibration and shaft misalignment; with flange and sleeve section that can be disassembled and removed without removing pump or motor.
10. Coupling: Flexible-spacer type, capable of absorbing torsional vibration and shaft misalignment for motor sizes of 100 hp and smaller; with flange and sleeve section that can be disassembled and removed without removing pump or motor, for sizes larger than 100 hp.
11. Coupling: Flexible-spacer type, capable of absorbing torsional vibration and shaft misalignment; with flange and sleeve section that can be disassembled and removed without removing pump or motor.
12. Coupling Guard: Steel, removable, and attached to mounting frame.
13. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A 36/A 36M channels and angles. Fabricate for mounting pump casing, coupling guard, and motor. Field-drill motor-mounting holes for field-installed motors.

    a. Option: Cast-iron frames are acceptable.

14. Motor: Secured to mounting frame, with adjustable alignment.

2.5 PUMP SPECIALTY FITTINGS

A. Suction Diffuser: Angle or straight pattern, 175-psig pressure rating, cast-iron body and end cap, pump-inlet fitting; with bronze startup and bronze or stainless-steel permanent strainers; bronze or stainless-steel straightening vanes; drain plug; and factory- or field-fabricated support.

B. Triple-Duty Valve: Angle or straight pattern, 175-psig pressure rating, cast-iron body, pump- discharge fitting; with drain plug and bronze-fitted shutoff, balancing, and check valve features.

2.6 AUTOMATIC CONDENSATE PUMP UNITS

A. Description: Packaged units with corrosion-resistant pump, plastic tank with cover, and automatic controls. Include factory- or field-installed check valve and a 72-inch- minimum electrical power cord with plug.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.

C. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CONCRETE BASES

A. Install concrete bases of dimensions indicated for pumps and controllers. Refer to Division 23 Section "Common Work Results for HVAC."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of base.
2. For supported equipment, 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.

B. Cast-in-place concrete materials and placement requirements are specified in Division 03.

3.3 PUMP INSTALLATION

A. Comply with ANSI Standards HI 1.4 and/or HI 2.4].

1. Install pumps according to HI 1.1-1.5, “Centrifugal Pumps for Nomenclature, Definitions, Application and Operation.

B. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.

C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

D. Install continuous-thread hanger rods and vibration-isolation hangers. Install seismic bracing as required by authorities having jurisdiction. Fabricate brackets or supports as required. Hanger and support materials are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

E. Set base-mounted pumps on concrete foundation. Disconnect coupling before setting. Do not reconnect couplings until alignment procedure is complete.

1. Support pump baseplate on rectangular metal blocks and shims, or on metal wedges with small taper, at points near foundation bolts to provide a gap of 3/4 to 1-1/2 inches between pump base and foundation for grouting.
2. Adjust metal supports or wedges until pump and driver shafts are level. Check coupling faces and suction and discharge flanges of pump to verify that they are level and plumb.

F. Automatic Condensate Pump Units: Install units for collecting condensate and extend to open drain.

3.4 ALIGNMENT

A. Align pump and motor shafts and piping connections after setting on foundation, grout has been set and foundation bolts have been tightened, and piping connections have been made.

B. Comply with pump and coupling manufacturers' written instructions.

C. Adjust pump and motor shafts for angular and offset alignment by methods specified in ANSI Standards HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation.”

D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.5 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.

D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

E. Install check valve and throttling valve on discharge side of in-line circulators.

F. Install nonslam check valve and globe valve on discharge side of vertical in-line pumps.

G. Install Y-type strainer or suction diffuser and shutoff valve on suction side of pumps.

H. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.

I. Install temperature and pressure gages on pump suction and discharge, at integral pressure-gage tapping.

J. Install temperature and pressure gages connector plugs on pump suction and discharge, at integral pressure-gage tapping.

K. Install check valve and gate or ball valve on each condensate pump unit discharge.

L. Install electrical connections for power, controls, and devices.

M. Electrical power and control wiring and connections are specified in Division 16 Sections.

N. Ground equipment.

1. Tighten electrical connectors and terminals according to manufacturer's published torque- tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.6 COMMISSIONING

A. Verify that pumps are installed and connected according to the Contract Documents.

B. Verify that electrical wiring installation complies with manufacturer's written instructions and the Contract Documents.

C. Perform the following preventive maintenance operations and checks before starting:

1. Lubricate bearings.
2. Remove grease-lubricated bearing covers, flush bearings with kerosene, and clean thoroughly. Fill with new lubricant according to manufacturer's written instructions.

3. Disconnect coupling and check motor for proper rotation that matches direction marked on pump casing.
4. Verify that pumps are free to rotate by hand and that pumps for handling hot liquids are free to rotate with pumps hot and cold. Do not operate pumps if they are bound or drag, until cause of trouble is determined and corrected.
5. Check suction piping connections for tightness to avoid drawing air into pumps.
6. Clean strainers.
7. Verify that pump controls are correct for required application.

D. Starting procedure for pumps with shutoff power not exceeding safe motor power is as follows:
1. Prime pumps by opening suction valves and closing drains, and prepare pumps for operation.
2. Open cooling water-supply valves in cooling water supply to bearings, where applicable.
3. Open cooling water-supply valves if stuffing boxes are water cooled.
4. Open sealing liquid-supply valves if pumps are so fitted.
5. Open warm-up valves of pumps handling hot liquids if pumps are not normally kept at operating temperature.
6. Open circulating line valves if pumps should not be operated against dead shutoff.
7. Start motors.
8. Open discharge valves slowly.
9. Observe leakage from stuffing boxes and adjust sealing liquid valve for proper flow to ensure lubrication of packing. Let packing "run in" before reducing leakage through stuffing boxes; then tighten glands.
10. Check general mechanical operation of pumps and motors.
11. Close circulating line valves once there is sufficient flow through pumps to prevent overheating.

E. When pumps are to be started against closed check valves with discharge shutoff valves open, steps are the same, except open discharge valves before starting motors.

F. Refer to Division 23 for detailed requirements for testing, adjusting, and balancing hydronic systems.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps as specified below:

1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining pumps.
2. Review data in maintenance manuals. Refer to Division 1 Section "Contract Closeout."
3. Review data in maintenance manuals. Refer to Division 1.
4. Schedule training with Owner, through Architect, with at least seven days' advance notice.

END OF SECTION 23 2123

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SECTION 23 3113

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.

B. This section applies to work associated with Add/Alternate #1. If Add/Alternate #1 is not accepted, this section does not apply.

1.2 SUMMARY

A. This Section includes metal ducts for supply, return, outside, and exhaust air-distribution systems in pressure classes as follows: (As per SMACNA).

1. Rectangular and round ducts and fittings: -2" w.g. to +4" w.g.
2. Duct liner: pressure classification is not applicable.

B. Related Sections include the following:

1. Division 23 Section "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.
2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 DEFINITIONS

A. FRP: Fiberglass-reinforced plastic.

1.4 SYSTEM DESCRIPTION

A. Duct system design, as indicated, has been used to select size and type of air-moving and -distribution equipment and other air system components. Changes to layout or configuration of duct system must be specifically approved in writing by Architect. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

1.5 SUBMITTALS

A. Shop Drawings: CAD-generated and drawn 1/8 inch equals 1 foot minimum scale. Show fabrication and installation details for metal ducts. Shop drawings are required for review before construction.

1. Plans, elevations and sectional drawings are required.

2. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
3. Duct layout indicating sizes and pressure classes.
4. Elevations of top and bottom 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. Duct accessories, including access doors and panels.
12. Hangers and supports, including methods for duct and building attachments..

B. Coordination Drawings: Reflected ceiling 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. Ceiling suspension assembly members.
2. Other systems installed in same space as ducts.
3. Ceiling- and wall-mounting access doors and panels required to provide access to dampers and other operating devices.
4. Ceiling-mounting items, including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

C. Welding certificates.

D. Field quality-control test reports.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," for hangers and supports, "Structural Welding Code--Aluminum," for aluminum supporting members and AWS D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. NFPA Compliance:

1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

C. Comply with NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operations," Ch. 3, "Duct System," for range hood ducts, unless otherwise indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SHEET METAL MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.

C. Carbon-Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets; commercial quality; with oiled, matte finish for exposed ducts.

D. Stainless Steel: ASTM A 480/A 480M, Type 316 or 304, and having a No. 2D finish for concealed ducts and for exposed ducts.

E. Aluminum Sheets: ASTM B 209, alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.

G. 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 DUCT LINER

A. Liner shall be installed on all supply and return duct.

B. Flexible Elastomeric Duct Liner: Comply with NFPA 90A or NFPA 90B.

1. Available Manufacturers:

    a. Armstrong World Industries, Inc.
    b. Armacell
    c. K-Flex.
    d. Aeroflex.

2. Materials: Unicellular polyethylene thermal plastic, preformed sheet insulation complying with ASTM C 534, Type II, except for density.

    a. Thickness**:** 2 inch.
    b. Thermal Conductivity (k-Value): 0.24 at 75 deg F mean temperature.
    c. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM C 411.
    d. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

2.4 SEALANT MATERIALS

A. Joint and Seam Sealants, General: The term "sealant" is not limited to materials of adhesive or mastic nature but includes tapes and combinations of open-weave fabric strips and mastics.

B. Joint and Seam Tape: 2 inches wide; glass-fiber-reinforced fabric.

C. Tape Sealing System: Woven-fiber tape impregnated with gypsum mineral compound and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.

D. Water-Based Joint and Seam Sealant: Flexible, adhesive sealant, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts.

E. Solvent-Based Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant formulated with a minimum of 75 percent solids.

F. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.

G. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.

2.5 HANGERS AND SUPPORTS

A. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached. Obtain written permission from Architect or Owner before fastening to concrete structural members.

1. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
2. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

B. Hanger Materials: Galvanized sheet steel or threaded steel rod.

1. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
2. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for steel sheet width and thickness and for steel rod diameters.
3. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.

C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

D. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel support materials.

2.6 RECTANGULAR DUCT FABRICATION

A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.

1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.

2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.

1. Available Manufacturers:

a. Ductmate Industries, Inc.
b. Nexus Inc.
c. Ward Industries, Inc.

C. Formed-On Flanges: Construct according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," Figure 1-4, using corner, bolt, cleat, and gasket details.

1. Available Manufacturers:

a. Ductmate Industries, Inc.
b. Lockformer.

2. Duct Size: Maximum 30 inches wide and up to 2-inch wg pressure class.
3. Longitudinal Seams: Pittsburgh lock sealed with noncuring polymer sealant.

D. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of nonbraced panel area unless ducts are lined.

2.7 APPLICATION OF LINER IN RECTANGULAR DUCTS

A. Follow manufacturer’s instructions first as that has precedence over this specification. 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.

B. Liner shall only be installed on the first ten feet of the supply and return duct from roof mounted equipment through the roof or where duct lining is recommended for sound attenuation.

C. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.

D. Butt transverse joints without gaps and coat joint with adhesive.

E. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.

F. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and standard liner product dimensions make longitudinal joints necessary.

G. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.

H. 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.

I. 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:

1. Fan discharges.

2. Intervals of lined duct preceding unlined duct.
3. Upstream edges of transverse joints in ducts where air velocities are greater than 2500 fpm (12.7 m/s) or where indicated.

J. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.

1. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.

K. 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.

PART 3 - EXECUTION

3.1 DUCT APPLICATIONS

A. Static-Pressure Classes: Unless otherwise indicated, construct ducts according to the following:

1. Supply Ducts (before Air Terminal Units): 2-inch wg.
2. Supply Ducts (after Air Terminal Units): 1-inch wg.
3. Return Ducts (Negative Pressure): 1/2-inch wg.
4. Exhaust Ducts (Negative Pressure): 1/2-inch wg.

3.2 DUCT INSTALLATION

A. Construct and install ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.

B. Install ducts with fewest possible joints.

C. Where mitered elbows must be used, provide air foil turning vanes.

D. Flex duct may be used for may be used for low pressure ductwork downstream of the terminal in classroom or office spaces. The length of the flex ducts should not exceed the distance between the terminal box and the diffuser plus 20 percent or 10 feet, whichever is shorter, to permit relocation of diffuser in the future while minimizing replacement of ductwork. Flex duct runs should not contain any bends.

E. Install fabricated fittings for changes in directions, size, and shape and for connections.

F. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches, with a minimum of 3 screws in each coupling.

G. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.

H. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

I. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

J. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.

K. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.

L. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.

M. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

N. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches.

O. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, sleeves, and firestopping sealant. Fire and smoke dampers are specified in Division 23 Section "Air Duct Accessories." Firestopping materials and installation methods are specified in Division 07 Section "Penetration Firestopping."

P. Protect duct interiors from the elements and foreign materials until building is enclosed. Follow SMACNA's "Duct Cleanliness for New Construction."

3.3 SEAM AND JOINT SEALING

A. Seal duct seams and joints according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for duct pressure class indicated.

1. For pressure classes lower than 2-inch wg , seal transverse joints.

B. Seal ducts before external insulation is applied.

3.4 HANGING AND SUPPORTING

A. Support horizontal ducts within 24 inches of each elbow and within 48 inches (1200 mm) of each branch intersection.

B. Support vertical ducts at maximum intervals of 16 feet and at each floor.

C. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.

D. Install concrete inserts before placing concrete.

E. Install powder-actuated concrete fasteners after concrete is placed and completely cured.

1. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

3.5 CONNECTIONS

A. Make connections to equipment with flexible connectors according to Division 23 Section "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections according to SMACNA's "HVAC Air Duct Leakage Test Manual" and prepare test reports:

1. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
2. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
3. Maximum Allowable Leakage: Comply with requirements for Leakage Class 3 for round and flat-oval ducts, Leakage Class 12 for rectangular ducts in pressure classes lower than and equal to 2-inch wg (both positive and negative pressures), and Leakage Class 6 for pressure classes from 2- to 10-inch wg.
4. Remake leaking joints and retest until leakage is equal to or less than maximum allowable.

3.7 CLEANING NEW SYSTEMS

A. Mark position of dampers and air-directional mechanical devices before cleaning, and perform cleaning before air balancing.

B. Use service openings, as required, for physical and mechanical entry and for inspection.

1. Create other openings to comply with duct standards.
2. Disconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling sections to gain access during the cleaning process.

C. Vent vacuuming system to the outside. Include filtration to contain debris removed from HVAC systems, and locate exhaust down wind and away from air intakes and other points of entry into building.

D. Clean the following metal duct systems 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, and actuators except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.

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.
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.

F. Cleanliness Verification:

1. Visually inspect metal ducts for contaminants.
2. Where contaminants are discovered, re-clean and reinspect ducts.

END OF SECTION 23 3113

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SECTION 23 3300

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. This Section includes the following:

1. Backdraft dampers.
2. Volume dampers.
3. Motorized control dampers
4. Fire dampers.
5. Smoke dampers
6. Combination fire and smoke dampers
7. Turning vanes.
8. Duct-mounting access doors.
9. Flexible connectors.
10. Flexible ducts.
11. Duct accessory hardware.

B. Related Sections include the following:

1. Division 23 Section "Instrumentation and Control for HVAC" for electric and pneumatic damper actuators.
2. Division 28 Section "Fire Detection and Alarm" for duct-mounting fire and smoke detectors.

1.3 SUBMITTALS

A. Product Data: For the following:
1. Backdraft dampers.
2. Volume dampers.
3. Motorized control dampers
4. Fire dampers.
5. Smoke dampers
6. Combination fire and smoke dampers
7. Turning vanes.
8. Duct-mounting access doors.
9. Flexible connectors.
10. Flexible ducts.
11. Duct accessory hardware.

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. Special fittings.
2. Manual-volume damper installations.
3. Motorized-control damper installations.
4. Fire-damper, smoke-damper, and combination fire- and smoke-damper installations, including sleeves and duct-mounting access doors.
5. Wiring Diagrams: Power, signal, and control wiring.

C. Coordination Drawings: Reflected ceiling plans, drawn to scale and coordinating penetrations and ceiling-mounting items. Show ceiling-mounting access panels and access doors required for access to duct accessories.

1.4 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

1.5 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SHEET METAL MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.

B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.

C. Stainless Steel: ASTM A 480/A 480M.

D. Aluminum Sheets: ASTM B 209, alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

E. Extruded Aluminum: ASTM B 221, alloy 6063, temper T6.

F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

G. 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 DAMPERS

A. Manufacturers:

1. Air Balance, Inc.
2. American Warming and Ventilating.
3. CESCO Products.
4. Duro Dyne Corp.
5. Greenheck.
6. Penn Ventilation Company, Inc.
7. Prefco Products, Inc.
8. Ruskin Company.
9. Vent Products Company, Inc.

B. Description: Multiple-blade, parallel action gravity balanced, with center-pivoted blades of maximum 6-inch width, with sealed edges, assembled in rattle-free manner with 90-degree stop, steel ball bearings, and axles; adjustment device to permit setting for varying differential static pressure.

C. Frame: 0.052-inch thick galvanized sheet steel, with welded corners and mounting flange.

D. Blades: 0.025-inch thick, roll-formed aluminum.

E. Blade Seals: Neoprene.

F. Blade Axles: Galvanized Steel.

G. Tie Bars and Brackets: Galvanized Steel.

H. Return Spring: Adjustable tension.

2.4 VOLUME DAMPERS

A. Available Manufacturers:

1. Air Balance, Inc.
2. American Warming and Ventilating.
3. Flexmaster U.S.A., Inc.
4. McGill AirFlow Corporation.
5. METALAIRE, Inc.
6. Nailor Industries Inc.
7. Penn Ventilation Company, Inc.
8. Ruskin Company.
9. Vent Products Company, Inc.

B. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.

1. Pressure Classes of 3-Inch wg or Higher: End bearings or other seals for ducts with axles full length of damper blades and bearings at both ends of operating shaft.

C. Standard Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.

1. Steel Frames: Hat-shaped, galvanized sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
2. Roll-Formed Steel Blades: 0.064-inch-thick, galvanized sheet steel.
3. Aluminum Frames: Hat-shaped, 0.10-inch-thick, aluminum sheet channels; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.
4. Roll-Formed Aluminum Blades: 0.10-inch-thick aluminum sheet.
5. Extruded-Aluminum Blades: 0.050-inch-thick extruded aluminum.
6. Blade Axles: Galvanized steel.
7. Bearings: Oil-impregnated bronze.
8. Tie Bars and Brackets: Aluminum.
9. Tie Bars and Brackets: Galvanized steel.

D. Low-Leakage Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, low-leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.

1. Steel Frames: Hat-shaped, galvanized steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
2. Roll-Formed Steel Blades: 0.064-inch-thick, galvanized sheet steel.
3. Aluminum Frames: Hat-shaped, 0.125-inch-thick, aluminum sheet channels; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
4. Roll-Formed Aluminum Blades: 0.10-inch-thick aluminum sheet.
5. Extruded-Aluminum Blades: 0.125-inch-thick extruded aluminum.
6. Blade Axles: Galvanized steel.
7. Bearings: Oil-impregnated bronze or Molded synthetic or Stainless-steel sleeve thrust or ball.
8. Blade Seals: Vinyl or Neoprene.
9. Jamb Seals: Cambered aluminum.
10. Tie Bars and Brackets: Galvanized steel.

E. Jackshaft: 1-inch-diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.

1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.

F. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch-thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

2.5 MOTORIZED CONTROL DAMPERS

A. Manufacturers:

1. Air Balance, Inc.
2. American Warming and Ventilating.
3. CESCO Products.

4. Duro Dyne Corp.
5. Greenheck.
6. McGill AirFlow Corporation.
7. METALAIRE, Inc.
8. Nailor Industries Inc.
9. Penn Ventilation Company, Inc.
10. Ruskin Company.
11. Vent Products Company, Inc.

B. General Description: AMCA-rated, opposed-blade design; minimum of 0.1084-inch thick, galvanized-steel frames with holes for duct mounting; minimum of 0.0635-inch thick, galvanized-steel damper blades with maximum blade width of 8 inches.

1. Secure blades to 1/2-inch diameter, zinc-plated axles using zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
2. Operating Temperature Range: From minus 40 to plus 200 deg F.
3. Provide opposed-blade design with inflatable seal blade edging, or replaceable rubber 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 being held by torque of 50 in. x lbf; when tested according to AMCA 500D].

2.6 FIRE DAMPERS

A. Manufacturers:

1. Air Balance, Inc.
2. CESCO Products.
3. Greenheck.
4. McGill AirFlow Corporation.
5. METALAIRE, Inc.
6. Nailor Industries Inc.
7. Penn Ventilation Company, Inc.
8. Prefco Products, Inc.
9. Ruskin Company.
10. Vent Products Company, Inc.
11. Ward Industries, Inc.

B. Fire dampers shall be labeled according to UL 555.

C. Fire Rating: 2 hours.

D. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.

E. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Minimum Thickness: 0.052 or 0.138 inch thick as indicated and of length to suit application.
2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.

F. Mounting Orientation: Vertical or horizontal as indicated.

G. Blades: Roll-formed, interlocking, 0.034-inch-thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch-thick, galvanized-steel blade connectors.

H. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

I. Fusible Links: Replaceable, 165 deg F rated.

2.7 COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers:

1. Air Balance, Inc.
2. CESCO Products.
3. Greenheck.
4. Nailor Industries Inc.
5. Penn Ventilation Company, Inc.
6. Ruskin Company.

B. General Description: Labeled according to UL 555S. Combination fire and smoke dampers shall be labeled according to UL 555 for 1-1/2-hour rating.

C. Fusible Links: Replaceable, 165 deg F rated.

D. Frame and Blades: 0.064-inch thick, galvanized sheet steel.

E. Mounting Sleeve: Factory-installed, 0.052-inch thick, galvanized sheet steel; length to suit wall or floor application.

F. Damper Motors: Modulating and two-position action.

1. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
2. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
3. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf .
4. Outdoor Motors and Motors in Outside-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
5. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
6. Electrical Connection: 115 V, single phase, 60 Hz.

2.8 TURNING VANES

A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.

B. Manufactured Turning Vanes: Fabricate 1-1/2-inch-wide, single-vane, curved blades of galvanized sheet steel set 3/4 inch o.c.; support with bars perpendicular to blades set 2 inches o.c.; and set into vane runners suitable for duct mounting.

1. Manufacturers:

a. Ductmate Industries, Inc.
b. Duro Dyne Corp.
c. METALAIRE, Inc.
d. Ward Industries, Inc.

C. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

2.9 DUCT-MOUNTING ACCESS DOORS

A. General Description: Fabricate doors airtight and suitable for duct pressure class.

B. Door: Double wall, duct mounting, and rectangular; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch butt or piano hinge and cam latches. Provide air tight gasketing all around door opening.

1. Manufacturers:

a. American Warming and Ventilating.
b. CESCO Products.
c. Ductmate Industries, Inc.
d. Flexmaster U.S.A., Inc.
e. Greenheck.
f. McGill AirFlow Corporation.
g. Nailor Industries Inc.
h. Ventfabrics, Inc.
i. Ward Industries, Inc.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Provide number of hinges and locks as follows:

a. Less Than 12 Inches Square: Secure with two sash locks.
b. Up to 18 Inches Square: Two hinges and two sash locks.
c. Up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
d. Sizes 24 by 48 Inches and Larger: One additional hinge.

C. Door: Double wall, duct mounting, and round; fabricated of galvanized sheet metal with insulation fill and 1-inch thickness. Include cam latches.

1. Available Manufacturers:

a. Ductmate Industries, Inc.
b. Flexmaster U.S.A., Inc.

2. Frame: Galvanized sheet steel, with spin-in notched frame.

D. Pressure Relief Access Door: Double wall and duct mounting; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated, latches, and retaining chain.

1. Available Manufacturers:

a. American Warming and Ventilating.
b. CESCO Products.
c. Ductmate Industries, Inc.
d. Greenheck.
e. KEES, Inc.
f. McGill AirFlow Corporation.
g. Nexus PDQ.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.

E. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.

F. Insulation: 1-inch-thick, fibrous-glass or polystyrene-foam board.

2.10 FLEXIBLE CONNECTORS

A. Available Manufacturers:

1. Ductmate Industries, Inc.
2. Duro Dyne Corp.
3. Ventfabrics, Inc.
4. Ward Industries, Inc.

B. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

C. Metal-Edged Connectors: Factory fabricated with a fabric strip approximately 5-3/4 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch thick, galvanized sheet steel. Select metal compatible with ducts.

D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd.
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

2.11 FLEXIBLE DUCTS

A. Available Manufacturers:

1. Flexmaster U.S.A., Inc.
2. Hart & Cooley, Inc.
3. McGill AirFlow Corporation.
4. Thermaflex

B. Insulated-Duct Connectors: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene or aluminized vapor barrier film.

1. Pressure Rating: 4-inch wg positive and 0.5-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 20 to plus 175 deg F
4. Minimum R-value = 6.0

C. Flexible Duct Clamps: Nylon strap, in sizes 3 through 18 inches to suit duct size.

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 APPLICATION AND 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. Provide duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install volume dampers in ducts with liner; avoid damage to and erosion of duct liner.

D. Provide balancing dampers at points on supply, return, and exhaust systems where branches lead from larger ducts as required for air balancing. Install at a minimum of two duct widths from branch takeoff.

E. Provide test holes at fan inlets and outlets and elsewhere as indicated.

F. Install fire and smoke dampers, with fusible links, according to manufacturer's UL-approved written instructions.

G. Install duct access doors to allow for inspecting, adjusting, and maintaining accessories and terminal units as follows:

1. On both sides of duct coils.
2. Downstream from volume dampers and equipment.
3. Adjacent to fire or smoke dampers, providing access to reset or reinstall fusible links.

H. Install the following sizes for duct-mounting, rectangular access doors:

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.

I. Install the following sizes for duct-mounting, pressure relief access doors:

1. One-Hand or Inspection Access: 7 inches in diameter.
2. Two-Hand Access: 10 inches in diameter.
3. Head and Hand Access: 13 inches in diameter.
4. Head and Shoulders Access: 19 inches in diameter.

J. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment."

K. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.

L. For fans developing static pressures of 5-inch wg and higher, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

M. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.

N. Connect diffusers or light troffer boots to low pressure ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.

O. Connect flexible ducts to metal ducts with adhesive plus sheet metal screws.

P. Install duct test holes where indicated and required for testing and balancing purposes.

3.2 ADJUSTING

A. Adjust duct accessories for proper settings.

B. Adjust fire and smoke dampers for proper action.

C. Final positioning of manual-volume dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

END OF SECTION 23 3300

SECTION 23 3600

AIR TERMINAL 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 the following:

1. Single-duct air terminal units.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated, include rated capacities, furnished specialties, sound-power ratings, and accessories.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.

1. Include a schedule showing unique model designation, room location, model number, size, and accessories furnished.
2. Wiring Diagrams: Power, signal, and control wiring.

C. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data" include the following:

1. Instructions for resetting minimum and maximum air volumes.
2. Instructions for adjusting software set points.

1.4 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of air terminal units and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. NFPA Compliance: Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

1.5 COORDINATION

A. Coordinate layout and installation of air terminal units and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 SINGLE-DUCT AIR TERMINAL UNITS

A. Manufacturers:

1. Environmental Technologies, Inc.: Enviro-Air Div.
2. Nailor Industries of Texas Inc.
3. Titus.
4. Trane Co. (The); Worldwide Applied Systems Group.
5. Metal Industries.

B. Configuration: Volume-damper assembly inside unit casing with control components located inside a protective metal shroud.

C. Casing: 0.034-inch steel or 0.032-inch aluminum.

1. Casing Lining: 1/2-inch-thick, coated, fibrous-glass duct liner complying with ASTM C1071; secured with adhesive[Cover liner with nonporous foil and perforated metal.
2. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment
3. Air Outlet: S-slip and drive connections.
4. Access: Removable panels for access to dampers and other parts requiring service, adjustment, or maintenance; with airtight gasket.

D. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.

1. Maximum Damper Leakage: ARI 880 rated, 2 percent of nominal airflow at 3-inch wg inlet static pressure.
2. Damper Position: Normally closed.

E. Hot-Water Heating Coil: Copper tube, mechanically expanded into aluminum-plate fins; leak tested underwater to 200 psig; and factory installed.

F. Electric Heating Coil: Slip-in-type, open-coil design with integral control box factory wired and installed. Include the following features:

1. Primary and secondary overtemperature protection.
2. Nickel chrome 80/20 heating elements.
3. Airflow switch.
4. Noninterlocking disconnect switch.
5. Fuses (for coils more than 48 A).
6. Mercury contactors.
7. Pneumatic-electric switches and relays.
8. Magnetic contactor for each step of control (for three-phase coils).

G. Factory-Mounted and -Wired Controls: The terminal unit manufacturer shall provide the following components for each cooling only VAV terminal unit for interface and mounting of the UC (Unitary Controller):

1. Primary air dampers to be controlled by the UC.
2. Enclosure to house the UC and associated components or suitable mounting brackets within the terminal unit enclosure.
3. Multi-point averaging type flow sensor at the primary air inlet to the terminal unit. The FMCS subcontractor shall furnish to the terminal unit manufacturer the unitary controller and damper actuator. The FMCS subcontractor shall field install the room temperature sensor and discharge air temperature sensor.

H. DDC Controls: DDC Controls shall be furnished by FMCS Contractor and installed at the terminal unit factory. Refer to Division 23 Section “Facility Management and Control System”.

2.2 SOURCE QUALITY CONTROL

A. Identification: Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and ARI certification seal.

B. Verification of Performance: Rate air terminal units according to ARI 880.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to air terminal units to allow service and maintenance.

C. Hot-Water Piping: In addition to requirements in Division 23 Section "Hydronic Piping," connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.

D. Connect ducts to air terminal units according to Division 23 Section "Metal Ducts."

E. Ground units with electric heating coils according to Division 26 Section "Grounding and Bonding for Electrical Systems."

F. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

G. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
2. Leak Test: After installation, fill water coils 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.

B. Remove and replace malfunctioning units and retest as specified above.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air terminal units. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 23 3600

SECTION 23 3713

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. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.

B. Related Sections include the following:
   1. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.3 SUBMITTALS

A. Product Data: For each 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.

B. Coordination Drawings: Reflected ceiling 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. Ceiling suspension assembly members.
   2. Method of attaching hangers to building structure.
   3. Size and location of initial access modules for acoustical tile.
   4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
   5. Duct access panels.

C. Samples for Initial Selection: For diffusers, registers, and grilles with factory-applied color finishes.

D. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 GRILLES AND REGISTERS

A. Fixed Face Grille or Register:

   1. Manufacturers:
      a. Krueger.
      b. Nailor Industries of Texas Inc.
      c. Price Industries.
      d. Titus.
      e. Tuttle & Bailey.

   2. Features and accessories: See schedule.

2.3 LINEAR SLOT OUTLETS

A. Linear Bar Grille or Diffuser

   1. Manufacturers:
      a. Krueger.
      b. Nailor Industries of Texas Inc.
      c. Price Industries.
      d. Titus.
      e. Tuttle & Bailey.

   2. Features and accessories: See schedule.

2.4 CEILING DIFFUSER OUTLETS

A. Square Ceiling Diffusers:

   1. Available Manufacturers:
      a. Krueger.
      b. METALAIRE, Inc.; Metal Industries Inc.
      c. Nailor Industries of Texas Inc.
      d. Price Industries.
      e. Titus.
      f. Tuttle & Bailey.

   2. Features and accessories: See schedule.

2.5 FLOOR MOUNTED GRILLES

A. Floor mounted grilles:

1. Available Manufacturers:
   a. Krueger.
   b. METALAIRE, Inc.; Metal Industries Inc.
   c. Nailor Industries of Texas Inc.
   d. Price Industries.
   e. Titus.
   f. Tuttle & Bailey.

2. Features and accessories: See schedule.

2.6 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 practicable. 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 23 3713

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SECTION 23 6423

AIR COOLED SCROLL WATER CHILLERS

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. Packaged, air-cooled, electric-motor-driven, scroll water chillers.

1.3 DEFINITIONS

A. COP: Coefficient of performance. The ratio of the rate of heat removal to the rate of energy input using consistent units for any given set of rating conditions.

B. EER: Energy-efficiency ratio. The ratio of the cooling capacity given in terms of Btu/h to the total power input given in terms of watts at any given set of rating conditions.

C. IPLV: Integrated part-load value. A single number part-load efficiency figure of merit calculated per the method defined by ARI 550/590 and referenced to ARI standard rating conditions.

D. kW/Ton: The ratio of total power input of the chiller in kilowatts to the net refrigerating capacity in tons at any given set of rating conditions.

E. NPLV: Nonstandard part-load value. A single number part-load efficiency figure of merit calculated per the method defined by ARI 550/590 and intended for operating conditions other than the ARI standard rating conditions.

1.4 SUBMITTALS

A. Product Data: Include refrigerant, rated capacities, operating characteristics, furnished specialties, and accessories.

1. Performance at ARI standard conditions and at conditions indicated.
2. Performance at ARI standard unloading conditions.
3. Minimum evaporator flow rate.
4. Refrigerant capacity of water chiller.
5. Oil capacity of water chiller.
6. Fluid capacity of evaporator.
7. Fluid capacity of condenser.

8. Characteristics of safety relief valves.

B. Shop Drawings: Complete set of manufacturer's prints of water chiller assemblies, control panels, sections and elevations, and unit isolation. Include the following:

1. Assembled unit dimensions.
2. Weight and load distribution.
3. Required clearances for maintenance and operation.
4. Size and location of piping and wiring connections.
5. Wiring Diagrams: For power, signal, and control wiring.

C. Coordination Drawings: Floor 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. Structural supports.
2. Piping roughing-in requirements.
3. Wiring roughing-in requirements, including spaces reserved for electrical equipment.
4. Access requirements, including working clearances for mechanical controls and electrical equipment, and tube pull and service clearances.

D. Certificates: For certification required in "Quality Assurance" Article.

E. Source quality-control test reports.

F. Startup service reports.

G. Operation and Maintenance Data: For each water chiller to include in emergency, operation, and maintenance manuals.

H. Warranty: Sample of special warranty.

1.5 QUALITY ASSURANCE

A. ARI Certification: Certify chiller according to ARI 590 certification program.

B. Factory Functional Test: The chiller shall be pressure tested, evacuated and fully charged with HFC-410A refrigerant and oil. In addition, a factory functional test to verify correct operation by cycling condenser fans, closing compressor contacts and reading data points from temperature and pressure sensors.

C. ARI Rating: Rate water chiller performance according to requirements in ARI 550/590, "Water Chilling Packages Using the Vapor Compression Cycle."

D. ASHRAE Compliance:
1. ASHRAE/IESNA 90.1 for energy efficiency.

E. ASME Compliance: Fabricate and stamp water chiller heat exchangers to comply with ASME Boiler and Pressure Vessel Code.

F. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Ship water chillers from the factory fully charged with refrigerant and filled with oil.

B. Package water chiller for export shipping.

1.7 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

B. Coordinate sizes, locations, and anchoring attachments of structural-steel support structures.

C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of water chillers that fail in materials or workmanship within one year from initial start-up

1. Compressor/Motor/Transmission Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PACKAGED AIR-COOLED WATER CHILLERS

A. Manufacturers: Subject to compliance with requirements, provide the product indicated on Drawings by one of the following:

1. Carrier Corporation; a United Technologies company.
2. Trane.
3. York International Corporation.

B. Description: Factory-assembled and run-tested water chiller complete with base and frame, condenser casing, compressors, compressor motors and motor controllers, evaporator, condenser coils, condenser fans and motors, electrical power, controls, and accessories.

C. Cabinet:

1. Base: Galvanized-steel base extending the perimeter of water chiller. Secure frame, compressors, and evaporator to base to provide a single-piece unit.
2. Frame: Heavy-gage, with a powder coated paint finish for both aesthetic appeal and to offer more resistance to corrosion.
3. Casing: Galvanized steel with galvanized steel panels and access doors.
4. Finish: Coat base, frame, and casing with a corrosion-resistant coating capable of withstanding a 1000-hour salt-spray test according to ASTM B 117.

D. Compressors:

1. Description: Fully hermetic scroll type compressors with R410A optimized and dedicated scroll profile.
2. Each compressor provided with suction and discharge service valves, crankcase oil heater, and suction strainer.
3. Operating Speed: Nominal 3600 rpm for 60-Hz applications.
4. Capacity Control: On-off compressor cycling.
5. Oil Lubrication System: Automatic pump with strainer, sight glass, filling connection, filter with magnetic plug, and initial oil charge.
6. Vibration Isolation: Mount individual compressors on vibration isolators.

E. Compressor Motors:

1. Hermetically sealed and cooled by refrigerant suction gas.
2. High-torque, two-pole induction type with inherent thermal-overload protection on each phase.

F. Compressor Motor Controllers:

1. Across the Line: NEMA ICS 2, Class A, full voltage, nonreversing.

G. Refrigeration:

1. Refrigerant: R-410A. Classified as Safety Group A1 according to ASHRAE 34.
2. Refrigerant Compatibility: Parts exposed to refrigerants shall be fully compatible with refrigerants, and pressure components shall be rated for refrigerant pressures.
3. Refrigerant Circuit: Each circuit shall include a thermal-expansion valve, refrigerant charging connections, a hot-gas muffler, compressor suction and discharge shutoff valves, a liquid-line shutoff valve, a replaceable-core filter-dryer, a sight glass with moisture indicator, a liquid-line solenoid valve, and an insulated suction line.
4. Refrigerant Isolation: Factory install positive shutoff isolation valves in the compressor discharge line and the refrigerant liquid-line to allow the isolation and storage of the refrigerant charge in the chiller condenser.

H. Evaporator:

1. The evaporator shall be a high efficiency, brazed plate-to-plate type heat exchanger consisting of parallel plates. Braze plates shall be stainless steel with copper braze material.

2. Heater: Factory-installed and -wired etched foil heater and insulated with 3/4 inch insulation with integral controls designed to protect the evaporator to minus 20 deg F.

I. Air-Cooled Condenser:

1. Plate-fin coil with integral subcooling on each circuit, rated at 650 psig.

    a. Construct coils of copper tubes mechanically bonded to aluminum fins.
    b. Hail Protection: Provide condenser coils with louvers, baffles, or hoods to protect against hail damage.

2. Fans: Direct-drive propeller type with statically and dynamically balanced fan blades, arranged for vertical air discharge.
3. Fan Motors: Totally enclosed nonventilating (TENV) or totally enclosed air over (TEAO) enclosure, with permanently lubricated bearings, and having built-in overcurrent- and thermal-overload protection.
4. Fan Guards: Steel safety guards with corrosion-resistant coating.

5. Unit shall be capable of starting and running at outdoor ambient temperatures from 0F to 125F for all sizes.

J. Electrical Power:

1. Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to water chiller.
2. House in a unit-mounted, NEMA 250, Type 3R enclosure with hinged access door with lock and key or padlock and key.
3. Wiring shall be numbered and color-coded to match wiring diagram.
4. Install factory wiring outside of an enclosure in a raceway.
5. Field power interface shall be to wire lugs.
6. Provide branch power circuit to each motor and to controls with one of the following disconnecting means:

    a. 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.
    b. NEMA KS 1, heavy-duty, nonfusible switch.
    c. NEMA AB 1, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.

7. Provide each motor with overcurrent protection.
8. Overload relay sized according to UL 1995, or an integral component of water chiller control microprocessor.
9. Phase-Failure and Undervoltage: Solid-state sensing with adjustable settings.
10. Provide power factor correction capacitors to correct power factor to 0.9 at full load.
11. Transformer: Unit-mounted transformer with primary and secondary fuses and sized with enough capacity to operate electrical load plus spare capacity.

    a. Power unit-mounted controls where indicated.
    b. Power unit-mounted, ground fault interrupt (GFI) duplex receptacle.

12. Control Relays: Auxiliary and adjustable time-delay relays.
13. Indicate the following for water chiller electrical power supply:

    a. Current, phase to phase, for all three phases.
    b. Voltage, phase to phase and phase to neutral for all three phases.
    c. Three-phase real power (kilowatts).
    d. Three-phase reactive power (kilovolt amperes reactive).
    e. Power factor.
    f. Running log of total power versus time (kilowatt hours).
    g. Fault log, with time and date of each.

K. Controls:

1. Stand-alone, microprocessor based. The microprocessor-based unit controller shall be factory-installed and factory-tested.
2. Enclosure: Share enclosure with electrical power devices or provide a separate enclosure of matching construction.
3. Operator Interface: Keypad or pressure-sensitive touch screen. Multiple-character, backlit, liquid-crystal display or light-emitting diodes. Display the following:

    a. Date and time.
    b. Operating or alarm status.

c. Operating hours.
d. Outside-air temperature if required for chilled-water reset.
e. Temperature and pressure of operating set points.
f. Entering and leaving temperatures of chilled water.
g. Refrigerant pressures in evaporator and condenser.
h. Saturation temperature in evaporator and condenser.
i. No cooling load condition.
j. Elapsed time meter (compressor run status).
k. Pump status.
l. Antirecycling timer status.
m. Percent of maximum motor amperage.
n. Current-limit set point.
o. Number of compressor starts.
p. Refrigerant levels and temperatures.
q. Flow switch status.
r. Compressor starts and run times.

4. Control Functions:

a. Manual or automatic startup and shutdown time schedule.
b. Entering and leaving chilled-water temperatures, control set points, and motor load limit. Chilled-water leaving temperature shall be reset based on OA temperature.
c. Current limit and demand limit.
d. External water chiller emergency stop.
e. Antirecycling timer.
f. The unit controller shall utilize a microprocessor that will automatically take action to prevent unit shutdown due to abnormal operating conditions associated with: evaporator refrigerant temperature, high condensing pressure and motor current overload.

5. Provide the following safety controls with indicating lights or diagnostic readouts.
a. Low chilled water temperature protection.
b. High refrigerant pressure.
c. Low oil flow protection.
d. Loss of chilled water flow.
e. Contact for remote emergency shutdown.
f. Motor current overload.
g. Phase reversal/unbalance/single phasing.
h. Over/under voltage.
i. Failure of water temperature sensor used by controller.
j. Compressor status (on or off).

6. Manual-Reset Safety Controls: The following conditions shall shut down water chiller and require manual reset:

a. Low evaporator pressure or high condenser pressure.
b. Low chilled-water temperature.
c. Refrigerant high pressure.
d. High or low oil pressure.
e. High oil temperature.
f. Loss of chilled-water flow.

g. Digital Communications to BAS system shall consist of a BACnet MS/TP interface via a single twisted pair wiring.

L. Insulation:

1. Material: Closed-cell, flexible elastomeric, thermal insulation complying with ASTM C 534, Type I, for tubular materials and Type II, for sheet materials.
2. Thickness: 3/4 inch.
3. Factory-applied insulation over cold surfaces of water chiller components.

    a. Adhesive: As recommended by insulation manufacturer and applied to 100 percent of insulation contact surface. Seal seams and joints.

4. Apply protective coating to exposed surfaces of insulation.

M. Accessories:

1. Factory-furnished, chilled-water flow switches for field installation.
2. Individual compressor suction and discharge pressure gages with shutoff valves for each refrigeration circuit.
3. Factory-furnished neoprene isolators for field installation.

2.2 SOURCE QUALITY CONTROL

A. Perform functional test of water chillers before shipping.

B. Factory performance test water chillers, before shipping, according to ARI 550/590, "Water Chilling Packages Using the Vapor Compression Cycle."

C. Factory test and inspect evaporator according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1. Stamp with ASME label.

D. For water chillers located outdoors, rate sound power level according to ARI 370 procedure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before water chiller installation, examine roughing-in for equipment support, anchor-bolt sizes and locations, piping, and electrical connections to verify actual locations, sizes, and other conditions affecting water chiller performance, maintenance, and operations.

1. Water chiller locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 WATER CHILLER INSTALLATION

A. Install water chillers on support structure indicated.

B. Equipment Mounting: Install water chiller on concrete bases using elastomeric pads. Comply with requirements in Division 03 Section.
   1. 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.
   2. For supported equipment, 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.

C. Maintain manufacturer's recommended clearances for service and maintenance.

D. Charge water chiller with refrigerant if not factory charged and fill with oil if not factory installed.

E. Install separate devices furnished by manufacturer and not factory installed.

3.3 CONNECTIONS

A. Comply with requirements in Division 23 Section "Hydronic Piping" Drawings indicate general arrangement of piping, fittings, and specialties.

B. Comply with requirements in Division 23 Section "Refrigerant Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

C. Install piping adjacent to chiller to allow service and maintenance.

D. Evaporator Fluid Connections: Connect to evaporator inlet with shutoff valve, strainer, flexible connector, thermometer, and plugged tee with pressure gage. Connect to evaporator outlet with shutoff valve, balancing valve, flexible connector, flow switch, thermometer, plugged tee with pressure gage, and drain connection with valve. Make connections to water chiller with a union, flange, or mechanical coupling.

E. Connect each drain connection with a union and drain pipe and extend pipe, full size of connection, to floor drain. Provide a shutoff valve at each connection if required.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assemblies, installations, and connections.

C. Complete installation and startup checks according to manufacturer's written instructions and perform the following:

   1. Verify that refrigerant charge is sufficient and water chiller has been leak tested.
   2. Verify that pumps are installed and functional.
   3. Verify that thermometers and gages are installed.
   4. Operate water chiller for run-in period.
   5. Check bearing lubrication and oil levels.
   6. Verify that refrigerant pressure relief device for chillers installed indoors is vented outside.

7. Verify proper motor rotation.
8. Verify static deflection of vibration isolators, including deflection during water chiller startup and shutdown.
9. Verify and record performance of chilled-water flow and low-temperature interlocks.
10. Verify and record performance of water chiller protection devices.
11. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.

D. Prepare a written startup report that records results of tests and inspections.

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain water chillers.

END OF SECTION 23 6423

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SECTION 23 7313

MODULAR INDOOR CENTRAL-STATION AIR-HANDLING 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 constant-volume, modular air-handling units with coils for indoor installations.

1.3 SUBMITTALS

A. Product Data: For each type of modular indoor air-handling unit indicated. Include the following:

1. Certified fan-performance curves with system operating conditions indicated.
2. Certified fan-sound power ratings.
3. Certified coil-performance ratings with system operating conditions indicated.
4. Motor ratings, electrical characteristics, and motor and fan accessories.
5. Material gages and finishes.
6. Filters with performance characteristics.
7. Dampers, including housings, linkages, and operators.

B. Shop Drawings: Signed and sealed by a qualified professional engineer.

1. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.
3. Wiring Diagrams: Power, signal, and control wiring.

C. Coordination Drawings: Submit with Shop Drawings. Show mechanical-room layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.

D. Field Quality-Control Test Reports: From manufacturer.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain modular indoor air-handling units through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of modular indoor air-handling units and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

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. NFPA Compliance: Modular indoor air-handling units and components shall be designed, fabricated, and installed in compliance with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."

E. ARI Certification: Modular indoor air-handling units and their components shall be factory tested according to ARI 430, "Central-Station Air-Handling Units," and shall be listed and labeled by ARI.

F. Comply with NFPA 70.

1.5 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

C. Coordinate size and location of structural-steel support members.

1.6 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: One set for each modular indoor air-handling unit.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
1. Carrier; Div. of United Technologies Corp.
2. Trane Company (The); Worldwide Applied Systems Group.
3. York International Corporation.
4. Temtrol.

2.2 MANUFACTURED UNITS

A. Modular indoor air-handling units shall be factory assembled and consist of fans, motor and drive assembly, coils, damper, plenums, filters, condensate pans, mixing dampers, control devices, and accessories.

2.3 AIR HANDLING UNIT CASING SOUND RATINGS

A. BELOW ARE THE MAXIMUM ALLOWABLE DECIBEL LEVELS FOR THE CASE SOUND RATING OF EACH UNIT.

Accoustical Performance (dB)									
		Frequency (Hz)							
		63	125	250	500	1000	2000	4000	8000
Mechanical Equipment	AHU-1	88	83	79	78	84	64	57	54
	AHU-2	82	82	75	89	79	59	52	56
	AHU-3	81	81	79	76	77	58	51	56
	AHU-4	77	75	73	81	72	62	62	57

2.4 CABINET

A. Materials: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.

1. Outside Casing: Galvanized Steel.
2. Inside Casing: Galvanized Steel.
3. The casing shall be able to withstand up to 4 inches w.g. positive or negative static pressure.
4. The unit panels shall not exceed 0.005 inch deflection per inch of panel span at 4 inches w.g. positive or negative static pressure.
5. Floor Plate: Shall support a 300-lb. load during maintenance activities and shall deflect no more than 0.005 inch per inch of panel span when sitting on a support structure.

B. Cabinet Insulation: Comply with NFPA 90A or NFPA 90B.

1. Materials: ASTM C 1071 with coated surface exposed to airstream to prevent erosion of glass fibers.
2. Minimum thermal resistance: 13 R-value.
3. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50, when tested according to ASTM C 411.
4. Liner Adhesive: Comply with NFPA 90A or NFPA 90B and ASTM C 916.
5. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
6. Location and Application: Factory applied with adhesive and mechanical fasteners to the internal surface of section panels downstream from and including the cooling coil section.
7. Location and Application: Encased between outside and inside casing.

C. Access Panels and Doors: Same materials and finishes as cabinet, complete with hinges, latches, handles, and gaskets. Inspection and access panels and doors shall be sized and located to allow periodic maintenance and inspections. Provide access panels and doors in the following locations:

1. Fan Section: Doors.
2. Access Section: Doors.
3. Coil Section: Doors.
4. Filter Section: Doors to allow periodic removal and installation of filters.

D. Condensate Drain Pans: Formed sections of stainless-steel sheet complying with requirements in ASHRAE 62. Fabricate pans with slopes in two planes to collect condensate from cooling coils (including coil piping

connections and return bends) and humidifiers when units are operating at maximum catalogued face velocity across cooling coil.

1. Double-Wall Construction: Fill space between walls with foam insulation and seal moisture tight.
2. Drain Connections: Both ends of pan.
3. Pan-Top Surface Coating: Elastomeric compound.
4. Units with stacked coils shall have an intermediate drain pan or drain trough to collect condensate from top coil.

2.5 FAN SECTION

A. Fan-Section Construction: Direct-drive axial fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and support structure and equipped with formed-steel channel base for integral mounting of fan, motor, and casing panels. Mount fan with vibration isolation.

B. Fan Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and motor horsepower.

C. Backward-Inclined Fan Wheels: [Steel] [Aluminum] construction with curved inlet flange, backplate, [and] backward-inclined blades[welded or riveted to flange and backplate; cast-iron or cast-steel hub riveted to backplate and fastened to shaft with set screws].

D. Direct-Drive Plenum Fan: The fan shall be a single-width, single-inlet, 10-blade plenum fan.
   1. Roller-Bearing Rating Life: ABMA 11, L_{10} of [50,000] [120,000] hours.

E. Vibration Control: Install fans on open-spring vibration isolators having a minimum of 1-inch static deflection and side snubbers.

F. Fan-Section Source Quality Control:

   1. Sound Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCA-certified sound ratings seal.
   2. Factory test fan performance for flow rate, pressure, power, air density, rotation speed, and efficiency. Establish ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

2.6 COILS

A. Coil Sections: Common or individual, insulated, galvanized-steel casings for heating and cooling coils. Design and construct to facilitate removal and replacement of coil for maintenance and to ensure full airflow through coils.

B. Water Coils: Continuous circuit coil fabricated according to ARI 410

   1. Piping Connections: Threaded, on same end.
   2. Tubes: Copper.
   3. Fins: Aluminum.
   4. Fin and Tube Joint: Mechanical bond.
   5. Headers: Seamless copper tube with brazed joints, prime coated.
   6. Frames: Galvanized-steel channel frame,

7. Frames: Stainless steel, Ratings: Design tested and rated according to ASHRAE 33 and ARI 410.

   a. Working-Pressure Ratings: 300 psig, 200 deg F.

8. Source Quality Control: Test to 450 psig.

2.7 FILTER SECTION

A. Filters: Comply with NFPA 90A.

B. Filter Section: Provide filter holding frames arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side.

C. Disposable Panel Filters: Factory-fabricated, viscous-coated, flat-panel-type, disposable air filters with holding frames.

1. Media: Interlaced glass fibers sprayed with nonflammable adhesive.
2. Frame: Galvanized steel with metal grid on outlet side, steel rod grid on inlet side, hinged, and with pull and retaining handles.
3. Duct-Mounting Frames: Welded, galvanized steel with gaskets and fasteners, suitable for bolting together into built-up filter banks.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of steam, hydronic, and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Contractor shall coordinate disassembly of AHU-1 for installation in basement. Contractor shall follow manufacturers guidelines for disassembly.

B. Concrete Bases: Install floor mounting units on 4-inch high concrete bases for AHU-1. The AHUs in the attic shall be mounted on platform with neoprene pads. See Division 23 Section "Common Work Results for HVAC" for concrete base materials and fabrication requirements.

C. Arrange installation of units to provide access space around modular indoor air-handling units for service and maintenance.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Connect piping to modular indoor air-handling units mounted on vibration isolators with flexible connectors.

D. Connect condensate drain pans using NPS 1-1/4, Type M copper tubing. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.

E. Chilled-Water Piping: Comply with applicable requirements in Division 23 Section "Hydronic Piping." Connect to supply and return coil tappings with shutoff or balancing valve and union or flange at each connection.

F. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connections.

G. Electrical: Comply with applicable requirements in Division 26 Sections for power wiring, switches, and motor controls.

H. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

I. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

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 piping and electrical connections. Report results in writing.

1. Leak Test: After installation, fill water coils with water and test coils and connections for leaks. Repair leaks and retest until no leaks exist.
2. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Final Checks before Startup: Perform the following:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Perform cleaning and adjusting specified in this Section.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify free fan wheel rotation and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.

6. Set outside- and return-air mixing dampers to minimum outside-air setting.
7. Comb coil fins for parallel orientation.
8. Install clean filters.
9. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.

C. Starting procedures for modular indoor air-handling units include the following:

1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm.
2. Measure and record motor electrical values for voltage and amperage.
3. Manually operate dampers from fully closed to fully open position and record fan performance.

D. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for modular indoor air-handling system testing, adjusting, and balancing.

3.6 CLEANING

A. Clean modular indoor air-handling units internally, on completion of installation, according to manufacturer's written instructions. Clean fan interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheels, cabinets, and coils entering air face.

B. After completing system installation and testing, adjusting, and balancing modular indoor air-handling and air-distribution systems, clean filter housings and install new filters.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain modular indoor air-handling units.

END OF SECTION 23 7313

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SECTION 23 8126

SPLIT-SYSTEM AIR-CONDITIONERS

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 split-system air-conditioning consisting of separate evaporator-fan and compressor-condenser components.

1.3 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics. Refrigerant piping type, pressure rating, and sizes.

B. Shop Drawings: Refrigerant routing, Diagram power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

E. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of split-system units and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Energy-Efficiency Ratio: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."

D. Coefficient of Performance: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."

E. Units shall be designed to operate with HCFC-free refrigerants.

1.5 COORDINATION

A. Coordinate size and location of concrete bases for units. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."

B. Coordinate size, location, and connection details with roof curbs, equipment supports, and roof penetrations specified in Division 07 Section "Roof Accessories."

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

   1. Filters: One set of filters for each unit.
   2. Fan Belts: One set of belts for each unit.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. Carrier Air Conditioning; Div. of Carrier Corporation.
   2. Johnson Controls.
   3. Lennox Industries Inc.
   4. Trane Company (The); Unitary Products Group.
   5. York International Corp.

2.2 WALL-MOUNTING, EVAPORATOR-FAN COMPONENTS

A. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.

B. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with thermal-expansion valve.

C. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements with refractory ceramic support bushings; automatic-reset thermal cutout; built-in magnetic contactors; manual-reset thermal cutout; airflow proving device; and one-time fuses in terminal box for overcurrent protection.

D. Fan: Direct drive, centrifugal fan.

E. Fan Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

F. Filters: Permanent, cleanable.

G. Wall mounted unit shall have independent power source. Cannot share power source with condenser unit.

2.3 EVAPORATOR-FAN COMPONENTS

A. Casing: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.

1. Insulation: Faced, glass-fiber duct liner.
2. Drain Pans: Slide-out composite, with connection for drain.

B. Refrigerant Coil: Aluminum tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with thermal-expansion valve.

C. Fan: Belt driven forward-curved, double-width wheel of galvanized steel.

D. Fan Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

1. Special Motor Features: Multitapped, multispeed with internal thermal protection and permanent lubrication.

E. Disposable Filters: 1 inch thick, in fiberboard frames.

F. Filter Rack: Provided by manufacturer compatible with 2” throwaway filters.

G. Wiring Terminations: Connect motor to chassis wiring with plug connection.

H. Wall mounted unit shall have independent power source. Cannot share power source with condenser unit.

2.4 AIR-COOLED, COMPRESSOR-CONDENSER COMPONENTS

A. Casing: Zinc coated galvanized steel, finished with baked enamel, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.

B. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
1. Compressor Type: scroll.
2. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
3. Refrigerant Charge: R-410A.

C. Refrigerant Coil: Aluminum tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with liquid subcooler.

D. Fan: Aluminum-propeller type, directly connected to motor.

E. Motor: Permanently lubricated, with integral thermal-overload protection.

F. Low Ambient Kit: Permits operation down to 0 deg F.

G. Mounting Base: Polyethylene.

H. Wall mounted unit shall have independent power source. Cannot share power source with condenser unit.

2.5 REFRIGERANT PIPING

A. Performance Requirements for Refrigerant R-410A:
   1. Suction Line for Air-Conditioning Applications: 300 psig.
   2. Hot-Gas and Liquid Lines: 535 psig.

B. Copper Tube and Fittings:
   1. Copper Tube: ASTM B 88, Type K or L
   2. Wrought-Copper Fittings: ASME B16.22.
   3. Wrought-Copper Unions: ASME B16.22.
   4. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
   5. Brazing Filler Metals: AWS A5.8.
   6. Flexible Connectors:
      a. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
      b. End Connections: Socket ends.
      c. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch long assembly.
      d. Pressure Rating: Factory test at minimum 500 psig.
      e. Maximum Operating Temperature: 250 deg F.

2.6 ACCESSORIES

A. Control equipment and sequence of operation are specified in Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls."

B. LonTalk building automation system controller.

C. Smoke Detectors: Install in supply and return air. The smoke detectors stop operation of the unit by interrupting power to the control board if smoke is detected within the air compartment.

D. Automatic-reset timer to prevent rapid cycling of compressor.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units level and plumb.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

C. Install ground-mounting, compressor-condenser components on 4-inch- thick, reinforced concrete base; 4 inches larger on each side than unit. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete." Coordinate anchor installation with concrete base.

D. Install ground-mounting, compressor-condenser components on polyethylene mounting base.

E. Install roof-mounting compressor-condenser components on equipment supports specified in Division 07 Section "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.

F. Install compressor-condenser components on restrained, spring isolators with a minimum static deflection of 1 inch.

G. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install refrigerant ball valves on each line at condensing unit and fan coil unit, a total of four valves shall be installed per split system.

C. Install piping adjacent to unit to allow service and maintenance.

D. Duct Connections: Duct installation requirements are specified in Division 23 Section "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply and return ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Division 23 Section "Air Duct Accessories."

E. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

F. Electrical Connections: Comply with requirements in Division 26 Sections for power wiring, switches, and motor controls.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 23 3826

SECTION 26 0500

COMMON WORK RESULTS FOR ELECTRICAL

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. Electrical equipment coordination and installation.
2. Common electrical installation requirements.
3. Product / manufacturer substitution procedures.

1.3 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed.

D. Coordinate sleeve selection and application with selection and application of firestopping.

PART 2 - PRODUCTS

2.1 PRODUCT SUBSTITUTION PROCEDURES

A. For any products proposed or manufacturers to be utilized which are not specifically listed on the drawings or within these division 26 specifications, the contractor/bidder must submit the product data for the proposed product to the engineer for review a minimum of 14 calendar days in advance of bid date.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

3.2 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly.

END OF SECTION 26 0500

SECTION 26 0519

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. This Section includes the following:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.
3. Sleeves and sleeve seals for cables.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.4 SUBMITTALS

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

B. Qualification Data: For testing agency.

C. Field quality-control test reports.

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. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. General Cable Corporation.
2. Southwire Company.
3. CME
4. Encore Wire Corporation.

B. Copper Conductors: Comply with NEMA WC 70.

C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN.

D. Multiconductor Cable: Comply with NEMA WC 70 for metal-clad cable, Type MC with ground wire.

2.2 CONNECTORS AND SPLICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AFC Cable Systems, Inc.
2. Hubbell Power Systems, Inc.
3. O-Z/Gedney; Emerson.
4. 3M; Electrical Products Division.
5. Tyco Electronics Corp.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SLEEVES FOR CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch (1.3- or 3.5-mm) thickness as indicated and of length to suit application.

D. Coordinate sleeve selection and application with selection and application of firestopping.

2.4 SLEEVE SEALS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Advance Products & Systems, Inc.

2. Calpico, Inc.
3. Metraflex Co.
4. Pipeline Seal and Insulator, Inc.

B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.

1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
2. Pressure Plates: Stainless steel. Include two for each sealing element.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Feeders and Branch Circuits: Type THHN-THWN, single conductors in raceway.

B. Final 6 feet of connection to devices, transformers and equipment: Type THHN-THWN, single conductors in raceway, or Metal-clad cable, Type MC.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."

F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

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 and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Coordinate sleeve selection and application with selection and application of firestopping.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Rectangular Sleeve Minimum Metal Thickness:

1. For sleeve rectangle perimeter less than 50 inches (1270 mm) and no side greater than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
2. For sleeve rectangle perimeter equal to, or greater than, 50 inches (1270 mm) and 1 or more sides equal to, or greater than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

F. Cut sleeves to length for mounting flush with both wall surfaces.

G. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

H. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.

I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint according to Division 07 Section "Joint Sealants."

K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at cable penetrations. Install sleeves and seal with firestop materials according to Division 07 Section "Penetration Firestopping."

L. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.

M. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

N. Underground Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between cable and sleeve for installing mechanical sleeve seals.

3.6 SLEEVE-SEAL INSTALLATION

A. Install to seal underground exterior-wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test for compliance with requirements.

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.

    a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
    b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
    c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

C. Test Reports: Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

D. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 26 0519

SECTION 26 0526

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. This Section includes methods and materials for grounding systems and equipment.

1.3 SUBMITTALS

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

B. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in Part 3 "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.
5. Grounding for sensitive electronic equipment.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For grounding to include the following in emergency, operation, and maintenance manuals:

1. Instructions for periodic testing and inspection of grounding features at test wells, ground rings, and grounding connections for separately derived systems based on NFPA 70B.

    a. Tests shall be to determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.
    b. Include recommended testing intervals.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper or tinned copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

C. Grounding Bus: Rectangular bars of annealed copper, 1/4 by 2 inches (6 by 50 mm) in cross section, 24” in length, unless otherwise indicated; with insulators.

2.2 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch by10 feet.

B. Chemical-Enhanced Grounding Electrodes: Copper tube, straight or L-shaped, charged with nonhazardous electrolytic chemical salts.

1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches (1200 mm) long.
2. Backfill Material: Electrode manufacturer's recommended material.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 10 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.

B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.

1. Bury at least 24 inches (600 mm) below grade.

C. Grounding Bus: Install in electrical and telecommunications equipment rooms, and in rooms housing service equipment.

1. Install bus on insulated spacers 1 inch (25 mm), minimum, from wall 6 inches (150 mm) 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 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.
7. Armored and metal-clad cable runs.
8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.

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. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate

conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.

F. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-24-inch (6-by-50-by-300-mm) grounding bus.
2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

3.3 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Common Ground Bonding with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

C. Ground Rods: Drive rods until tops are 2 inches (50 mm) 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.

D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes shall be at least 12 inches (300 mm) deep, with cover.

1. Test Wells: Install test wells for ground loop at locations indicated on drawings. Set top of test well flush with finished grade/sidewalk. Covers shall be rated for light vehicular traffic.

E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

F. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

H. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each indicated item, extending around the perimeter of building.

1. Install tinned-copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel.
2. Bury ground ring not less than 24 inches from building foundation.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.

    a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    b. Perform tests by fall-of-potential method according to IEEE 81.

3. 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.

B. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.
2. Power and Lighting Equipment or System with Capacity 500 to 1000 kVA: 5 ohms.
3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.

C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 26 0526

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SECTION 26 0529

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. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Steel slotted support systems.
2. Nonmetallic slotted support systems.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze hangers. Include Product Data for components.

2. Steel slotted channel systems. Include Product Data for components.
3. Nonmetallic slotted channel systems. Include Product Data for components.
4. Equipment supports.

C. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Comply with NFPA 70.

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

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. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Allied Tube & Conduit.
b. Cooper B-Line, Inc.; a division of Cooper Industries.
c. ERICO International Corporation.
d. GS Metals Corp.
e. Thomas & Betts Corporation.
f. Unistrut; Tyco International, Ltd.
g. Wesanco, Inc.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
3. Channel Dimensions: Selected for applicable load criteria.

B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch- (14-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c., in at least 1 surface.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Allied Tube & Conduit.
b. Cooper B-Line, Inc.; a division of Cooper Industries.
c. Fabco Plastics Wholesale Limited.
d. Seasafe, Inc.

2. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
3. Fitting and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.
4. Rated Strength: Selected to suit applicable load criteria.

C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

    a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

        1) Hilti Inc.
        2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
        3) MKT Fastening, LLC.
        4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.

2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

    a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

        1) Cooper B-Line, Inc.; a division of Cooper Industries.
        2) Empire Tool and Manufacturing Co., Inc.
        3) Hilti Inc.
        4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
        5) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Division 05 specification sections for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

C. 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 two-bolt conduit clamps.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1 inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
7. To Light Steel: Sheet metal screws.

8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 05 specification sections 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 or not less than 4 inches (100 mm) 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 (20.7-MPa), 28-day compressive-strength concrete.

C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touchup: Comply with requirements in Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 26 0529

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SECTION 26 0533

RACEWAY 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. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. ENT: Electrical nonmetallic tubing.

C. EPDM: Ethylene-propylene-diene terpolymer rubber.

D. FMC: Flexible metal conduit.

E. IMC: Intermediate metal conduit.

F. LFMC: Liquidtight flexible metal conduit.

G. LFNC: Liquidtight flexible nonmetallic conduit.

H. NBR: Acrylonitrile-butadiene rubber.

I. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.

1. Custom enclosures and cabinets.

C. Coordination Drawings: Conduit routing 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 in the paths of conduit groups with common supports.

2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.
3. Historic ceiling and wall areas.

D. Source quality-control test reports.

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.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AFC Cable Systems, Inc.
2. Alflex Inc.
3. Allied Tube & Conduit; a Tyco International Ltd. Co.
4. Anamet Electrical, Inc.; Anaconda Metal Hose.
5. Electri-Flex Co.
6. Manhattan/CDT/Cole-Flex.
7. Maverick Tube Corporation.
8. O-Z Gedney; a unit of General Signal.
9. Wheatland Tube Company.

B. Rigid Steel Conduit: ANSI C80.1.

C. IMC: ANSI C80.6.

D. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch (1 mm), minimum.

E. EMT: ANSI C80.3.

F. FMC: Zinc-coated steel.

G. LFMC: Flexible steel conduit with PVC jacket.

H. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
2. Fittings for EMT: Steel compression type.

3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

I. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND TUBING

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AFC Cable Systems, Inc.
2. Anamet Electrical, Inc.; Anaconda Metal Hose.
3. Arnco Corporation.
4. CANTEX Inc.
5. CertainTeed Corp.; Pipe & Plastics Group.
6. Condux International, Inc.
7. ElecSYS, Inc.
8. Electri-Flex Co.
9. Lamson & Sessions; Carlon Electrical Products.
10. Manhattan/CDT/Cole-Flex.
11. RACO; a Hubbell Company.
12. Thomas & Betts Corporation.

B. ENT: NEMA TC 13.

C. RNC: NEMA TC 2, Type EPC-40 or EPC-80-PVC as indicated.

D. LFNC: UL 1660.

E. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.

F. Fittings for LFNC: UL 514B.

2.3 METAL WIREWAYS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper B-Line, Inc.
2. Hoffman.
3. Square D; Schneider Electric.

B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, unless otherwise indicated.

C. Fittings and Accessories: Include 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: Screw-cover type for interior applications and Flanged-and-gasketed type for exterior applications, unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.4 NONMETALLIC WIREWAYS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Hoffman.
2. Lamson & Sessions; Carlon Electrical Products.

B. Description: Fiberglass polyester, extruded and fabricated to size and shape indicated, with no holes or knockouts. Cover is gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections are flanged, with stainless-steel screws and oil-resistant gaskets.

C. Fittings and Accessories: Include 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.

2.5 SURFACE RACEWAYS

A. Surface Metal Raceways: Galvanized steel with snap-on covers. Prime coating, ready for field painting.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Thomas & Betts Corporation.
b. Wiremold Company (The).
c. Hubbell.

B. Surface Nonmetallic Raceways: Two-piece construction, manufactured of rigid PVC with texture and color selected by Architect.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Butler Manufacturing Company; Walker Division.
b. Enduro Systems, Inc.; Composite Products Division.
c. Hubbell Incorporated; Wiring Device-Kellems Division.
d. Lamson & Sessions; Carlon Electrical Products.
e. Panduit Corp.
f. Walker Systems, Inc.; Wiremold Company (The).
g. Wiremold Company (The); Electrical Sales Division.

2.6 BOXES, ENCLOSURES, AND CABINETS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. EGS/Appleton Electric.
3. Erickson Electrical Equipment Company.
4. Hoffman.
5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
6. O-Z/Gedney; a unit of General Signal.
7. RACO; a Hubbell Company.

8. Robroy Industries, Inc.; Enclosure Division.
9. Scott Fetzer Co.; Adalet Division.
10. Spring City Electrical Manufacturing Company.
11. Thomas & Betts Corporation.
12. Walker Systems, Inc.; Wiremold Company (The).
13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

D. Nonmetallic Outlet and Device Boxes: NEMA OS 2.

E. Metal Floor Boxes: Cast metal, fully adjustable, rectangular.

F. Nonmetallic Floor Boxes: Nonadjustable, round.

G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

H. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, galvanized, cast iron with gasketed cover.

I. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Plastic.

J. Cabinets:

1. NEMA 250, Type 1, 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.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:

1. Exposed Conduit: Rigid steel conduit.
2. Concealed Conduit, Aboveground: IMC.
3. Underground Conduit: RNC, Type EPC-40 or EPC-80-PVC as indicated, direct buried.
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.
6. Application of Handholes and Boxes for Underground Wiring:

a. Handholes and Pull Boxes in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Polymer-concrete units, SCTE 77, Tier 8 structural load rating.

B. Comply with the following indoor applications, 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: Rigid steel conduit or IMC. Includes raceways in the following locations:

   a. Loading dock.
   b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
   c. Mechanical rooms.

4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: Rigid steel conduit or IMC.
7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.

C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

F. Do not install aluminum conduits in contact with concrete.

3.2 INSTALLATION

A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

B. Keep raceways at least 6 inches (150 mm) 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. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."

E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.

G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

H. 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.

I. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

J. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire.

K. Install raceway sealing fittings at suitable, approved, and accessible locations 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 at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where otherwise required by NFPA 70.

L. Expansion-Joint Fittings for RNC: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg F (17 deg C), and that has straight-run length that exceeds 25 feet (7.6 m).

1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:

    a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
    b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
    c. Indoor Spaces: Connected with the Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
    d. Attics: 135 deg F (75 deg C) temperature change.

2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change.
3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.

M. Flexible Conduit Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed lighting fixtures, 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 or LFNC in damp or wet locations not subject to severe physical damage.

N. 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.

O. Set metal floor boxes level and flush with finished floor surface.

P. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 26 0533

SECTION 26 0553

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. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Warning labels and signs.
5. Instruction signs.
6. Equipment identification labels.
7. Miscellaneous identification products.

1.3 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

C. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.4 QUALITY ASSURANCE

A. Comply with ANSI A13.1.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

B. Colors for Raceways Carrying Circuits at 600 V or Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage and system or service type.

C. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.2 METAL-CLAD CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Colors for Raceways Carrying Circuits at 600 V and Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage and system or service type.

C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.4 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.5 FLOOR MARKING TAPE

A. 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

2.6 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Baked-Enamel Warning Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch (6.4-mm) grommets in corners for mounting.
3. Nominal size, 7 by 10 inches (180 by 250 mm).

C. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

2.7 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. inches (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.

2.8 EQUIPMENT IDENTIFICATION LABELS

A. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).

2.9 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black.

C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 7000 psi (48.2 MPa).
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
5. Color: Black.

2.10 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

F. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

G. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

H. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.2 IDENTIFICATION SCHEDULE

A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 20A, and 120V to ground: Identify with self-adhesive vinyl label. Install labels at 30-foot (10-m) maximum intervals.

B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:

1. Emergency Power.
2. Normal Power.
3. UPS Power.

C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit conductors.

a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
b. Colors for 208/120-V Circuits:

1) Phase A: Black.
2) Phase B: Red.
3) Phase C: Blue.

c. Colors for 480/277-V Circuits:

1) Phase A: Brown.
2) Phase B: Orange.
3) Phase C: Yellow.

d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

D. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

E. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.

F. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

G. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts in all basement electrical rooms. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces, or in electrical rooms other than in the basement.

H. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.

1. Comply with 29 CFR 1910.145.
2. Identify system voltage with black letters on an orange background.
3. Apply to exterior of door, cover, or other access.
4. 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.

I. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

J. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer and load shedding.

K. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

    a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.
    b. Outdoor Equipment: Stenciled legend 4 inches (100 mm) high.
    c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.

d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:

a. Panelboards: Typewritten directory of circuits in the location provided by contractor. Panelboard identification shall be self-adhesive, engraved, laminated acrylic or melamine label.
b. Enclosures and electrical cabinets.
c. Access doors and panels for concealed electrical items.
d. Switchgear.
e. Switchboards.
f. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
g. Emergency system boxes and enclosures.
h. Enclosed switches.
i. Enclosed circuit breakers.
j. Enclosed controllers.
k. Variable-speed controllers.
l. Push-button stations.
m. Power transfer equipment.
n. Contactors.
o. Power-generating units.
p. Monitoring and control equipment.
q. UPS equipment.
r. Lighting controllers.

END OF SECTION 26 0553

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SECTION 26 0800

ELECTRICAL COMMISSIONING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Commissioning. Commissioning is a systematic process of ensuring that all building systems perform interactively according to the Owner's Project Requirements (OPR). Commissioning during the construction phase is intended to achieve the following specific objectives according to the Contract Documents:

1) Verify that applicable equipment and systems are installed according to the manufacturer's recommendations and to industry accepted minimum standards and that they receive adequate operational checkout by installing contractors.
2) Verify and document proper performance of equipment and systems.
3) Verify that O&M documentation is complete.
4) Verify that the Owner's operating personnel are adequately trained

B. The electrical systems to be commissioned are the lighting and respective controls, power equipment (switchboards/panelboards), UPS system, transformers, transfer switches, generator unit, and power monitoring equipment (including hardware and software).

C. Commissioning requires the participation of affected Division contractors to ensure that all systems are operating in a manner consistent with the Contract Documents. All affected Division contractors shall be familiar with all parts of the commissioning plan issued by the CA (Commissioning Authority) and shall execute all commissioning responsibilities assigned to them in the Contract Documents.

D. Commissioning Team. The members of the commissioning team consist of the Commissioning Authority (CA), the designated representative of the owner, the General Contractor (GC or Contractor), the Architect and Design Engineers, the Mechanical Contractor (MC), the Electrical Contractor (EC), the Controls Contractor (CC), the Fire Alarm Contractor, and any other installing subcontractors or suppliers of equipment. The Owner's building or plant operator/engineer is also a member of the commissioning team.

1.2 COMMISSIONING AUTHORITY

A. The commissioning authority and/or agency shall be selected and employed by the building owner. The commissioning agent shall be a licensed professional engineer in the State where the work will be performed, and shall be experienced in the commissioning of mechanical and electrical systems of the type installed in this project. Experience in construction process, direct digital control systems, test and balance and ASHRAE Guidelines is mandatory. The commissioning agent shall not be associated with or employed by a electrical designer, contractor, or equipment supplier associated with the project.

1.3 COMMISSIONING PLAN

A. Commissioning Plan. The commissioning plan provides guidance in the execution of the commissioning process. Just after the initial commissioning scoping meeting the CA will provide the plan, which will continue to evolve and expand as the project progresses. The *Specifications* will take precedence over the *Commissioning Plan*.

B. Commissioning Process. The following narrative provides a brief overview of the typical commissioning tasks during construction and the general order in which they occur.

1. Commissioning during design begins at the initiation of the Owner's Project Requirements development and documentation, and proceeds through commissioning specification development, preliminary commissioning plan development and plans and specifications review.
2. Commissioning during construction begins with a scoping meeting conducted by the CA where the commissioning process is reviewed with the commissioning team members.
3. Additional meetings will be required throughout construction, scheduled by the CA with necessary parties attending, to plan, scope, coordinate, schedule future activities and resolve problems. Generally, these meetings will be included with or will be sequential with regular subcontractor meetings.
4. Equipment documentation is submitted to the CA during normal submittals, including detailed start-up procedures.
5. The CA works with the Subs in developing startup plans and startup documentation formats, including prefunctional checklists to be completed, during the startup process.
6. In general, the checkout and performance verification proceeds from simple to complex; from component level to equipment to systems and intersystem levels with prefunctional checklists being completed before functional testing.
7. The Subcontractors, under their own direction, execute and document the prefunctional checklists and perform startup and initial checkout. The CA documents that the checklists and startup were completed according to the approved plans. This may include the CA witnessing start-up of selected equipment and systems.
8. The installing contractors, suppliers and manufacturers, develop specific equipment and system functional performance test procedures with the assistance of the CA.
9. The procedures are executed by the Subcontractors, under the observation of the CA.
10. Items of non-compliance in material, installation or setup are corrected at the Subcontractor's expense and the system retested.
11. The CA reviews the O&M documentation for completeness. All O&M documentation must be submitted and approved before the start of training.
12. Commissioning shall be completed before Substantial Completion.
13. The CA reviews, pre-approves and coordinates the training provided by the Subs and verifies that it was completed.
14. Deferred testing is conducted, as specified or required.

1.4 RESPONSIBILITIES

A. General Contractor (GC)

1. Facilitate the coordination of the commissioning work by the CA, and with the CA ensure that commissioning activities are being scheduled into the master schedule.
2. Include the cost of commissioning planning, coordination and execution in the contract price.
3. Furnish a copy of all construction documents, addenda, change orders and approved submittals and shop drawings related to commissioned equipment to the CA in electronic PDF form.
4. In each purchase order or subcontract written, include requirements for submittal data, Systems/O&M data, commissioning tasks and training.
5. Ensure that all Subs execute their commissioning responsibilities according to the Contract Documents and schedule.
6. A representative shall attend a commissioning scoping meeting and other necessary meetings scheduled by the CA to facilitate the Commissioning process.
7. Coordinate the training of owner personnel.
8. Prepare Systems Manuals and O&M manuals, according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.

Warranty Period

1. Ensure that Subcontractors execute seasonal or deferred functional performance testing, witnessed by the CA, according to the specifications.
2. Ensure that Subs correct deficiencies and make necessary adjustments to O&M manuals and record drawings for applicable issues identified in any seasonal testing.

B. Electrical Contractors and Sub-Contractors

The commissioning responsibilities applicable to each of the subcontractors are generally as follows (all references apply to commissioned equipment only). Specific requirements are shown in the appropriate Divisions.

Construction and Acceptance Phases

1. Include the cost of commissioning planning, coordination and execution in the contract price.
2. In each purchase order or subcontract written, include requirements for submittal data, commissioning documentation, Systems/O&M data and training.
3. Attend a commissioning scoping meeting and other meetings necessary to facilitate the Commissioning process.
4. Contractors shall provide the CA with normal cut sheets and shop drawing submittals of commissioned equipment as part of the normal submittal process.
5. Provide additional requested documentation, prior to normal O&M manual submittals, to the CA for development of start-up and functional testing procedures.
    a. Typically this will include detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures, full details of any owner-contracted tests, full factory testing reports, if any, and full warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified. In addition, the installation, start-up and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Commissioning Authority.
    b. The Commissioning Authority may request further documentation necessary for the commissioning process.
6. Provide a copy of the Systems Manuals and O&M manuals and submittals of commissioned equipment, through normal channels, to the CA for review and approval.
7. Contractors shall assist (along with the design engineers) in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.
8. Provide assistance to the CA in preparing the specific functional performance test procedures. Subs shall review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests.
9. Develop a full start-up and initial checkout plan using manufacturer's start-up procedures and the prefunctional checklists from the CA for all commissioned equipment. Submit to CA for review and approval prior to startup.
10. During the startup and initial checkout process, execute the construction/verification checklists for all commissioned equipment.
11. Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the CA.
12. Address current A/E punch list items before functional testing
13. Provide skilled technicians to execute starting of equipment and to execute the functional performance tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem solving.
14. Perform functional performance testing under the observation of the CA for specified equipment. Assist the CA in interpreting the monitoring data, as necessary.
15. Correct deficiencies (differences between specified and observed performance) as interpreted by the CA, and A/E and retest the equipment.

16. Prepare Systems Manuals and O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.
17. Prepare redline as-built drawings for all drawings and final as-builds for contractor-generated coordination drawings.
18. Provide training of the Owner's operating personnel as specified.
19. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

Warranty Period

1. Execute seasonal or deferred functional performance testing, witnessed by the CA, according to the specifications.
2. Correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

C. Equipment Suppliers

1. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of the Owner to keep warranties in force.
2. Assist in equipment testing per agreements with Subs.
3. Include all special tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment according to these Contract Documents in the base bid price to the Contractor, except for stand-alone data logging equipment that may be used by the CA.
4. Provide information requested by CA regarding equipment sequence of operation and testing procedures.
5. Review test procedures for equipment installed by factory representatives.

C. Commissioning Authority (CA)

The CA is not responsible for design concept, design criteria, compliance with codes, design or construction documents, general construction scheduling, cost estimating, or construction management. The CA may assist with problem-solving non-conformance or deficiencies, but ultimately that responsibility resides with the general contractor and the A/E. The primary role of the CA is to develop and coordinate the execution of a testing plan, observe and document performance—that systems are functioning in accordance with the documented design intent and in accordance with the Contract Documents. The Contractors will provide all tools or the use of tools to start, checkout and functionally test equipment and systems, except for specified testing equipment supplied and installed by the CA.

1. Coordinates and directs the commissioning activities in a logical, sequential and efficient manner using consistent protocols and forms, centralized documentation, clear and regular communications and consultations with all necessary parties, frequently updated timelines and schedules and technical expertise.
2. Coordinate the commissioning work and, with the GC, ensure that commissioning activities are being scheduled into the master schedule.
3. Revise, as necessary, *Commissioning Plan—Construction Phase.*
4. Plan and conduct a commissioning scoping meeting.
5. Request and review additional information required to perform commissioning tasks, including Systems Manuals and O&M materials, contractor start-up and checkout procedures.
6. Before startup, gather and review the current control sequences and interlocks and work with contractors and design engineers until sufficient clarity has been obtained, in writing, to be able to write detailed testing procedures.
7. Review and approve normal Contractor submittals applicable to systems being commissioned for compliance with commissioning needs, along with A/E reviews.
8. Perform site visits, as necessary, to observe component and system installations. Attend selected planning and job-site meetings to obtain information on construction progress. Review construction meeting minutes for revisions/substitutions relating to the commissioning process. Assist in resolving any discrepancies.

9. Approve construction/verification tests and checklist completion by reviewing checklist reports and by selected site observation and spot checking.
10. Approve systems startup by reviewing start-up reports and by selected site observation.
11. Review the functional performance test procedures for equipment and systems developed by the subcontractors and suppliers. This may include energy management control system trending, or manual functional testing.
12. Coordinate, witness, and approve manual functional performance tests performed by installing contractors. Coordinate retesting as necessary until satisfactory performance is achieved.
13. Review equipment warranties to ensure that the Owner's responsibilities are clearly defined.
14. Oversee and approve the training of the Owner's operating personnel.
15. Compile and maintain a commissioning record.
16. Review and approve the preparation of the Systems Manuals and O&M manuals.
17. Provide a final commissioning report.

Warranty Period

1. Coordinate and supervise required seasonal or deferred testing and deficiency corrections.
2. Return to the site at 10 months into the 12-month warranty period and review with facility staff the current building operation and the condition of outstanding issues. Also interview facility staff and identify problems or concerns they have operating the building as originally intended. Make suggestions for improvements and for recording these changes in the Systems Manuals and O&M manuals. Identify areas that may come under warranty or under the original construction contract. Assist facility staff in developing reports, documents and requests for services to remedy outstanding problems.

1.5 Scheduling. The CA will work with the GC according to established protocols to schedule the commissioning activities. The CA will provide sufficient notice to the CM and GC for scheduling commissioning activities. The GC will integrate all commissioning activities into the master schedule. All parties will address scheduling problems and make necessary notifications in a timely manner in order to expedite the commissioning process.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. All standard testing equipment required to perform startup and initial checkout and required functional performance testing shall be provided by the Division contractor for the equipment being tested

B. Special equipment, tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment, according to these Contract Documents shall be included in the base bid price to the Contractor and left on site.

C. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the *Specifications*

PART 3 – EXECUTION

3.1 MEETINGS

A. Scoping Meeting. Within 90 days of commencement of construction or when all subcontractors have been selected, the CA will schedule, plan and conduct a commissioning scoping meeting with the entire commissioning team in attendance. Meeting minutes will be distributed to all parties by the GC. Information gathered from this meeting will allow the CA to revise the *Commissioning Plan* to its "final" version, which will also be distributed to all parties.

B. Miscellaneous Meetings. Other meetings will be planned and conducted by the CA as construction progresses. These meetings will cover coordination, deficiency resolution and planning issues with particular subcontractor. The CA will plan these meetings and will minimize unnecessary time being spent by Subs.

3.2 REPORTING

A. The CA will regularly communicate with all members of the commissioning team, keeping them apprised of commissioning progress and scheduling changes through memos, progress reports, etc.

B. Testing or review approvals and non-conformance and deficiency reports are made regularly with the review and testing as described in later sections.

C. A final summary report by the CA will be provided focusing on evaluating commissioning process issues and identifying areas where the process could be improved. All acquired documentation, logs, minutes, reports, deficiency lists, communications, findings, unresolved issues, etc., will be compiled in appendices and provided with the summary report.

3.3 SUBMITTALS

A. The CA will provide appropriate contractors with a specific request for the type of submittal documentation the CA requires to facilitate the commissioning work. These requests will be integrated into the normal submittal process and protocol of the construction team. At minimum, the request will include the manufacturer and model number, the manufacturer's printed installation and detailed start-up procedures, full sequences of operation, Systems Manuals and O&M data, performance data, any performance test procedures, control drawings and details of owner contracted tests. In addition, the installation and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Commissioning Authority. All documentation requested by the CA will be included by the Subcontractors in their Systems Manuals and O&M manual contributions.

B. The Commissioning Authority will review and approve submittals related to the commissioned equipment for conformance to the Contract Documents as it relates to the commissioning process, to the functional performance of the equipment and adequacy for developing test procedures. This review is intended primarily to aid in the development of functional testing procedures and only secondarily to verify compliance with equipment specifications. The Commissioning Agent will notify the appropriate persons as requested, of items missing or areas that are not in conformance with Contract Documents and which require resubmission.

C. The CA may request additional design narrative from the A/E and Controls Contractor, depending on the completeness of the design intent documentation and sequences provided with the Specifications.

3.4 START-UP, CONSTRUCTION/VERIFICATION CHECKLISTS AND INITIAL CHECKOUT

A. The following procedures apply to all equipment to be commissioned. Some systems that are not comprised so much of actual dynamic machinery may have very simplified PCs and startup.

B. General. Construction/verification checklists are important to ensure that the equipment and systems are hooked up and operational. It ensures that functional performance testing (in-depth system checkout) may proceed without unnecessary delays. Each piece of equipment receives full construction/verification checkout. No sampling strategies are used by the contractor. The prefunctional testing for a given system must be successfully completed prior to formal functional performance testing of equipment or subsystems of the given system.

D. Start-up and Initial Checkout Plan. The CA shall assist the commissioning team members responsible for startup of any equipment in developing detailed start-up plans for all equipment. The primary role of the CA in this process is to ensure that there is written documentation that each of the manufacturer-recommended procedures have been completed. Parties responsible for construction/verification checklists and startup are identified in the commissioning scoping meeting and in the checklist forms. Parties responsible for executing functional performance tests are identified in the testing requirements.

1. The CA assist in the development of checklists that indicate required procedures to be executed as part of startup and initial checkout of the systems and the party responsible for their execution.
2. The Contractor determines which trade is responsible for executing and documenting each of the line item tasks and notes that trade on the form. Each form may have more than one trade responsible for its execution.
3. The subcontractor responsible for the purchase of the equipment develops the full start-up plan by combining (or adding to) the CA's checklists with the manufacturer's detailed start-up and checkout procedures from the O&M manual and the normally used field checkout sheets. The plan will include checklists and procedures with specific boxes or lines for recording and documenting the checking and inspections of each procedure and a summary statement with a signature block at the end of the plan.
   The full start-up plan could consist of something as simple as:
   a. The contractor and CA construction/verification checklists.
   b. The manufacturer's standard written start-up procedures copied from the installation manuals with check boxes by each procedure and a signature block added by hand at the end.
   c. The manufacturer's normally used field checkout sheets.
4. The subcontractor submits the full startup plan to the CA for review and approval.
5. The CA reviews and approves the procedures and the format for documenting them, noting any procedures that need to be added.
6. The full start-up procedures and the approval form may be provided to the CM for review and approval, depending on management protocol.

D. Execution of Construction/verification Checklists and Startup.

1. Four weeks prior to startup, the Subs and vendors schedule startup and checkout with the GC and CA. The performance of the construction/verification checklists, startup and checkout are directed and executed by the Sub or vendor. When checking off construction/verification checklists, signatures may be required of other Subcontractors for verification of completion of their work.
2. The CA shall observe, at minimum, the procedures for each piece of primary equipment, unless there are multiple units, (in which case a sampling strategy may be used as approved).
3. For lower-level components of equipment the CA shall observe a sampling of the prefunctional and start-up procedures.
4. The Subcontractors and vendors shall execute startup and provide the CA with a signed and dated copy of the completed start-up and construction/verification tests and checklists.
5. Only individuals that have direct knowledge and witnessed that a line item task on the prefunctional checklist was actually performed shall initial or check that item off.

E. Deficiencies, Non-Conformance and Approval in Checklists and Startup.

1. The Subcontractors shall clearly list any outstanding items of the initial start-up and construction/verification procedures that were not completed successfully, at the bottom of the procedures form or on an attached sheet. The procedures form and any outstanding deficiencies are provided to the CA within two days of test completion.
2. The CA shall work with the Subcontractors and vendors to correct and retest deficiencies or uncompleted items. The CA will involve the CM or GC and others as necessary. The installing Subcontractors or vendors shall correct all areas that are deficient or incomplete in the checklists and tests in a timely manner, and shall notify the CA as soon as outstanding items have been corrected and resubmit an updated start-up report and a Statement of Correction on the original non-compliance report. When satisfactorily completed, the CA recommends approval of the execution of the checklists and startup of each system using a standard form.

3.5 FUNCTIONAL PERFORMANCE TESTING

A. This sub-section applies to all commissioning functional performance testing for all divisions.

B. Objectives and Scope. The objective of functional performance testing is to demonstrate that each system is operating according to the documented design intent and Contract Documents. Functional testing facilitates bringing the systems from a state of substantial completion to full dynamic operation. Additionally, during the testing process, areas of deficient performance are identified and corrected, improving the operation and functioning of the systems.

In general, each system should be operated through all modes of operation where there is a specified system response. Verifying each sequence in the sequences of operation is required.

C. Development of Test Procedures. Before test procedures are written, the CA shall obtain all requested documentation and a current list of change orders affecting equipment or systems, including an updated points list, program code, control sequences and parameters. Each Sub or vendor responsible to execute a test, shall provide assistance to the CA in developing the procedures review (answering questions about equipment, operation, sequences, etc.). Prior to execution, the CA shall provide a copy of the test procedures to the Sub(s) who shall review the tests for feasibility, safety, equipment and warranty protection. The CA may submit the tests to the A/E for review, if requested.

The purpose of any given specific test is to verify and document compliance with the stated criteria of acceptance given on the test form.

D. Test Methods.

1. Functional performance testing may be achieved by manual testing (persons manipulate the equipment and observe performance) or by monitoring the performance and analyzing the results. The CA will determine which method is most appropriate for tests that do not have a method specified.

E. Coordination and Scheduling. The Subcontractors shall provide sufficient notice to the CA regarding their completion schedule for the construction/verification checklists and startup of all equipment and systems. The CA will schedule functional tests through the GC and affected Subcontractors. The CA shall direct, witness and document the functional testing of all equipment and systems. The Subs shall execute the tests.

In general, functional testing is conducted after construction/verification testing and startup has been satisfactorily completed. Testing proceeds from components to subsystems to systems. When the proper performance of all interacting individual systems has been achieved, the interface or coordinated responses between systems is checked.

3.6 DOCUMENTATION, NON-CONFORMANCE AND APPROVAL OF TESTS

A. Documentation. The CA shall witness and document the results of all functional tests using the specific procedural forms developed for that purpose. Prior to testing, these forms are provided to the GC for review and approval and to the Subs for review. The CA will include the filled out forms in the Commissioning Report.

B. Non-Conformance.

1. All deficiencies or non-conformance issues shall be noted and reported on a standard non-compliance form.
2. Corrections of minor deficiencies identified may be made during the tests at the discretion of the CA. In such cases the deficiency and resolution will be documented on the procedure form.
3. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures.
4. As tests progress and a deficiency is identified, the CA discusses the issue with the executing contractor.
    a. When there is no dispute on the deficiency and the Sub accepts responsibility to correct it:
        1) The CA documents the deficiency and the Sub's response and intentions and they go on to another test or sequence
    b. If there is a dispute about a deficiency, regarding whether it is a deficiency or who is responsible:

1) The deficiency shall be documented on the non-compliance form with the Subcontractor's response and a copy given to the GC and to the Subcontractor representative assumed to be responsible.
2) Resolutions are made at the lowest management level possible. Other parties are brought into the discussions as needed. Final interpretive authority is with the A/E. Final acceptance authority is with the Owner.
3) Once the interpretation and resolution have been decided, the appropriate party corrects the deficiency, signs the statement of correction on the non-compliance form and provides it to the CA. The CA reschedules the test and the test is repeated until satisfactory performance is achieved.

5. Cost of Retesting.

a. The cost for the Subcontractor to retest a construction/verification or functional test, if they are responsible for the deficiency, shall be theirs. If they are not responsible, any cost recovery for retesting costs shall be negotiated with the GC.

6. The Contractor shall respond in writing to the CA at least as often as commissioning meetings are being scheduled concerning the status of each apparent outstanding discrepancy identified during commissioning. Discussion shall cover explanations of any disagreements and proposals for their resolution.

7. The CA retains the original non-conformance forms until the end of the project.

C. Failure Due to Manufacturer Defect. If 10%, or three, whichever is greater, of identical pieces (size alone does not constitute a difference) of equipment fail to perform to the Contract Documents (mechanically or substantively) due to manufacturing defect, not allowing it to meet its submitted performance spec, all identical units may be considered unacceptable. In such case, the Contractor shall provide the Owner with the following:

a. Within one week of notification, the Contractor or manufacturer's representative shall examine all other identical units making a record of the findings. The findings shall be provided within two weeks of the original notice.
b. Within two weeks of the original notification, the Contractor or manufacturer shall provide a signed and dated, written explanation of the problem, cause of failures, etc. and all proposed solutions which shall include full equipment submittals. The proposed solutions shall not significantly exceed the specification requirements of the original installation.
c. The Owner will determine whether a replacement of all identical units or a repair is acceptable.
d. Upon acceptance, the Contractor and/or manufacturer shall replace or repair all identical items, at their expense and extend the warranty accordingly, if the original equipment warranty had begun. The replacement/repair work shall proceed with reasonable speed beginning within one week from when parts can be obtained.

D. Approval. The CA notes each satisfactorily demonstrated function on the test form. The CA recommends acceptance of each test using a standard form. The Owner gives final approval on each test using the same form, providing a signed copy to the CA and the Contractor.

3.6 SYSTEMS MANUALS AND OPERATION AND MAINTENANCE (O&M) MANUALS

A. The following Systems Manuals and O&M manual requirements do not replace O&M manual documentation requirements elsewhere in these specifications.

B. Each Division shall compile and prepare documentation for all equipment and systems covered in that Division and deliver this documentation to the GC for inclusion in the Systems Manuals and O&M manuals, according to this section, prior to the training of owner personnel.

C. The CA shall receive a copy of the O&M manuals for review.

D. Field checkout sheets and logs should be provided to the CA for inclusion in the Commissioning Record Book.

E. Review and Approvals. Review of the commissioning related sections of the Systems/O&M manuals shall be made by the A/E and by the CA.

3.7. TRAINING OF OWNER PERSONNEL

A. The GC shall be responsible for training coordination and scheduling and ultimately to ensure that training is completed.

B. The CA shall be responsible for overseeing and approving the content and adequacy of the training of Owner personnel for commissioned equipment.

3.8 WRITTEN WORK PRODUCTS

A. Written work products of Contractors will consist of the start-up and initial checkout plan described and the filled out start-up, initial checkout and prefunctional checklists, manufacturer's factory and field testing and inspection forms, contractor's inspection and functional testing forms, Systems Manuals and O&M Manuals, /training plans and training records. These work products will be supplied to the CA to be included in the final commissioning report.

END OF SECTION 26 0800

SECTION 26 0923

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. This Section includes the following lighting control devices:

1. Indoor occupancy sensors.
2. Outdoor photoelectric switches / sensors.
3. Indoor photoelectric switches / sensors.
4. Lighting contactors.

B. Related Sections include the following:

1. Division 26 Section "Wiring Devices" for wall-switch occupancy sensors, and manual light switches.

1.3 DEFINITIONS

A. LED: Light-emitting diode.

B. PIR: Passive infrared.

1.4 SUBMITTALS

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

B. Shop Drawings: Show installation details for occupancy and light-level sensors.

1. Interconnection diagrams showing field-installed wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

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.

1.6 COORDINATION

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 system, and partition assemblies.

PART 2 - PRODUCTS

2.1 OUTDOOR PHOTOELECTRIC SWITCHES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Tyco Electronics.
2. Intermatic, Inc.
3. Square D; Schneider Electric.
4. TORK; NSI Industries.
5. Watt Stopper (The).

B. Description: Solid state, with dry contacts rated to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.

1. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of photocell to prevent fixed light sources from causing turn-off.
2. Time Delay: 15-second minimum, to prevent false operation.
3. Surge Protection: Metal-oxide varistor, complying with IEEE C62.41.1, IEEE C62.41.2, and IEEE 62.45 for Category A1 locations.

2.2 INDOOR PHOTOELECTRIC SWITCHES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Tyco Electronics.
2. Eaton Electrical Inc. / Cooper Industries
3. Intermatic, Inc.
4. Acuity Brands.
5. Square D; Schneider Electric.
6. TORK: NSI Industries.
7. Watt Stopper (The).

B. Ceiling-Mounted Photoelectric Switch: Solid-state, light-level sensor unit, with separate relay unit, to detect changes in lighting levels that are perceived by the eye. Cadmium sulfide photoresistors are not acceptable.

1. Sensor Output: Contacts rated to operate the associated relay, complying with UL 773A. Sensor shall be powered from the relay unit.
2. Light-Level Monitoring Range: 10 to 200 fc (108 to 2152 lx), with an adjustment for turn-on and turn-off levels within that range.
3. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling, with deadband adjustment.
4. Indicator: Two LEDs to indicate the beginning of on-off cycles.

2.3 INDOOR OCCUPANCY SENSORS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Hubbell Lighting.
2. Leviton Mfg. Company Inc.
3. Acuity Brands.
4. Sensor Switch, Inc.
5. TORK; NSI Industries.
6. Watt Stopper (The).

B. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.

1. Operation: Unless otherwise indicated, turn 50% of the room lights on when covered area is occupied, and turn off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes.
2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
3. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
4. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lx); keep lighting off when selected lighting level is present.

C. Dual-Technology Type: Ceiling and wall mounting as indicated; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be 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- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

2.4 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 24 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas or rooms indicated where installed. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 WIRING INSTALLATION

A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 3/4 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.

3.3 IDENTIFICATION

A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."

1. Identify controlled circuits in lighting contactors.
2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
2. Operational Test: Verify operation of each lighting control device, and adjust time delays.

B. Lighting control devices that fail tests and inspections are defective work.

3.5 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control system specified in Division 26 Section "Network Lighting Controls."

B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 26 0923

SECTION 26 09 43

NETWORK LIGHTING CONTROLS

PART 1. GENERAL

1.01 SUMMARY

A. Section Includes:

1. Networked Central Lighting Control systems. Systems are composed of:
    a. Network integrated power switching systems.
    b. Network integrated dimming systems.
    c. Standalone power switching and dimming systems.
    d. DALI-compliant network integrated lighting controller.
    e. Automation control processors.
    f. Sensors
    g. User Interfaces:
        1) Keypad
        2) Touch screen
        3) Virtual touch screen
2. System Functions and Sequences

1.02 REFERENCES

A. Definitions

1. Control: Effecting a change in state by one PC program onto a microprocessor or device.
2. Scene: Predetermined light level of a single fixture of group of fixtures.
3. DALI: Digital addressable lighting interface.
4. RS-485: A serial network protocol complying with TIA-485-A.
5. UTP: Unshielded twisted pair.

B. Reference Standards

1. National Fire Protection Association (NFPA):
2. NFPA 70 - National Electrical Code.
3. Underwriters Laboratories (UL)
4. UL 508 – Industrial Control Equipment

1.03 SYSTEM DESCRIPTION

A. Web Accessible, network connected, lighting control system utilizing preset control software, central signal microprocessor, lighting control panel.

B. System Components: System includes the following addressable components:

1. Keypad controls.
2. Touch screen controls.
3. Remote occupancy sensors.
4. Lighting load shedding.
5. Timed room lighting.
6. Daylight compensating lighting controls.
7. Communication interface to facility-wide room management system.

8. Communication interface to building automation system gateway/interface.

1.04 SUBMITTALS

A. Product Data: For each type of product required for complete network lighting control system, demonstrating compliance with requirements.

B. Shop Drawings: Indicated the following:

1. Schematic diagram showing complete network lighting control system and accessories.

2. Circuits and emergency circuits with capacity and phase, control zones, loads, load type and voltage per circuit.

1.05 CLOSEOUT SUBMITTALS

A. Operating and maintenance instructions.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualification: Manufacturer of network lighting controls with minimum [5] years record of satisfactory manufacturing and support of components comparable to basis of design system.

B. Source Requirements: Provide Network Lighting System through a single source from a single manufacturer.

C. Manufacturer Qualifications: Approved manufacturer of network lighting controls listed in this Section with minimum [5] years record of satisfactory manufacturing and support of components comparable to basis of design system.

1. Approval of Comparable Products: Submit the following in accordance with project substitution requirements, within time allowed for substitution review:

a. Product data, including certified independent test data indicating compliance with requirements.

b. Samples of each component.

c. Sample submittal from similar project.

d. Project references: Minimum of 5 installations not less than 5 years old, with Owner and Architect contact information.

e. Sample warranty.

2. Approved manufacturers must comply with separate requirements of Submittals Article.

D. Electrical Components, Devices, and Accessories: UL listed and labeled per NFPA 70.

1.07 PROJECT CONDITIONS

A. Environmental Conditions Range:

1. Temperature: 32 – 104 deg F (0 - 40 deg C).

2. Relative Humidity: 10 – 90 percent, noncondensing.

1.08 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of modular dimming controls system the fail in materials or workmanship within the specified warranty period following substantial completion.

1. Warranty Period: Touch screen display and overlay components: 90 days.

2. Warranty Period: Disc drives and other moving parts, pan/tilt heads, and power supplies: 1 year.

3. Warranty Period: Other components, up to 8 years as per warranty contract.

B. Manufacturer's Extended Support Service: Extended telephone support: Unlimited period.

PART 2. PRODUCTS

2.01 1-3 ZONE LIGHTING CONTROLLER

A. MANUFACTURERS

1. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide products of Crestron Electronics, Inc., with the following components and characteristics.

B. Provide 1, 2, or 3 zone lighting controller for switching or 0-10v zones. Unit shall operate as an autonomous lighting controller for the space. All sensors and zones within the space shall be controlled without the need for additional equipment.

C. Lighting controller shall be networked as part of the building wide lighting control system using Cresnet serial communication.

D. Lighting controller shall be a surface-mounted industrial control enclosure mounts directly on two side by side 4" square electrical junction boxes, suitable for concealed locations. Lighting controller shall have flying leads with wing nut type connections.

E. Circuit Input: 100 – 277 VAC, 50/60 Hz. Input, one 16 amp

F. Zone Outputs

1. 1, 2, or 3 high inrush mechanically held relays for switching loads
    a. 1,000,000 cycle mechanically latching relays
    b. Zero-cross arc-less high inrush
    c. Air gap off protection on each channel
2. 0-10v dimming models shall include 0-10v 4 wiring dimming for each channel

G. Product

1. Crestron GLPP-SWCN (1 zone switching)
2. Crestron GLPP-1SW2CN (2 zones switching
3. Crestron GLPP-1SW3CN (3 zones switching
4. Crestron GLPP-DIMFLVCN-PM (1 zone 0-10v dimming with power monitoring)
5. Crestron GLPP-1DIMFLVCN2-PM (2 zones 0-10v dimming with power monitoring)
6. Crestron GLPP-1DIMFLVCN3-PM (3 zones 0-10v dimming with power monitoring)

H. GLPP SPECIFIC ACCESSORIES

1. Keypads
    a. Connects to lighting controller with class II (2) #18 AWG or greater conductors.
    b. Color shall be white, black, or almond.
    c. Scene Functions
        1) ROCKER (ON/OFF/hold to dim) or 4 Button (ON/SCENE 1/SCENE 2/OFF)
            i) Product: Crestron GLPPA-KP-W [B] [A]-S
    d. Zone Functions
        1) Rocker controlling zone 1 (ON/OFF/hold to dim)
            i) Product: Crestron GLPPA-KP1-W [B] [A]-S
        2) Rocker controlling zone 2 (ON/OFF/hold to dim)
            i) Product: Crestron GLPPA-KP2-W [B] [A]-S
        3) Rocker controlling zone 3 (ON/OFF/hold to dim)
            i) Product: Crestron GLPPA-KP3-W [B] [A]-S
        4) 4 Button controlling zones 1-3 (ZONE 1 toggle/ZONE 2 toggle/ZONE 3 toggle/OFF)
            i) Product: Crestron GLPPA-KP4-W [B] [A]-S
2. Configuration Remote Control

a. Lighting controller shall be adjustable using the handheld battery operated configuration remote.
b. Pre-programmed at factory, no configuration or programming required.
c. Remote shall provide features:
1) Zone control
2) Scene setting
3) Motion sensor mode select and timeout
4) Daylight sensor calibration
d. Provide minimum [2] configuration remotes for the project.
e. Product: Crestron GLPPA-REMOTE-PROG

3. Motion Sensors
a. Motion sensors shall be provided in spaces as shown on the Contract Drawings.
b. Dual technology ultrasonic and passive infrared motion sensing.
c. Lighting controller selectable occupancy (auto-on, auto off) and vacancy (manual-on, auto-off) modes.
d. Vacancy time out shall be adjustable
e. Equipped with 4-wire interface for direct connection to lighting controller enables IR handheld remote signals to be passed through the ceiling to the lighting controller.
f. Coverage: 360 deg., 2000 sq. ft
g. Ceiling or flush mounted
h. Color shall be white
i. Product: Crestron GLS-ODT-C-NS

2.02 CENTRALIZED PANEL

A. MANUFACTURERS
1. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide products of Crestron Electronics, with the following components and characteristics.

B. PANEL CHARACTERISTICS
1. Panel shall be digitally addressable using serial or Ethernet communication from Control Processor Panel specified hereto after.
2. Lighting dimmers shall be compatible with drivers / ballasts and LEDs / lamps.
3. Dimmers shall be provided in quantities, control types, and rated for the connected load as shown on the Contract Drawings.
4. Line and load phases shall be coordinated per manufacturers recommendations.
5. Dimming modules shall be field replaceable.
6. Dimming panels shall be listed to UL508.
7. Lighting control panels shall be convection cooled without the use of moving parts.
8. Lightning Protection: can withstand 6 kV / 3 kA surge, as per IEC 61000-4-5 and ANSI/IEEE C62.41-1991
9. NEMA Type 1 enclosure, IP20 rated protection, for indoor use only; 16-gauge galvanized steel, surface wall mount; gray front cover with powder coated finish
10. Lighting control panels shall comply with NEMA PB 1 and UL 50 (CAN/CSA C22.2, No. 94), UL 67 (CSA C22.2, No. 29), UL 489 (CAN/CSA C22.2, No. 65), and UL 916 (CSA C22.2, No. 205).

C. FEED TYPE
1. FEED-THROUGH (FT)

a. No branch circuit overcurrent protection.

b. [Panels shall be fabricated as tub and tray. The tub shall be installable at time of rough-in while the factory wired tray is installed separately at time of trim.]

D. ZONE CONTROL MODULES

1. Standard switching

a. 100,000 cycle mechanically latching relays

b. Air gap off protection on each channel

2. 4-Wire 0-10v Dimming

a. Use for any 4-wire 0-10v dimming load

b. Zero-cross arc-less high inrush

c. Air gap off protection on each channel

3. 2-Wire Phase Dimming

a. Universal Phase Dimming

1) Used for any 2-wire phase dimming loads.

2) Auto-load detection shall select forward- or reverse-phase control based on each channels load.

3) Zero-cross filtering to reduce lamp flickering

4) Air gap off protection on each channel

b. Reverse Phase Dimming

1) Used for electronic low voltage (ELV) loads unless specifically noted otherwise or recommended by fixture manufacturer.

2) Reverse-phase dimming

3) Zero-cross filtering to reduce lamp flickering

4) Air gap off protection on each channel]

2.03 DMX SOLUTIONS

A. MANUFACTURERS

1. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide products of Crestron Electronics, with the following components and characteristics.

B. DMX Architectural Control

1. All Crestron series 2 or 3 processors shall support open DMX Ethernet.

2. DMX architectural control shall include color and intensity selection, preset saving/recall, and simple fade effects. Presets may be recalled from any user interface or triggered by astronomical time clock or BMS event.

3. Touch screens specified hereto after and called out on the Contract Drawings shall have a color picker user interface. Interface shall accept graphical selections or numerical selections.

4. Adding zones of DMX controlled fixtures shall only require the addition of a DMX Ethernet converter.

5. Contractor shall provide DMX Ethernet converters as required to interface with architectural DMX zones as shown on the Contract Drawings.

6. sACN to DMX-512 Converter

a. Compatible with ESP and Art-Net DMX over Ethernet protocols.

b. Supports RDM bi-directional communication.

c. IEEE 802.3af PoE powered.

d. Single port DMX to Ethernet node that can be used in either input or output mode depending on software utility set up configuration.

e. Product: Crestron GLA-DIN-ODE-POE

C. DMX Show Control

1. Full DMX show control shall be provided for the following spaces:
   a. Entry area RGB lighting at Founder's Plaza entry.
2. The DMX Control Interface shall be a microprocessor based lighting system designed specifically as a multi-purpose lighting and show playback controller for entertainment and architectural applications. A personal computer running emulation software shall not be acceptable.
3. The DMX Control Interface shall be an integrated device that combines DMX-based lighting playback with architectural control features, scripting capability, and web-based control.
4. The DMX Control Interface shall store all of its programming data in non-volatile flash memory, including built-in flash memory and/or a removable flash memory card and can be transferred to/from a remote personal computer via Ethernet.
5. The DMX Control Interface shall have an internal real-time clock and calendar that operates from an internal lithium battery even in the absence of external power and be able to trigger shows and other events based on time of day, sunrise, sunset, day of week, day of year and/or a combination of these events.
6. The DMX Control Interface shall be capable of synchronizing its operation with and/or remotely controlling other DMX Control Interfaces of the same kind across an Ethernet network.
7. The DMX Control Interface shall support standard theatrical lighting playback models including direct channel control, fixture level control, groups, channel parking, scaling, disabling, offsets, transparency, tracking and overrides, which can be used to create submasters and grandmaster control, partitioning, zones and other control setups.
8. System capacity
   a. The DMX Control Interface shall support:
   b. Up to 2000 cues.
   c. Up to 200 macros.
   d. Up to 100 groups.
   e. Up to 100 timer events.
   f. Up to 500 timecode event triggers.
   g. Up to 256 DMX input triggers.
   h. Up to 512 button station buttons.
   i. Up to 512 contact closures.
   j. Up to 16 TCP/UDP packet triggers.
   k. Reception of 512 DMX input levels.
   l. Processing of 512 DMX output levels.
   m. Additional DMX outputs may be supported by networking multiple DMX Control Interfaces together via Ethernet.
9. Product
   a. Crestron GLA-DMX-1UNIVERSE (one 512 address DMX universe)

2.04 USER INTERFACES

A. MANUFACTURERS

1. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide products of Crestron Electronics, with the following components and characteristics.

B. KEYPADS

1. Provide keypad quantities and locations as specified herein and shown on the Contract Drawings.

2. Field-configurable remote keypad with auto-adjusting backlight illuminating replaceable, engraveable programmable buttons in number indicated, with white LED indicators, configured to fit in standard single-gang box.
3. Trimmed using decorator face plates.
4. Cresnet connected for power and communication
5. Maximum buttons: 8
6. Color shall be white, black, or almond.
7. Product: Crestron C2N-CBD-P-W [B] [A]-S

C. FACE PLATES

1. Provide decorator faceplates for all keypad devices.
2. Multiple devices adjacent to door jams shall be ganged together.
3. Decorator faceplates shall be as directed by architect and shall match in texture and color the keypad devices.
4. Product
    a. FP-G1-W [B] [A]-S (1 gang faceplate)
    b. FP-G2-W [B] [A]-S (2 gang faceplate)
    c. FP-G3-W [B] [A]-S (3 gang faceplate)
    d. FP-G4-W [B] [A]-S (4 gang faceplate)

D. TOUCH SCREENS

1. TFT active-matrix color LCD touch screen
2. Projected capacitive, 5-point multi-touch technology
3. 24-bit 16.7M colors, and dual-window HD video, HDTV, and high-resolution RGB streaming multimedia, IP intercom, and web browsing capabilities. Dynamic graphics and text capability. Enables custom control screen programming.
4. 5 hard keys pushbuttons
5. Bidirectional 10/100 Mbps Ethernet communication.
6. H.264 and MJPEG streaming video.
7. 5.0 MP camera
8. Built-in microphone and speaker with multi-language voice recognition
9. Rava SIP intercom
10. Connected via IEEE 802.3af Class 3 PoE Powered Device
11. Surface mount over 2-gang or 3-gang electrical box.
12. Color: Black or White.
13. Products
    a. Crestron TSW-760-W-S (7” white, 2-gang mounted)
    b. Crestron TSW-1060-W-S (10” white, 3-gang mounted)
    c. Crestron TSW-760-B-S (7” black, 2-gang mounted)
    d. Crestron TSW-1060-B-S (10” black, 3-gang mounted)

E. XPanel Interface: Virtual Touch Screen

1. Touch screen user interface, network-connected lighting management interface running on Crestron lighting control processor to provide lighting control, daylight harvesting, occupancy sensing, lighting schedules and overall adjustment to system functionality
2. Virtual touch screen is to be accessible via computer or laptop interface furnished by other.
3. Access to XPanel shall be via browser-based IP address or .EXE file application.

4. Product: Crestron XPANEL

2.05 SENSORS

A. MANUFACTURERS

1. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide products of Crestron Electronics, Inc., with the following components and characteristics.
2. Contractor shall provide quantities and locations of sensors per the Contract Drawings and as required for turnkey commercial lighting control operation.

B. MOTION SENSORS

1. Dual-Technology Ceiling Mounted (networked)
   a. Detects movement within space while reducing false triggering or shutoffs while space is occupied. Combination of ultrasonic motion detection and passive infrared detection with internal microprocessor. Sensitivity is independently adjustable for installed conditions. Delayed time off adjustment. Walk-through mode.
   b. Equipped with 4-wire interface for direct connection to control bus.
   c. Includes connection port for remotely mounted photocell.
   d. Coverage: 360 deg., 2000 $ft.^2$
   e. Set-up and commissioning parameters shall be configurable via a handheld wireless remote.
   f. Mounts to 3” octagon box
   g. Product: Crestron GLS-ODT-C-CN
2. Dual Technology Wall Mounted
   a. Detects movement within space while reducing false triggering or shutoffs while space is occupied. Combination of ultrasonic motion detection and passive infrared detection with internal microprocessor. Sensitivity is independently adjustable for installed conditions. Delayed time off adjustment. Walk-through mode.
   b. Equipped with 3-wire interface for direct connection to control system utilizing control processor
   c. Coverage: 110 deg horizontal., 1200 $ft.^2$
   d. Mounts to 4” octagon box or surface mounted.
   e. Product: Crestron GLS-ODT-W-1200

C. DAYLIGHT SENSORS

1. Indoor Daylight Sensor (open loop)
   a. Continually monitors daylight entering window or skylight to enable daylight harvesting applications to provide control of room lighting based on presence of daylight. Equipped with 3-wire interface for direct connection to control system utilizing control processor; 24 VDC power from network control bus.
   b. Light sensitivity: 3 to 6,000 foot-candles
   c. Mounting: As indicated.
   d. Product: Crestron GLS-LOL
2. Indoor Daylight Sensor (closed loop)
   a. Continually monitors daylight at work station location to enable daylight harvesting or lumen maintenance applications to provide control of room lighting based on lighting level at workstation. Equipped with 3-wire interface for direct connection to control system utilizing control processor; 24 VDC power from network control bus.
   b. Light sensitivity: 0 to 70 foot-candles
   c. Mounting: As indicated.

d. Product: Crestron GLS-LCL

3. Exterior Daylight Sensor

a. Sensor shall continually monitor the total ambient light level and can adjust the lighting as necessary to reach the desired light level. The sensitivity is adjustable so that a 10V signal matches full daylight and 0V matches total darkness. A built in visor provides more consistent readings by blocking direct sunlight, and also protects the lens from the elements.

b. Sensor shall be installed facing north.

c. Light Sensitivity: 5 to 750 foot-candles

d. Power: 24 VDC

e. Mounting: surface mount

f. Product: Crestron GLS-LEXT

D. PARTITION SENSORS

1. Single sided diffuse reflective sensing technology.

2. Digital device with control bus connectivity.

3. Surface mounted to 1-gang back box.

4. Trim using decorator face plate to match mounting surface

5. Product: Crestron GLS-PART-CN

E. SENSOR INTERFACE MODULE

1. Sensor Interface Device: Integrates occupancy sensors and related sensors with control network. In separate enclosure. 4-wire bus providing 24 VDC power to network devices, with two independent sensing inputs.

2. Product: Crestron GLS-SIM

2.06 CONTROL PROCESSOR PANEL

A. Manufacturers

1. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide products of Crestron Electronics, Inc., with the following components and characteristics.

B. Control Processor Panels shall be provided in quantities and locations per the Contract Drawings, or as required for a fully networked lighting control system.

C. Control Processor Panels shall be factory assembled in a UL508 panelshop.

D. Shall include but not be limited to the following equipment to support all lighting control devices.

1. Cabinets

a. Cabinet shall be made of 16-gauge galvanized steel

b. NEMA 1 rated

c. All DIN rails and mounting accessories shall be furnished an properly installed.

d. Product: Crestron DIN-EN

2. Processors

a. Crestron 3-series control system

b. Modular architecture supports multiple simultaneous running programs.

c. Ethernet 10/100Base-T and Cresnet connected

d. Astronomical time clock with events stored in non-volatile RAM

e. Native BACnet/IP with support for up to 500 BACnet objects

f. Built-In Web Server: IIS v.6.0

g. SNMP remote management.

h. Active Directory support.

i. IPv6 ready.
j. DHCP and DNS Support
k. Native Email Client
l. Remote Diagnostics
m. Remote Program Loading and Administration
n. SSL security plug in
o. Support user assigned or dynamic IP address.
p. Products
1) Crestron DIN-AP3
2) Crestron RMC3

3. Power Supplies
a. Provide regulated 24 VDC power supplies as required to support lighting control equipment.
b. 120 VAC input
c. Product: Crestron DIN-PWS50

4. Hubs
a. Provide Cresnet distribution hubs as required to support all Cresnet devices.
b. Product: Crestron DIN-HUB

2.07 UL924 EMERGENCY OVERRIDE

A. Automatic Load Control Relays (ALCR)
1. 0-10v Loads
a. UL924 listed 4-wire automatic load control relay shall bring life safety lights on to 100% on loss of power.
b. 120/277 VAC
c. Product: Crestron GLA-EPC-FLV

2. Switched Loads
a. UL924 listed 2-wire automatic load control relay shall bring life safety lights on to 100% on loss of power.
b. Products
1) Crestron GLA-EPC-P-120 (120 VAC)
2) Crestron GLA-EPC-P-277 (277 VAC)

B. Emergency Shunt Relays (ESR)
1. 2 or 3 Wire Phase Controlled Loads
a. UL924 listed 2/3-wire emergency shunt relay shall bring life safety lights on to 100% on loss of power.
b. Products
1) Crestron GLA-ESR-120-3/4 (120 VAC)
2) Crestron GLA-ESR-277-3/4 (277 VAC)

2.08 PROGRAMMING AND CONFIGURATION SOFTWARE

A. Lighting system configuration software shall allow custom programming of embedded operating systems for control of lighting system.

B. Lighting system configuration software shall Provide a graphical symbol based programming and development environment.

C. The Lighting System Configuration software shall generate Custom Software Control Interface Modules for communication with compatible remote integrated systems.

D. The Custom Software Control Interface shall include the following control data:

1. Complete lighting system control functions.
2. System specific control sets for sub systems and supervisory systems.
3. The Custom Software Control Interface shall be capable of communicating the following data types:
4. Bidirectional digital and analog data communication.
5. Bidirectional serial data communication.

2.09 CONDUCTORS AND CABLING

A. Power Supply Side of Remote-Control Power Sources: Comply with requirements of Division 26 Section "Low-Voltage Electrical Power Conductors."

B. UTP Cable: 100-ohm, UTP. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:

C. Communications Control Cable, Non-Plenum Rated: 22 AWG data pair stranded bare copper, and 18 AWG power pair stranded bare copper, Type CM.

1. Product: Crestron CRESNET-NP.

D. Communications Control Cable, Plenum Rated: 22 AWG data pair, stranded bare copper and 18 AWG power pair, stranded bare copper, Type CMP, complying with NFPA 262.

1. Product: Crestron CRESNET-P.

E. Communications High-Power Control Cable, Non-Plenum Rated: 22 AWG stranded bare copper data pair, and 12 AWG stranded bare copper power pair, Type CM.

1. Product: Crestron CRESNET-HP-NP.

PART 3. EXECUTION

3.01 FIXTURE TESTING

A. Contractor shall provide lighting control factory test reports for each fixture specified on this project.

B. Fixtures already tested and listed in the factory database do not require re-testing.

C. Test report shall include:

1. Confirmation of compatibility with control device
2. Dimming Range
3. Performance notations

D. Crestron factory fixture compatibility testing information may be found here: http://www.crestron.com/resources/lighting-fixture-compatibility

3.02 ENGRAVING

A. Keypad buttons shall be factory engraved using laser technology.

B. Initial shipment of keypads shall be factory engraved per the sequence of operations specified herein and shown on the Contract Drawings.

C. Custom keypad engravings shall be provided as part of the close out procedures.

3.03 BMS INTEGRATION

A. The lighting control system shall be integrated with the BMS system as specified in Division 25.

B. Communication shall occur using BACnet/IP.

C. Contractor shall provide licenses for each the following objects shall be shared with the BMS system:

1. Occupancy Status
2. Zone On/Off/Dim
3. Photocell reading

D. The lighting control system shall also accept time clocked events from the BMS system.

E. Provide necessary coordination labor for integration of all BACnet objects listed hereto before.

3.04 AV INTEGRATION

A. The lighting control system shall be integrated with the AV solutions as specified in Division 26.

B. The lighting and AV systems shall interface via Ethernet communication.

C. Contractor shall provide Ethernet drops as required for the lighting control system to talk to the AV solutions.

D. The following objects shall be shared with the AV system:

1. Occupancy Status
2. Zone On/Off/Dim
3. Photocell reading
4. Scene preset recalls

E. Provide necessary coordination labor for integration of all AV objects listed hereto before.

3.05 SYSTEM FUNCTIONS AND SEQUENCES

A. System Control Functions: The system shall be capable of the following lighting control functions:

B. Scene Creation: store levels of selected fixture circuits in preset groups.

C. Scene Recall: recall previously stored scenes.

D. Off: all zones off.

E. Dim up/down: raise/lower level of all zones.

F. Password Entry: enter password to enable touch screen control access.

G. Room/Zone Selection: select room, zone or area to be controlled.

H. Shade Control: raise or lower room shades.

I. Event Scheduler: select times for scenes to be automatically recalled.

3.06 USER INTERFACE CONTROL FUNCTIONS

A. The Keypad interface shall be capable of the following system control functions:

1. Scene Recall
2. Off
3. Dim up/down

B. Touch Screen and Virtual Touch Screen: Touch Screen and Virtual Touch Screen interfaces shall be capable of the following system control functions:

1. Password Entry
2. Multiple levels
3. Room/Zone Selection
4. Scene Recall
5. Dim up/down
6. Shade Control
7. Scene Recall
8. Event Scheduler
9. Customer logo and color scheme

C. Optional Control Sequences for Advanced Control:

1. Occupancy adjustments
2. Timeout
3. Control logic (occupancy or vacancy sensor)
4. Lighting Scenes
5. Custom scene adjustment through sliders and press+hold operation
6. Individual zone control override
7. Timeclock Adjustment
8. Modify timeclock activation schedule
9. Select/unselect pre-programmed timeclock events
10. Display all timeclock events
11. Daylight Harvesting Adjustments
12. Minimum dim level
13. Response time
14. Zone control
15. Scene Recall
16. Fade time
17. Color scene recall and saving

3.07 TIME CLOCK EVENTS

A. The lighting control system shall have astronomical time clocked events. 6 time clock events shall be provided.

B. End User shall have the option to create additional time clock events via touch screen or XPanel interfaces

3.08 INSTALLATION

A. Prior to installation, examine work area to verify measurements, and that commencing installation complies with manufacturer's requirements.

B. Comply with requirements of Division 26 Sections "Common Work Results for Electrical."

C. Do not install network power controls until space is enclosed, HVAC systems are running, and overhead and wet work in space are complete.

D. Install network power switching controls in accordance with manufacturer's instructions.

E. Grounding: Provide electrical grounding in accordance with NFPA 70.

3.09 MANUFACTURER SUPPORTED SERVICES

A. PRE-WIRE

1. Manufacturer shall provide on-site visit during the rough-in stage of the installation. At this time wiring topologies and terminations shall be reviewed with the Contractor.

B. STARTUP

1. Provide manufacturer's system startup and adjustment.
2. Switch each load on and off with manual line test feature of the power switching module before installing processors.
3. Perform operational testing to verify compliance with Specifications. Adjust as required.

C. TUNING

1. Within 12 months of the date of Substantial Completion provide onsite service to adjust the system to account for actual occupied conditions.

D. TRAINING

1. Factory authorized service representative to instruct owner's staff to adjust, operate and maintain network power switching systems; and provide instruction using the system software.
2. Demonstration: Schedule demonstration with Owner.
3. Training: Train Owner's personnel to operate, maintain, and program network power switching systems. Allow for a minimum of trips to the jobsite to provide additional training as needed.
4. Furnish set of approved submittals, and record drawings of actual installation for Owner's personnel in attendance at training session.

END OF SECTION 26 0943

SECTION 26 2413

SWITCHBOARDS

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 and distribution switchboards rated 600 V and less.
2. Transient voltage suppression devices.
3. Disconnecting and overcurrent protective devices.
4. Instrumentation.
5. Accessory components and features.
6. Identification.
7. Mimic bus.

1.3 SUBMITTALS

A. Product Data: For each type of switchboard, overcurrent protective device, transient voltage suppression device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

B. Shop Drawings: For each switchboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
5. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.
6. Detail utility company's metering provisions with indication of approval by utility company.
7. Include evidence of NRTL listing for series rating of installed devices.
8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
9. Include diagram and details of proposed mimic bus.
10. Include schematic and wiring diagrams for power, signal, and control wiring.

C. 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.

D. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Routine maintenance requirements for switchboards and all installed components.
2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
3. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.

B. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

C. Product Selection for Restricted Space: Equipment outline dimensions on drawings indicate maximum dimensions for switchboards. Switchboards to be used must be equal in size or smaller than those shown on the plans.

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.

E. Comply with NEMA PB 2.

F. Comply with NFPA 70.

G. Comply with UL 891.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.

B. Remove loose packing and flammable materials from inside switchboards.

C. Handle and prepare switchboards for installation according to NEMA PB 2.1.

1.6 PROJECT CONDITIONS

A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.

B. Environmental Limitations:

1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards 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 104 deg F (40 deg C).
   b. Altitude: Not exceeding 6600 feet (2000 m).

C. Service Conditions: NEMA PB 2, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet (2000 m).

D. 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 Construction Manager 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 Construction Manager's written permission.
4. Comply with NFPA 70E.

1.7 COORDINATION

A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

1.9 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Potential Transformer Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
2. Control-Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
3. Fuses and Fusible Devices for Fused Circuit Breakers: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

4. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
5. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
6. Indicating Lights: Equal to 10 percent of quantity installed for each size and type, but no fewer than one of each size and type.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.
2. General Electric Company.
3. Siemens.
4. Square D; a brand of Schneider Electric.

B. Front-Connected, Front-Accessible Switchboards:

1. Main Devices: Fixed, individually mounted.
2. Branch Devices: Panel mounted.
3. Sections front and rear aligned.

C. Nominal System Voltage: 208Y/120 V.

D. Main-Bus Continuous: Amperage as indicated on the Drawings.

E. Indoor Enclosures: Steel, NEMA 250, Type 1.

F. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

G. Barriers: Between adjacent switchboard sections.

H. Insulation and isolation for main bus of main section and main and vertical buses of feeder sections.

I. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.

J. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.

K. Pull Box on Top of Switchboard:

1. Adequate ventilation to maintain temperature in pull box within same limits as switchboard.
2. Set back from front to clear circuit-breaker removal mechanism.
3. Removable covers shall form top, front, and sides. Top covers at rear shall be easily removable for drilling and cutting.
4. Bottom shall be insulating, fire-resistive material with separate holes for cable drops into switchboard.
5. Cable supports shall be arranged to facilitate cabling and adequate to support cables indicated, including those for future installation.

L. Buses and Connections: Three phase, four wire unless otherwise indicated.

1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity, with tin-plated copper feeder circuit-breaker line connections.
2. Load Terminals: Insulated, rigidly braced, runback bus extensions, of same material as through buses, equipped with compression connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full-ampere rating of circuit-breaker position.
3. Ground Bus: Minimum-size required by UL 891, hard-drawn copper of 98 percent conductivity, equipped with compression connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
4. Main Phase Buses and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
5. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with compression connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
6. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.

M. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

N. Bus-Bar Insulation: Factory-applied, flame-retardant, tape wrapping of individual bus bars or flame-retardant, spray-applied insulation. Minimum insulation temperature rating of 105 deg C.

O. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components including instruments and instrument transformers.

2.2 TRANSIENT VOLTAGE SUPPRESSION DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Surge Protection Device Description: IEEE C62.41-compliant, integrally mounted, solid-state, parallel-connected, modular type, with sine-wave tracking suppression and filtering modules, UL 1449, second edition, short-circuit current rating matching or exceeding the switchboard short-circuit rating, and with the following features and accessories:

1. Fuses, rated at 200-kA interrupting capacity.
2. Fabrication using bolted compression lugs for internal wiring.
3. Integral disconnect switch.
4. Redundant suppression circuits.
5. Redundant replaceable modules.
6. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
7. LED indicator lights for power and protection status.
8. Audible alarm, with silencing switch, to indicate when protection has failed.
9. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position on failure of any surge diversion module

or on opening of any current-limiting device. Coordinate with building power monitoring and control system.

10. Six-digit, transient-event counter set to totalize transient surges.

C. Peak Single-Impulse Surge Current Rating: 160 kA per mode/320 kA per phase.

D. Withstand Capabilities: 12,000 IEEE C62.41, Category C3 (10 kA), 8-by-20-mic.sec. surges with less than 5 percent change in clamping voltage.

E. Protection modes and UL 1449 SVR for grounded wye circuits with 208Y/120-V, three-phase, four-wire circuits shall be as follows:

1. Line to Neutral: 400 V for 208Y/120.
2. Line to Ground: 400 V for 208Y/120.
3. Neutral to Ground: 400 V for 208Y/120

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:

    a. Instantaneous trip.
    b. Long- and short-time pickup levels.
    c. Long- and short-time time adjustments.
    d. Ground-fault pickup level, time delay, and I^2t response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
6. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
7. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

    a. Standard frame sizes, trip ratings, and number of poles.
    b. Lugs: Compression style, suitable for number, size, trip ratings, and conductor material.
    c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
    d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    e. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.

f. Communication Capability: Communication module with functions and features compatible with power monitoring and control system specified.
g. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
h. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.

2.4 INSTRUMENTATION

A. Instrument Transformers: IEEE C57.13, NEMA EI 21.1, and the following:

1. Potential Transformers: IEEE C57.13; 120 V, 60 Hz, [single] [tapped] [double] secondary; disconnecting type with integral fuse mountings. Burden and accuracy shall be consistent with connected metering and relay devices.
2. Current Transformers: IEEE C57.13; 5 A, 60 Hz, secondary; [wound] [bushing] [bar or window] type; [single] [double] secondary winding and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.
3. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kVA.
4. Current Transformers for Neutral and Ground-Fault Current Sensing: Connect secondary wiring to ground overcurrent relays, via shorting terminals, to provide selective tripping of main and tie circuit breaker. Coordinate with feeder circuit-breaker, ground-fault protection.

B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:

1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:

a. Phase Currents, Each Phase: Plus or minus 1 percent.
b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
d. Megawatts: Plus or minus 2 percent.
e. Megavars: Plus or minus 2 percent.
f. Power Factor: Plus or minus 2 percent.
g. Frequency: Plus or minus 0.5 percent.
h. Accumulated Energy, Megawatt Hours: Plus or minus 2 percent; accumulated values unaffected by power outages up to 72 hours.
i. Megawatt Demand: Plus or minus 2 percent; demand interval programmable from five to 60 minutes.
j. Contact devices to operate remote impulse-totalizing demand meter.

2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.

C. Ammeters, Voltmeters, and Power-Factor Meters: ANSI C39.1.

1. Meters: 4-inch (100-mm) diameter or 6 inches (150 mm) square, flush or semiflush, with antiparallax 250-degree scales and external zero adjustment.
2. Voltmeters: Cover an expanded-scale range of nominal voltage plus 10 percent.

D. Instrument Switches: Rotary type with off position.

1. Voltmeter Switches: Permit reading of all phase-to-phase voltages and, where a neutral is indicated, phase-to-neutral voltages.

2. Ammeter Switches: Permit reading of current in each phase and maintain current-transformer secondaries in a closed-circuit condition at all times.

E. Feeder Ammeters: 2-1/2-inch (64-mm) minimum size with 90- or 120-degree scale. Meter and transfer device with off position, located on overcurrent device door for indicated feeder circuits only.

F. Watt-Hour Meters and Wattmeters:

1. Comply with ANSI C12.1.
2. Three-phase induction type with two stators, each with current and potential coil, rated 5 A, 120 V, 60 Hz.
3. Suitable for connection to three- and four-wire circuits.
4. Potential indicating lamps.
5. Adjustments for light and full load, phase balance, and power factor.
6. Four-dial clock register.
7. Integral demand indicator.
8. Contact devices to operate remote impulse-totalizing demand meter.
9. Ratchets to prevent reverse rotation.
10. Removable meter with drawout test plug.
11. Semiflush mounted case with matching cover.
12. Appropriate multiplier tag.

G. Impulse-Totalizing Demand Meter:

1. Comply with ANSI C12.1.
2. Suitable for use with switchboard watt-hour meter, including two-circuit totalizing relay.
3. Cyclometer.
4. Four-dial, totalizing kilowatt-hour register.
5. Positive chart drive mechanism.
6. Capillary pen holding a minimum of one month's ink supply.
7. Roll chart with minimum 31-day capacity; appropriate multiplier tag.
8. Capable of indicating and recording [five] [15] [30] <Insert time period>-minute integrated demand of totalized system.

2.5 CONTROL POWER

A. Control Circuits: 120-V ac, supplied through secondary disconnecting devices from control-power transformer.

B. Control Circuits: 120-V ac, supplied from remote branch circuit.

C. Electrically Interlocked Main and Tie Circuit Breakers: Two control-power transformers in separate compartments, with interlocking relays, connected to the primary side of each control-power transformer at the line side of the associated main circuit breaker. 120-V secondaries connected through automatic transfer relays to ensure a fail-safe automatic transfer scheme.

D. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.

E. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.6 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 switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.

C. Portable Circuit-Breaker Lifting Device: Floor-supported, roller-based, elevating carriage arranged for movement of circuit breakers in and out of compartments for present and future circuit breakers.

D. Overhead Circuit-Breaker Lifting Device: Mounted at top front of switchboard, with hoist and lifting yokes matching each drawout circuit breaker.

E. Spare-Fuse Cabinet: Suitably identified, wall-mounted, lockable, compartmented steel box or cabinet. Arrange for wall mounting.

2.7 IDENTIFICATION

A. Mimic Bus: Entire single-line switchboard bus work, as depicted on factory record drawing, on a photoengraved nameplate.

1. Nameplate: At least 0.032-inch- (0.813-mm-) thick anodized aluminum, located at eye level on front cover of the switchboard incoming service section.

B. Mimic Bus: Entire single-line switchboard bus work, as depicted on factory record drawing, on an engraved laminated-plastic (Gravoply) nameplate.

1. Nameplate: At least 0.0625-inch- (1.588 mm-) thick laminated plastic (Gravoply), located at eye level on front cover of the switchboard incoming service section.

C. Mimic Bus: Continuously integrated mimic bus factory applied to front of switchboard. Arrange in single-line diagram format, using symbols and letter designations consistent with final mimic-bus diagram.

D. Coordinate mimic-bus segments with devices in switchboard sections to which they are applied. Produce a concise visual presentation of principal switchboard components and connections.

E. Presentation Media: Painted graphics in color contrasting with background color to represent bus and components, complete with lettered designations.

F. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store switchboards according to [NECA 400] [NEMA PB 2.1].

B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.

C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install switchboards and accessories according to NEMA PB 2.1.

B. Equipment Mounting: Install switchboards on concrete base, 4-inch (100-mm) nominal thickness.

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
2. For supported equipment, 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 switchboards.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.

D. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

E. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.

F. Install filler plates in unused spaces of panel-mounted sections.

G. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.

1. Set field-adjustable switches and circuit-breaker trip ranges.

H. Install spare-fuse cabinet.

I. Comply with NECA 1.

3.3 CONNECTIONS

A. Comply with requirements for terminating feeder bus specified in Division 26 Section "Enclosed Bus Assemblies." Drawings indicate general arrangement of bus, fittings, and specialties.

3.4 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. 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.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

E. 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 switchboard. 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 switchboard 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.

4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. Switchboard will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 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 Division 26 Section "Overcurrent Protective Device Coordination Study."

3.7 PROTECTION

A. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories.

END OF SECTION 26 2413

SECTION 26 2416

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. Load centers.

1.3 DEFINITIONS

A. SVR: Suppressed voltage rating.

B. SPD: Surge Protection Device.

1.4 SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, surge protection device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Include evidence of NRTL listing for series rating of installed devices.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include wiring diagrams for power, signal, and control wiring.
8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

C. Qualification Data: For qualified testing agency.

D. 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.

E. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

F. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. 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.

1.5 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 panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

C. 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.

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.

E. Comply with NEMA PB 1.

F. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NECA 407.

1.7 PROJECT CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

   a. Ambient Temperature: Not exceeding minus 22 deg F to plus 104 deg F.
   b. Altitude: Not exceeding 6600 feet (2000 m).

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet (2000 m).

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 [Construction Manager] [Owner] no fewer than [two] <Insert number> days in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without [Construction Manager's] [Owner's] written permission.
3. Comply with NFPA 70E.

1.8 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

1.10 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: Two spares for each type of panelboard cabinet lock.
2. Circuit Breakers Including GFCI and Ground Fault Equipment Protection (GFEP) Types: Two spares for each panelboard, in addition to the spares to be installed within the panelboard in accordance with panel schedules on drawings.
3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
4. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Enclosures: Flush- and surface-mounted cabinets, as indicated on drawings.

1. Rated for environmental conditions at installed location.

a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
b. Outdoor Locations: NEMA 250, Type 3R.
c. Kitchen and Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
4. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
6. 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.
c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.

7. Directory Card: Inside panelboard door, mounted in transparent card holder.

B. Incoming Mains Location: Top or bottom as required.

C. Phase, Neutral, and Ground Buses:

1. Material: Where “Aluminum” indicated on the drawings, use tin-plated aluminum. Where “Copper” indicated on the drawings, use 98% conductivity hard drawn copper.
2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
3. Isolated Ground Bus: Where indicated on the drawings; adequate for branch-circuit isolated ground conductors; insulated from box.
4. Extra-Capacity Neutral Bus: Where indicated on the drawings, neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.

D. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Main and Neutral Lugs: Compression type, suitable for use with conductor material.
2. Ground Lugs and Bus-Configured Terminators: Mechanical type.
3. Feed-Through Lugs: Compression type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

4. Subfeed (Double) Lugs: Compression type, suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
5. Gutter-Tap Lugs: Compression type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
6. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.

E. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.

F. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

G. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include size and type of allowable upstream and branch devices, listed and labeled for series-connected short-circuit rating by an NRTL.

H. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 DISTRIBUTION PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.
2. General Electric Company.
3. Siemens.
4. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, power and feeder distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

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: Plug-in or Bolt-on circuit breakers as indicated on the drawings.

F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.
2. General Electric Company.
3. Siemens.
4. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit Breaker or Lugs Only as indicated on the drawings.

D. Branch Overcurrent Protective Devices: Plug-in or Bolt-on circuit breakers (as indicated on the drawings), replaceable without disturbing adjacent units.

E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

F. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

2.4 LOAD CENTERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.
2. General Electric Company.
3. Siemens.
4. Square D; a brand of Schneider Electric.

B. Load Centers: Comply with UL 67.

C. Mains: Circuit Breaker or Lugs Only as indicated on the drawings.

D. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.

E. Conductor Connectors: Mechanical type for main, neutral, and ground lugs and buses.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.
2. General Electric Company.
3. Siemens.
4. Square D; a brand of Schneider Electric.

B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:

    a. Instantaneous trip.
    b. Long- and short-time pickup levels.
    c. Long- and short-time time adjustments.
    d. Ground-fault pickup level, time delay, and I^2t response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
7. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

    a. Standard frame sizes, trip ratings, and number of poles.
    b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
    c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
    d. Ground-Fault Protection (where indicated on drawings): Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    e. Shunt Trip (where indicated on drawings): 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
    f. Undervoltage Trip (where indicated on drawings): Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
    g. Alarm Switch (where indicated on drawings): Single-pole, normally open contact that actuates only when circuit breaker trips.
    h. Key Interlock Kit (where indicated on drawings): Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
    i. Zone-Selective Interlocking (where indicated on drawings): Integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices.
    j. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
    k. Handle Padlocking Device (where indicated on drawings): Fixed attachment, for locking circuit-breaker handle in on or off position.
    l. Handle Clamp (where indicated on drawings): Loose attachment, for holding circuit-breaker handle in on position.

2.6 PANELBOARD SUPPRESSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Current Technology.
2. Eaton Electrical Inc.
3. Emerson.
4. General Electric Company.
5. Siemens.
6. Square D; a brand of Schneider Electric.

B. Surge Protection Device: IEEE C62.41-compliant, integrally mounted, solid-state, parallel-connected, non-modular type, with sine-wave tracking suppression and filtering modules, UL 1449, second edition, short-circuit current rating matching or exceeding the panelboard short-circuit rating, and with the following features and accessories:

1. Accessories:

    a. LED indicator lights for power and protection status.
    b. Audible alarm, with silencing switch, to indicate when protection has failed.

c. One set of dry contacts rated at 5 A and 250-V ac, for remote monitoring of protection status.Select first option in first subparagraph below for high exposure and cost, second option for medium exposure and cost, and third option for low exposure and cost.

2. Minimum single-impulse current ratings, using 8-by-20-mic.sec. waveform described in IEEE C62.41.2.

3. Withstand Capabilities: 12,000 IEEE C62.41, Category C3 (10 kA), 8-by-20-mic.sec. surges with less than 5 percent change in clamping voltage.
4. Protection modes and UL 1449 SVR for grounded wye circuits with 208Y/120-V, three-phase, four-wire circuits shall be as follows:

a. Line to Neutral: 400 V for 208Y/120.
b. Line to Ground: 400 V for 208Y/120.
c. Neutral to Ground: 400 V for 208Y/120.

2.7 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. Receive, inspect, handle, and store panelboards according to NECA 407.

B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install panelboards and accessories according to NECA 407.

B. Equipment Mounting: Install floor mounted panelboards on concrete bases, 4-inch nominal thickness, unless otherwise indicated on drawings.

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of base.
2. For panelboards, 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 panelboards.
5. Attach panelboard to the vertical finished or structural surface behind the panelboard.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

D. Mount top of trim 90 inches above finished floor unless otherwise indicated.

E. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

F. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

G. Install filler plates in unused spaces.

H. Stub four 1-inch empty conduits from recessed panelboards into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits from recessed panelboards into raised floor space or below slab not on grade, where applicable.

I. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

J. Comply with NECA 1.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. 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.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

E. 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 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.

F. Panelboards will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "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.

1. Measure as directed during period of normal system loading.
2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.6 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 26 2416

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SECTION 26 2726

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. This Section includes the following:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Twist-locking receptacles.
3. Floor service outlets, poke-through assemblies, and multioutlet assemblies.

1.3 DEFINITIONS

A. GFCI: Ground-fault circuit interrupter.

B. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

C. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

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

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Samples: One for each type of device and wall plate specified, in each color specified.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.6 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1.7 EXTRA MATERIALS

A. Furnish extra materials described in subparagraphs below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Service/Power Poles: One for every 10, but no fewer than one.
2. Floor Service Outlet Assemblies: One for every 10, but no fewer than one.
3. Poke-Through, Fire-Rated Closure Plugs: One for every five floor service outlets installed, but no fewer than two.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
3. Leviton Mfg. Company Inc. (Leviton).
4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 5351 (single), 5352 (duplex).
b. Hubbell; HBL5351 (single), CR5352 (duplex).
c. Leviton; 5891 (single), 5352 (duplex).
d. Pass & Seymour; 5381 (single), 5352 (duplex).

2.3 GFCI RECEPTACLES

A. General Description: Straight blade, non-feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Cooper; GF20.
    b. Pass & Seymour; 2084.

2.4 SNAP SWITCHES

A. Comply with NEMA WD 1 and UL 20.

B. Switches, 120/277 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
    b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
    c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
    d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

2.5 OCCUPANCY SENSORS

A. Wall-Switch Sensors:

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Cooper; 6111 for 120 V, 6117 for 277 V.
    b. Hubbell; WS1277.
    c. Leviton; ODS 10-ID.
    d. Pass & Seymour; WS3000.
    e. Watt Stopper (The); WS-200.

2. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft.

2.6 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: Smooth, high-impact thermoplastic.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in "wet locations."

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant , die-cast aluminum with lockable cover.

2.7 FLOOR SERVICE FITTINGS

A. Type: Modular, flap-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.

2.8 POKE-THROUGH ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hubbell Incorporated; Wiring Device-Kellems.
2. Pass & Seymour/Legrand; Wiring Devices & Accessories.
3. Square D/ Schneider Electric.
4. Thomas & Betts Corporation.
5. Wiremold Company (The).

B. Description: Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service outlet assembly.
1. Size: Selected to fit cored holes in floor and matched to floor thickness.
2. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
3. Closure Plug: Arranged to close unused cored openings and reestablish fire rating of floor.

2.9 FINISHES

A. Wall Plate Color: White, or as selected by Architect to match surrounding wall finish.

B. Wiring Device Color: Wiring device catalog numbers in Section Text do not designate device color.

1. Wiring Devices Connected to Normal Power System: White, unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Emergency Power System: Red.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:

1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:

    a. Cut back and pigtail, or replace all damaged conductors.
    b. Straighten conductors that remain and remove corrosion and foreign matter.
    c. Pigtailing existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the left.

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 and service poles to suit arrangement of partitions and furnishings.

3.2 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.
1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION 26 2726

SECTION 26 28 16

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. Nonfusible 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 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.

C. Qualification Data: For qualified testing agency.

D. 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.

E. Manufacturer's field service report.

F. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. 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.

1.5 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. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

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.

E. Comply with NFPA 70.

1.6 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.

1.7 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.

1.8 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. 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.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.
2. General Electric Company.
3. Siemens.
4. Square D; a brand of Schneider Electric.

B. Type GD, General Duty, Single Throw, 240-V ac, 800 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with cartridge fuse interiors to accommodate indicated fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Type HD, Heavy Duty, Single Throw, 240 and 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Type HD, Heavy Duty, Six Pole, Single Throw, 240 and 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

E. Type HD, Heavy Duty, Double Throw, 240 and 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

F. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Lugs: Compression type, suitable for number, size, and conductor material.

2.2 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.
2. General Electric Company.
3. Siemens.
4. Square D; a brand of Schneider Electric.

B. Type GD, General Duty, Single Throw, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Type HD, Heavy Duty, Single Throw, 240 and 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Type HD, Heavy Duty, Six Pole, Single Throw, 240 and 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

E. Type HD, Heavy Duty, Double Throw, 240 and 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

F. 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. Lugs: Compression type, suitable for number, size, and conductor material.

2.3 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.
2. General Electric Company.
3. Siemens.
4. Square D; a brand of Schneider Electric.

B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

D. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: 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.

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. Kitchen and Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.

5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
6. Hazardous Areas Indicated on Drawings: NEMA 250, Type 9.

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 Division 26 Section "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. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. 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.

D. 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.

E. 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.

F. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

G. 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 Division 26 Section "Overcurrent Protective Device Coordination Study".

END OF SECTION 26 2816

SECTION 26 3213

ENGINE GENERATORS

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 packaged engine-generator sets for standby power supply with the following features:

1. Fuel: Natural Gas.
2. Unit-mounted cooling system.
3. Remote control and monitoring.

B. Related Sections include the following:

1. Division 26 Section "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.

1.3 DEFINITIONS

A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

1.4 SUBMITTALS

A. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:

1. Thermal damage curve for generator.
2. Time-current characteristic curves for generator protective device.

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. Shop drawings shall be approved by the engineer of record prior to ordering generator and components.

1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.
2. Wiring Diagrams: Power, signal, and control wiring.

C. Qualification Data: For installer, manufacturer and testing agency.

D. Source quality-control test reports.

1. Certified summary of prototype-unit test report.
2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
3. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria for sensitive loads.
4. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
5. Report of sound generation.
6. Report of exhaust emissions showing compliance with applicable regulations.
7. Certified Torsional Vibration Compatibility: Comply with NFPA 110.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.

G. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL), and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

C. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.

D. 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.

E. Comply with ASME B15.1.

F. Comply with NFPA 37.

G. Comply with NFPA 70.

H. Comply with NFPA 99.

I. Comply with UL 2200.

J. Engine Exhaust Emissions: Comply with applicable state and local government requirements.

K. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 5 year comprehensive warranty.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: One for every 10 of each type and rating, but no fewer than one of each.
2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.
3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Kohler Co.; Generator Division.
2. Generac Power Systems, Inc.
3. Onan/Cummins Power Generation; Industrial Business Group.

2.2 ENGINE-GENERATOR SET

A. Factory-assembled and -tested, engine-generator set.

B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.

1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.

C. Capacities and Characteristics:

1. Power Output Ratings: Nominal ratings as indicated on drawings.
2. Output Connections: Three-phase, four wire.
3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.

D. Generator-Set Performance:

1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.
2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
7. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
8. Start Time: Comply with NFPA 110, Type 10, system requirements.

E. Generator-Set Performance for Sensitive Loads:

1. Oversizing generator compared with the rated power output of the engine is permissible to meet specified performance.

    a. Nameplate Data for Oversized Generator: Show ratings required by the Contract Documents rather than ratings that would normally be applied to generator size installed.

2. Steady-State Voltage Operational Bandwidth: 1 percent of rated output voltage from no load to full load.
3. Transient Voltage Performance: Not more than 10 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 0.5 second.
4. Steady-State Frequency Operational Bandwidth: Plus or minus 0.25 percent of rated frequency from no load to full load.
5. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
6. Transient Frequency Performance: Less than 2-Hz variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within three seconds.
7. Output Waveform: At no load, harmonic content measured line to neutral shall not exceed 2 percent total with no slot ripple. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
8. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to winding insulation or other generator system components.
9. Excitation System: Performance shall be unaffected by voltage distortion caused by nonlinear load.

a. Provide permanent magnet excitation for power source to voltage regulator.

10. Start Time: Comply with NFPA 110, Type 10, system requirements.

2.3 OUTDOOR GENERATOR-SET ENCLOSURE

A. Description: Vandal-resistant, weatherproof steel housing, wind resistant up to 100 mph (160 km/h). Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.

B. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.

1. Louvers: Fixed-engine, cooling-air inlet and discharge. Storm-proof and drainable louvers prevent entry of rain and snow.

2.4 ENGINE

A. Fuel: Natural gas

B. Rated Engine Speed: 1800 rpm.

C. Maximum Piston Speed for Four-Cycle Engines: 2250 fpm (11.4 m/s).

D. Lubrication System: The following items are mounted on engine or skid:

1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

E. Engine Fuel System:

1. Natural Gas:

a. Carburetor.
b. Fuel-Shutoff Solenoid Valves: One for each fuel source.
c. Flexible Fuel Connectors: One for each fuel source.

F. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.

G. Governor: Electronic.

H. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.

1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
3. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.

    a. Rating: 50-psig (345-kPa) maximum working pressure with coolant at 180 deg F (82 deg C), and non-collapsible under vacuum.
    b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

I. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.

1. Minimum sound attenuation of 25 dB at 500 Hz.
2. Sound level measured at a distance of 10 feet (3 m) from exhaust discharge after installation is complete shall be 85 dBA or less.

J. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.

K. Starting System: 12-V electric, with negative ground.

1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
3. Cranking Cycle: As required by NFPA 110 for system level specified.
4. Battery: Adequate capacity within ambient temperature range specified in Part 1 "Project Conditions" Article to provide specified cranking cycle at least twice without recharging.
5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 10 deg C regardless of external ambient temperature within range specified in Part 1 "Project Conditions" Article. Include accessories required to support and fasten batteries in place.
7. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation.
8. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236 and include the following features:

    a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.

b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.5 CONTROL AND MONITORING

A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.

B. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts generator set. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.

C. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration.

D. Indicating and Protective Devices and Controls:
1. Equal to Kohler “Decision Maker 550”

E. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

F. Remote Alarm Annunciator: Comply with NFPA 99. An LED labeled with proper alarm conditions shall identify each alarm event and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.

G. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

2.6 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Generator Circuit Breaker: Molded-case, thermal-magnetic type; 100 percent rated; complying with NEMA AB 1 and UL 489.

1. Tripping Characteristic: Designed specifically for generator protection.
2. Trip Rating: Matched to generator rating.
3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
4. Mounting: Adjacent to or integrated with control and monitoring panel.

2.7 SOURCE QUALITY CONTROL

A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.

1. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.

B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:

1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
2. Full load run.
3. Maximum power.
4. Voltage regulation.
5. Transient and steady-state governing.
6. Single-step load pickup.
7. Safety shutdown.
8. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.
9. Report factory test results within 10 days of completion of test.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.

B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.

B. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.

C. Install packaged engine generator with elastomeric isolator pads a minimum deflection of 1 inch (25 mm). Secure sets to anchor bolts installed in concrete bases.

D. Install Schedule 40, black steel piping with welded joints and connect to engine muffler. Install thimble at wall. Piping shall be same diameter as muffler outlet.

1. Install condensate drain piping to muffler drain outlet full size of drain connection with a shutoff valve, stainless-steel flexible connector, and Schedule 40, black steel pipe with welded joints.

E. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.3 CONNECTIONS

A. Drawings indicate general arrangement of piping and specialties. Coordinate with other divisions for installation of all required components.

B. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow service and maintenance.

C. Connect fuel piping to engines with a gate valve and union and flexible connector.
1. Natural-gas piping, valves, and specialties for gas distribution are specified in Division 23 Sections.
2. LP-gas piping, valves, and specialties for gas piping are specified in Division 23 Sections.

D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 IDENTIFICATION

A. Identify system components according to Division 26 Section "Identification for Electrical Systems."

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. Report results in writing.

B. Tests and Inspections:

1. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection for "AC Generators and for Emergency Systems" specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.
3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.

a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.

b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
c. Verify acceptance of charge for each element of the battery after discharge.
d. Verify that measurements are within manufacturer's specifications.

4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
6. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg (120 kPa). Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.
7. Exhaust Emissions Test: Comply with applicable government test criteria.
8. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
9. Harmonic-Content Tests: Measure harmonic content of output voltage under 25 percent and at 100 percent of rated linear load. Verify that harmonic content is within specified limits.

C. Coordinate tests with tests for transfer switches and run them concurrently.

D. Test instruments shall have been calibrated within the last 12 months, traceable to standards of NIST, and adequate for making positive observation of test results. Make calibration records available for examination on request.

E. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

F. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

G. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

H. Remove and replace malfunctioning units and retest as specified above.

I. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

J. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

K. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each power wiring termination and each bus connection. Remove all access panels so terminations and connections are accessible to portable scanner.
1. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
2. Record of Infrared Scanning: Prepare a certified report that identifies terminations and connections checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 26 3213

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SECTION 26 3600

TRANSFER SWITCHES

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 transfer switches rated 600 V and less, including the following:

1. Automatic transfer switches

2. Remote annunciation systems

B. Related Sections include the following:

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.

1. Technical data on all major components of all transfer switches and other products described in this section. Data is required for the transfer switch mechanism, control system, cabinet, and protective devices specifically listed for use with each transfer switch. Include steady state and fault current ratings, weights, operating characteristics, and furnished specialties and accessories.

2. Single Line Diagram: Show connections between transfer switch, power sources and load

B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.

1. Dimensioned outline drawings of assembly, including elevations, sections, and details including minimal clearances, conductor entry provisions, gutter space, installed features and devices and material lists for each switch specified.

2. Internal electrical wiring and control drawings.

3. Interconnection wiring diagrams, showing recommended conduit runs and point-to-point terminal connections to generator set.

4. Installation and mounting instructions, including information for proper installation of equipment to meet seismic requirements.

C. Manufacturer and Supplier Qualification Data

1. The transfer switch manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.

2. The manufacturer of this equipment shall have produced similar equipment for a minimum period of 10 years. When requested, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Features and operating sequences, both automatic and manual.

2. List of all factory settings of relays, timers and protective devices; provide setting and calibration instructions where applicable.

E. Warranty documents demonstrating compliance with the project's contract requirements.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: The equipment supplier shall maintain a service center capable of providing training, parts, maintenance and emergency repairs to equipment, including transfer switch generator sets and remote monitoring equipment (if applicable) at the site within a response period of less than (eight hours or appropriate time period designated for Project) from time of notification.

1. The transfer switch shall be serviced by technicians employed by, and specially trained and certified by, the generator set supplier and the supplier shall have a service organization that is factory-certified in both generator set and transfer switch service. The supplier shall maintain an inventory of critical replacement parts at the local service organization, and in service vehicles. The service organization shall be on call 24 hours per day, 365 days per year.

2. Submit names, experience level, training certifications, and locations for technicians that will be responsible for servicing equipment at this site.

3. The manufacturer shall maintain model and serial number records of each transfer switch provided for at least 20 years.

B. Source Limitations: All transfer switches are to be obtained through one source from a single manufacturer. The generator set manufacturer shall warrant transfer switches to provide a single source of responsibility for products provided.

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 as suitable for use in emergency, legally required or optional standby use as appropriate for the connected load.

D. The automatic transfer switch installation and application shall conform to the requirements of the following codes and standards:

1. Transfer switches and enclosures shall be UL 1008 listed and labeled as suitable for use in emergency, legally required, and optional standby applications.

2. CSA 282, Emergency Electrical Power Supply for Buildings, and CSA C22.2, No. 14-M91 Industrial Control Equipment

3. NFPA 70, National Electrical Code. Equipment shall be suitable for use in systems in compliance with Articles 700, 701 and 702.

4. Comply with NEMA ICS 10-1993 AC Automatic Transfer Switches

5. IEEE 446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications

6. EN55011, Class B Radiated Emissions and Class B Conducted Emissions

7. IEC 1000-4-5 (EN 61000-4-5); AC Surge Immunity

8. IEC 1000-4-4 (EN 61000-4-4) Fast Transients Immunity

9. IEC 1000-4-2 (EN 61000-4-2) Electrostatic Discharge Immunity

10. IEC 1000-4-3 (EN 61000-4-3) Radiated Field Immunity

11. IEC 1000-4-6 Conducted Field Immunity

12. IEC 1000-4-11 Voltage Dip Immunity

13. IEEE 62.41, AC Voltage Surge Immunity

14. IEEE 62.45, AC Voltage Surge Testing

E. Comply with NFPA 99 – Essential Electrical Systems for Healthcare Facilities

F. Comply with NFPA 110 – Emergency and Standby Power Systems. The transfer switch shall meet all requirements for Level 1 systems, regardless of the actual circuit level.

G. The manufacturer shall warrant the material and workmanship of the transfer switch equipment for a minimum of two (2) year from the warranty start date. The warranty start date is the date of registered commissioning and start up or eighteen (18) months from date of shipment, whichever is sooner.

H. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, and etc. during the minimum noted warranty period described above.

1.5 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service:

1. Notify (Architect/Construction Manager/Owner) no fewer than (insert appropriate number) days in advance of proposed interruption of electrical service.

2. Do not proceed with interruption of electrical service without (Architect/Construction Manager/Owner's) written permission.

3. Do not energize any new service or distribution equipment without notification and permission of the (Architect/Construction Manager/Owner).

1.6 COORDINATION

A. Size and location of concrete bases and anchor bolt inserts shall be coordinated. Concrete, reinforcement and formwork must meet the requirements specified in Division 03. See section "INSTALLATION" for additional information on installation

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cummins Power Generation

B. Equipment specifications for this Project are based on automatic transfer switches manufactured by Cummins Power Generation. Switches manufactured by other manufacturers that meet the requirement of this specification are acceptable, if approved not less than two weeks before scheduled bid date. Proposals must include a line-by-line compliance statement based on this specification.

C. Transfer switches utilizing molded case circuit breakers do not meet the requirements of this specification and will not be accepted.

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

A. Provide transfer switches in the number and ratings that are shown on the drawings.

B. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer.

C. Fault-Current Closing and Withstand Ratings: UL 1008 WCR ratings must be specifically listed as meeting the requirements for use with protective devices at installation locations, under specified fault conditions. Withstand and closing ratings shall be based on use of the same set of contacts for the withstand test and the closing test.

D. Solid-State Controls: All settings should be accurate to +/- 2% or better over an operating temperature range of - 40 to + 60 degrees C (- 40 to + 140 degrees F).

E. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

F. Electrical Operation: Accomplished by a non-fused, momentarily energized solenoid or electric motor operator mechanism, mechanically and electrically interlocked in both directions (except that mechanical interlock is not required for closed transition switches).

G. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

1. Switches using molded-case switches or circuit breakers, or insulated case circuit breaker components are not acceptable.

2. Transfer switches shall be double-throw, electrically and mechanically interlocked, and mechanically held in the Source 1 and Source 2 positions.

3. Main switch contacts shall be high pressure silver alloy. Contact assemblies shall have arc chutes for positive arc extinguishing. Arc chutes shall have insulating covers to prevent inter-phase flashover.

4. Contacts shall be operated by a high-speed electrical mechanism that causes contacts to open or close within three electrical cycles from signal.

5. Transfer switch shall be provided with flame retardant transparent covers to allow viewing of switch contact operation but prevent direct contact with components that could be operating at line voltage levels.

6. The transfer switch shall include the mechanical and control provisions necessary to allow the device to be field-configured for operating speed. Transfer switch operation with motor loads shall be as is recommended in NEMA MG1.

    a. Phase angle monitoring/timing equipment is not an acceptable substitute for this functionality

7. Transfer switches designated on the drawings as “4-pole” shall be provided with a switched neutral pole switched which is switched simultaneously with phase poles.

H. Control: Transfer switch control shall be capable of communicating with the genset control, other switches and remote programming devices over a high-speed network interface.

I. Factory wiring: Transfer switch internal wiring shall be composed of pre-manufactured harnesses that are permanently marked for source and destination. Harnesses shall be connected to the control system by means of locking disconnect plug(s), to allow the control system to be easily disconnected and serviced without disconnecting power from the transfer switch mechanism

J. Terminals: Terminals shall be pressure type and appropriate for all field wiring. Control wiring shall be equipped with suitable lugs, for connection to terminal strips.

K. Enclosures: All enclosures shall be third-party certified for compliance to NEMA ICS 6 and UL 508, unless otherwise indicated:

1. The enclosure shall provide wire bend space in compliance to the latest version of NFPA70, regardless of the direction from which the conduit enters the enclosure.

2. Exterior cabinet doors shall provide complete protection for the system’s internal components. Doors must have permanently mounted key-type latches. Bolted covers or doors are not acceptable.

3. Transfer switches shall be provided in enclosures that are third party certified for their intended environment per NEMA requirements.

2.3 AUTOMATIC TRANSFER SWITCHES

A. Comply with requirements for Level 1 equipment according to NFPA 110.

B. Indicated current ratings:

1. Refer to the Project drawings for specifications on the sizes and types of transfer switch equipment, withstand and closing ratings, number of poles, voltage and ampere ratings, enclosure type, and accessories.

2. Main contacts shall be rated for 600 VAC minimum.

3. Transfer switches shall be rated to carry 100% of rated current continuously in the enclosure supplied, in ambient temperatures of -40 to +60 degrees C (-40 to +140 degrees F), relative humidity up to 95% (non-condensing), and altitudes up to 10,000 feet (3000 meters).

C. Relay Signal: Control shall include provisions for addition of a pre-transfer relay signal, adjustable from 0 to 60 seconds, to be provided if necessary for elevator operation, based on equipment provided for the project.

D. Control: Transfer switch control shall be provided with necessary equipment and software to communicate with the genset control, other transfer switches, remote annunciation equipment, and other devices over a high speed control network.

E. Neutral Switching: Transfer switches designated on the drawings as 4-pole shall be provided with a switched neutral pole. The neutral pole shall be of the same construction and have the same ratings as the phase poles. All poles shall be switched simultaneously using a common crossbar. Substitute equipment using overlapping neutral contacts is not acceptable.

F. Automatic Transfer Switch Control Features

1. The transfer switch control system shall be configurable in the field for any operating voltage level up to 600 VAC. Voltage sensing shall be monitored based on the normal voltage at the site. Systems that utilize voltage monitoring based on standard voltage conditions that are not field configurable are not acceptable.

2. All transfer switch sensing shall be configurable from an operator panel or from a Windows XP or later PC-based service tool. Designs utilizing DIP switches or other electromechanical devices are not acceptable.

3. The transfer switch shall be configurable to accept a relay contact signal and a network signal from an external device to prevent transfer to the generator service.

4. The transfer switch shall provide a relay contact signal prior to transfer or re-transfer. The time period before and after transfer shall be adjustable in a range of 0 to 60 seconds.

5. The control system shall be designed and prototype tested for operation in ambient temperatures from - 40 degrees C to + 60 degrees C (- 40 to +140 degrees F). It shall be designed and tested to comply with the requirements of the noted voltage and RFI/EMI standards.

6. The control shall have optically isolated logic inputs, high isolation transformers for AC inputs and relays on all outputs, to provide optimum protection from line voltage surges, RFI and EMI.

7. The transfer switch network monitoring equipment, when supplied, shall be provided with a battery-based auxiliary power supply to allow monitoring of the transfer switch when both AC power sources are non-operational.

G. Transfer Switch Control Panel: The transfer switch shall have a microprocessor-based control with a sealed membrane panel incorporating pushbuttons for operator-controlled functions, and LED lamps for system status indicators. The panel shall also include an alphanumeric display for detailed system information. Panel display and indicating lamps shall include permanent labels.

1. The indicator panel LEDs shall display:

   a. Which source the load is connected to (Source 1 or Source 2)

   b. Which source or sources are available

   c. When switch is not set for automatic operation, the control is disabled

   d. When the switch is in test/exercise mode

2. The indicator shall have pushbuttons that allow the operator to activate the following functions:

   a. Activate pre-programmed test sequence

   b. Override programmed delays, and immediately go to the next operation

   c. Reset the control by clearing any faults

d. Test all of the LEDs by lighting them simultaneously

3. The alphanumeric digital display shall be vacuum fluorescent-type, clearly visible in both bright sunlight and no-light conditions over an angle of 120 degrees, and shall display the following:

a. AC voltage for all phases, normal and emergency

b. Source status: connected or not connected.

4. The display panel shall be password-protected, and allow the operator to view and make adjustments:

a. Set nominal voltage and frequency for the transfer switch

b. Adjust voltage and frequency sensor operation set points

c. Set up time clock functions

d. Set up load sequence functions

e. Enable or disable control functions including program transition

f. View real-time clock data, operation log (hours connected, times transferred, failures) and service history

H. Control Functions: Functions managed by the control shall include:

1. Software adjustable time delays:

a. Engine start (prevents nuisance genset starts in the event of momentary power fluctuation): 0 to 120 seconds (default 3 sec)

b. Transfer normal to emergency (allows genset to stabilize before load is transferred): 0 to 120 seconds (default 3 sec)

c. Re-transfer emergency to normal (allows utility to stabilize before load is transferred from genset): 0 to 30 minutes (default 3 sec)

d. Engine cooldown: 0 to 30 minutes (default 10 min)

e. Programmed transition: 0 to 60 seconds (default 3 sec)

2. Undervoltage sensing: three-phase normal, three-phase emergency source.

3. Over-voltage sensing: three-phase normal, three-phase emergency source.

4. Over/under frequency sensing:

a. Pickup: +/- 5 to +/-20% of nominal frequency (default 10%)

b. Dropout: +/-1% beyond pickup (default 1%)

c. Dropout time delay: 0.1 to 15.0 seconds (default 5 sec)

d. Accurate to within +/- 0.05 Hz

5. Voltage imbalance sensing:

a. Dropout: 2 to 10% (default 4%)

b. Pickup: 90% of dropout

c. Time delay: 2.0 to 20 seconds (default 5 sec)

6. Phase rotation sensing:

a. Time delay: 100 msec

7. Loss of single-phase detection:

a. Time delay: 100 msec

I. Control features shall include:

1. Programmable genset exerciser: A field-programmable control shall periodically start and run the generator with or without transferring the load for a preset time period, then re-transfer and shut down the generator after a preset cool-down period.

2. In event of a loss of power to the control, all control settings, real-time clock setting and the engine start-time delay setting will be retained.

3. The system continuously logs information including the number of hours each source has been connected to the load, the number of times transferred, and the total number of times each source has failed. An event recorder stores information, including time and date-stamp, for up to 50 events.

4. Re-Transfer Inhibit Switch: Inhibits automatic re-transfer control so automatic transfer switch will remain connected to emergency power source as long as it is available regardless of condition of normal source.

5. Transfer Inhibit Switch: Inhibits automatic transfer control so automatic transfer switch will remain connected to normal power source regardless of condition of emergency source.

J. Control Interface

1. Provide one set Form C auxiliary contacts on both sides, operated by transfer switch position, rated 10 amps 250 VAC.

2. The transfer switch shall be provided with a network communication card, and configured to allow network-based communication with the transfer switch and other network system components, including the generator set(s) provided for the Project.

3. Unassigned Auxiliary Contacts: Two normally open, 1-pole, double-throw contacts for each switch position, rated 10A at 240 VAC.

K. Engine Starting Contacts

1. One isolated and normally closed pair of contacts rated 10A at 32 VDC minimum.

2.4 REMOTE ANNUNCIATOR SYSTEM

A. Functional Description: Remote annunciator panel shall annunciate conditions for indicated transfer switches. Annunciation shall include the following:

1. Sources available, as defined by actual pickup and dropout settings of transfer-switch controls.

2. Switch position.

3. Switch in test mode.

4. Failure of communication link.

B. Annunciator Panel: LED-lamp type with audible signal and silencing switch.

1. Indicating Lights: Grouped for each transfer switch monitored.

2. Label each group, indicating transfer switch it monitors, location of switch, and identity of load it serves.

3. Switch in test mode.

4. Lamp Test: Push-to-test or lamp-test switch on front panel.

C. Malfunction of annunciator or communication link shall not affect functions of automatic transfer switch. In the event of failure of communication link, automatic transfer switch automatically reverts to stand-alone, self-contained operation.

D. Automatic transfer-switch sensing, controlling, or operating function shall not depend on remote panel for proper operation. The remote annunciation system shall not prevent transfer to the alternate source when the primary power source fails, nor prevent return to the primary source if the alternate source fails

PART 3 - EXECUTION

3.1 INSTALLATION

A. Design each fastener and support to carry load indicated by seismic requirements and according to seismic-restraint details. See Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

B. Floor-Mounting Switch: Anchor to floor by bolting.

1. Floor-mounted transfer switches (except drawout switches supported by wheeled carriages, which must be rolled out at floor level) shall be mounted on concrete bases complying with the following requirements:

a. Concrete Bases: 4 inches (100 mm) high, reinforced, with chamfered edges. Extend base no more than 4 inches (100 mm) in all directions beyond the maximum dimensions of switch, unless otherwise indicated or unless required for seismic support. Construct concrete bases according to Division 26 Section "Hangers and Supports for Electrical Systems."

C. Annunciator Panel Mounting: Flush in wall, unless otherwise indicated.

D. Identify components according to Division 26 Section "Identification for Electrical Systems."

E. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.2 CONNECTIONS

A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

B. Field control connections shall be made on a common terminal block that is clearly and permanently labeled.

C. Transfer switch shall be provided with AL/CU mechanical lugs sized to accept the full output rating of the switch. Lugs shall be suitable for the number and size of conductors shown on the drawings.

D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 SOURCE QUALITY CONTROL

A. Prior to shipping, factory shall test and inspect components, assembled switches, and associated equipment to ensure proper operation.

B. Factory shall check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements.

C. Factory shall perform dielectric strength test complying with NEMA ICS 1.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: The supplier of the transfer switch(es) and associated equipment shall inspect, test, and adjust components, assemblies, and equipment installations, including connections, and report results in writing.

B. Manufacturer’s representative shall perform tests and inspections and prepare test reports.

C. After installing equipment and after electrical circuitry has been energized, installer shall test for compliance with requirements.

1. Perform recommended installation tests as recommended in manufacturer’s installation and service manuals.

2. After energizing circuits, demonstrate interlocking sequence and operational function for each switch.

a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.

b. Verify time-delay settings.

c. Verify that the transfer switch is accurately metering AC voltage.

d. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

D. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.

1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.

2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

3. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 DEMONSTRATION

A. After generator set installation, the generator and transfer switch supplier shall conduct a complete operation, basic maintenance, and emergency service seminar covering generator set and transfer switch equipment, for up to 10 people employed by the Owner.

1. The seminar shall include instruction on operation of the transfer equipment, normal testing and exercise, adjustments to the control system, use of the PC based service and maintenance tools provided under this contract, and emergency operation procedures.

2. The class duration shall be at least 8 hours in length, and include practical operation with the installed equipment.

3.6 SERVICE AND SUPPORT

A. The manufacturer shall supply the Service Provider with a complete set of the service and maintenance software required to support the product. The software shall be provided at a training class attended by the user, to qualify the user in proper use of the software. The software shall have the following features and capabilities:

1. The software shall allow adjustment of all functions described herein, adjustment of operating levels of all protective functions, and programming of all optional functions in the controller. Adjustments shall be possible over modem from a facility that is remote from the generator set.

2. The software shall be capable of storing and displaying data for any function monitored by the generator set control. This data shall be available in common file formats, and on graphical “strip chart” displays.

3. The software shall automatically record all control operations and adjustments performed by any operator or software user, for tracking of changes to the control.

4. The software shall display all warning, shutdown, and status changes programmed into transfer switch controller. For each event, the control shall provide information on the nature of the event, when it last occurred, and how many times it has occurred.

END OF SECTION 26 3600

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SECTION 26 41 13

LIGHTNING PROTECTION FOR STRUCTURES

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 lightning protection for structures.

1.3 SUBMITTALS

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

B. Shop Drawings: For air terminals and mounting accessories.

1. Layout of the lightning protection system, along with details of the components to be used in the installation.
2. Include indications for use of raceway, data on how concealment requirements will be met, and calculations required by NFPA 780 for bonding of grounded and isolated metal bodies.

C. Qualification Data: For qualified Installer and manufacturer. Include data on listing or certification by UL.

D. Certification, signed by Contractor, that roof adhesive is approved by manufacturer of roofing material.

E. Field quality-control reports.

F. Comply with recommendations in NFPA 780, Annex D, "Inspection and Maintenance of Lightning Protection Systems," for maintenance of the lightning protection system.

G. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features, including the following:

1. Ground rods.
2. Ground loop conductor.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Certified by UL or LPI as a Master Installer/Designer, trained and approved for installation of units required for this Project.

B. System Certificate:

1. UL Master Label.
2. LPI System Certificate.
3. UL Master Label Recertification.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 780, "Definitions" Article.

1.5 COORDINATION

A. Coordinate installation of lightning protection with installation of other building systems and components, including electrical wiring, supporting structures and building materials, metal bodies requiring bonding to lightning protection components, and building finishes.

B. Coordinate installation of air terminals attached to roof systems with roofing manufacturer and Installer.

C. Flashings of through-roof assemblies shall comply with roofing manufacturers' specifications.

PART 2 - PRODUCTS

2.1 LIGHTNING PROTECTION SYSTEM COMPONENTS

A. Comply with UL 96 and NFPA 780.

B. Roof-Mounted Air Terminals: NFPA 780, Class II, aluminum unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. East Coast Lightning Equipment Inc.
b. ERICO International Corporation.
c. VFC Lightning Protection.

2. Air Terminals More than 24 Inches (600 mm) Long: With brace attached to the terminal at not less than half the height of the terminal.
3. Single-Membrane, Roof-Mounted Air Terminals: Designed specifically for single-membrane roof system materials. Comply with requirements in Division 07 roofing Sections.

C. Main and Bonding Conductors: Copper.

D. Ground Loop Conductor: The same size and type as the main conductor except tinned.

E. Ground Rods: Copper-clad steel; 3/4 inch (19 mm) in diameter by 10 feet (3 m) long.

F. Heavy-Duty, Stack-Mounted, Lightning Protection Components: Stainless steel.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install lightning protection components and systems according to UL 96A and NFPA 780.

B. Install conductors with direct paths from air terminals to ground connections. Avoid sharp bends.

C. Conceal the following conductors:

1. System conductors.
2. Down conductors.
3. Interior conductors.
4. Conductors within normal view of exterior locations at grade within 200 feet (60 m) of building.

D. Cable Connections: Use crimped or bolted connections for all conductor splices and connections between conductors and other components. Use exothermic-welded connections in underground portions of the system.

E. Air Terminals on Single-Ply Membrane Roofing: Comply with roofing membrane and adhesive manufacturer's written instructions.

F. Bond extremities of vertical metal bodies exceeding 60 feet (18 m) in length to lightning protection components.

G. Ground Loop: Install ground-level, potential equalization conductor and extend around the perimeter of structure.

1. Bury ground ring not less than 24 inches (600 mm) from building foundation.
2. Bond ground terminals to the ground loop.
3. Bond grounded building systems to the ground loop conductor within 12 feet (3.6 m) of grade level.

H. Bond lightning protection components with intermediate-level interconnection loop conductors to grounded metal bodies of building at 60-foot (18-m) intervals.

3.2 CORROSION PROTECTION

A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.

B. Use conductors with protective coatings where conditions cause deterioration or corrosion of conductors.

3.3 FIELD QUALITY CONTROL

A. Notify Architect at least 48 hours in advance of inspection before concealing lightning protection components.

B. UL Inspection: Meet requirements to obtain a UL Master Label for system.

C. LPI System Inspection: Meet requirements to obtain an LPI System Certificate.

END OF SECTION 26 4113

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SECTION 265100

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. This Section includes the following:

1. Interior lighting fixtures.
2. Emergency lighting units.
3. Exit signs.
4. Lighting fixture supports.

B. This Section is to be referenced for new standard fixtures only. For existing fixtures to be refurbished / reused, and for new custom fixtures, refer to architectural for requirements.

1.3 DEFINITIONS

A. Luminaire: Complete lighting fixture, including LEDs, drivers, heat sink, and all other components.

1.4 SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Physical description of lighting fixture including dimensions.
2. Emergency lighting units including battery and charger.
3. Life, output, and energy-efficiency data.

B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.

1. Wiring Diagrams: Power and control wiring.

C. Coordination Drawings: Reflected ceiling plan(s) and other details, 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. Lighting fixtures.
2. Suspended ceiling components.
3. Structural members to which suspension systems for lighting fixtures will be attached.

4. Other items in finished ceiling including the following:

   a. Air outlets and inlets.
   b. Speakers.
   c. Sprinklers.
   d. Smoke and fire detectors.
   e. Occupancy sensors.
   f. Access panels.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.

F. DLC Certification for LED fixtures: Provide lighting facts documentation.

G. Warranties: Special warranties specified in this Section.

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. All LED fixtures are to be tested and should adhere to IESNA LM79 testing standards for lumen output and depreciation.

C. All LED fixtures are to be tested to LM80 standards.

D. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.7 WARRANTY

A. Warranty for LED luminaires: Manufacturer's standard form, made out to Owner and signed by luminaire manufacturer agreeing to replace any component of the luminaire that fails in materials or workmanship, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

   1. Warranty Period: 5 years from date of Substantial Completion.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Plastic Diffusers and Lenses: 1 of each type and rating installed.
2. Guards: 1 for every 20 of each type and rating installed. Furnish at least one of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Basis-of-Design Product: The design for each lighting fixture is based on the product named on the drawings. Subject to compliance with requirements, provide either the named product or a comparable product by another manufacturer.

2.2 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Metal Parts: Free of burrs and sharp corners and edges.

C. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

D. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally when secured in operating position.

E. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.
4. Laminated Silver Metallized Film: 90 percent.

2.3 LED LUMINAIRES AND ACCESSORIES

A. Description:
1. All fixtures are to be tested and should adhere to IESNA LM79 testing standards for lumen output and depreciation.
2. All fixtures are to be tested to LM80 standards.
3. All fixtures are to be DLC certified.
4. All fixtures are to be rated to deliver L80 performance for a minimum of 50,000 hours.
5. All fixtures are to be equipped with a 0-10V dimming driver.

2.4 EXIT SIGNS

A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:
   1. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.
   2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.

      a. Battery: Sealed, maintenance-free, nickel-cadmium type.
      b. Charger: Fully automatic, solid-state type with sealed transfer relay.
      c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
      d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
      e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lighting fixtures: Set level, plumb, and square with ceilings and walls.

B. Suspended Lighting Fixture Support:

   1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
   2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
   3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.

C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION 26 5100

SECTION 265600

EXTERIOR LIGHTING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:

1. Exterior luminaires.
2. Poles and accessories.

B. Related Sections include the following:

1. Division 26 Section "Interior Lighting" for exterior luminaires normally mounted on exterior surfaces of buildings.

1.03 DEFINITIONS

A. CRI: Color-rendering index.
B. HID: High-intensity discharge.
C. Luminaire: Complete lighting fixture.
D. Pole: Luminaire support structure.
E. Standard: Same definition as "Pole" above.

1.04 SUBMITTALS

A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:

1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
2. Details of attaching luminaires and accessories.
3. Details of installation and construction.
4. Luminaire materials.
5. Photometric data based on laboratory tests of each luminaire type, complete with indicated lamps and accessories.
    a. Photometric data shall be certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

6. Materials, dimensions, and finishes of poles.
7. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
8. Anchor bolts for poles.
9. Manufactured pole foundations.

B. Shop Drawings:

1. Anchor-bolt templates keyed to specific poles and certified by manufacturer.
2. Design calculations, certified by a qualified professional engineer, indicating strength of screw foundations and soil conditions on which they are based.
3. Wiring Diagrams: Power wiring.

C. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements in AASHTO LTS-4 and that load imposed by luminaire has been included in design.

D. Qualification Data: For agencies providing photometric data for lighting fixtures.
E. Field quality-control test reports.
F. Operation and Maintenance Data: For luminaires and poles to include in emergency, operation, and maintenance manuals.
G. Warranty: Special warranty specified in this Section.

1.05 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
C. Comply with IEEE C2, "National Electrical Safety Code."
D. Comply with NFPA 70.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Package aluminum poles for shipping according to ASTM B 660.
B. Store poles on decay-resistant-treated skids at least 12 inches (300 mm) above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.

C. Retain factory-applied pole wrappings on metal poles until right before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

1.07 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products 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 specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.

1. Warranty Period for Luminaires: Five years from date of Substantial Completion.
2. Warranty Period for Metal Corrosion: Five years from date of Substantial Completion.
3. Warranty Period for Color Retention: Five years from date of Substantial Completion.
4. Warranty Period for Poles: Repair or replace lighting poles and standards that fail in finish, materials, and workmanship within manufacturer's standard warranty period, but not less than three years from date of Substantial Completion.

PART 2 -PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design Product: The design of each item of exterior luminaire and its support is based on the product named on the drawings. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

2.02 LUMINAIRES, GENERAL REQUIREMENTS

A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.

B. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
C. Metal Parts: Free of burrs and sharp corners and edges.
D. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.
E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
F. 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. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.
G. Exposed Hardware Material: Stainless steel.
H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.
J. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

K. 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.

L. 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.

M. 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.

2.03 POLES AND SUPPORT COMPONENTS, GENERAL REQUIREMENTS

A. Structural Characteristics: Comply with AASHTO LTS-4.

1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in Part 1 "Structural Analysis Criteria for Pole Selection" Article, with a gust factor of 1.3.

B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts, unless otherwise indicated.

C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.

1. Materials: Shall not cause galvanic action at contact points.
2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication, unless stainless-steel items are indicated.
3. Anchor-Bolt Template: Plywood or steel.

D. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."

E. Power-Installed Screw Foundations: Factory fabricated by pole manufacturer, with structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123M; and with top-plate and mounting bolts to match pole base flange and strength required to support pole, luminaire, and accessories.

F. Breakaway Supports: Frangible breakaway supports, tested by an independent testing agency acceptable to authorities having jurisdiction, according to AASHTO LTS-4.

2.04 STEEL POLES

A. Poles: Comply with ASTM A 500, Grade B, carbon steel with a minimum yield of 46,000 psig (317 MPa); 1-piece construction up to 40 feet (12 m) in height with access handhole in pole wall.

1. Shape: As indicated on fixture schedule.
2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

B. Brackets for Luminaires: Detachable, cantilever, without underbrace.

1. Adapter fitting welded to pole and bracket, then bolted together with stainless-steel bolts.
2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire.
3. Match pole material and finish.

C. Intermediate Handhole and Cable Support: Weathertight, 3-by-5-inch (76-by-127-mm) handhole located at bottom of pole with cover for access to internal welded attachment lug for electric cable support grip.

D. Grounding and Bonding Lugs: Welded 1/2-inch (13-mm) threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.

E. Cable Support Grip: Wire-mesh type with rotating attachment eye, sized for diameter of cable and rated for a minimum load equal to weight of supported cable times a 5.0 safety factor.

F. Factory-Painted Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

PART 3 -EXECUTION

3.01 LUMINAIRE INSTALLATION

A. Fasten luminaire to indicated structural supports.

1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

B. Adjust luminaires that require field adjustment or aiming.

3.02 POLE INSTALLATION

A. Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.

B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features, unless otherwise indicated on Drawings:

1. Fire Hydrants and Storm Drainage Piping: 60 inches (1520 mm)
2. Water, Gas, Electric, Communication, and Sewer Lines: 10 feet (3 m)
3. Trees: 15 feet (5 m)

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 Division 03 Section "Cast-in-Place Concrete."

D. Foundation-Mounted Poles: Mount pole with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.

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 nonshrink 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- (13-mm-) diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.

E. Raise and set poles using web fabric slings (not chain or cable).

3.03 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 Division 26 Section "Raceway and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- (0.254-mm-) thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.04 GROUNDING

A. Ground metal poles and support structures according to Division 26 Section "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.

3.05 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.
C. Test fixture operation with lighting controls and verify proper operation with control elements specified.
D. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION

SECTION 27 00 00

COMMUNICATIONS BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes general administrative and procedural requirements for Division 27 and 28, and is intended to supplement, not supersede, the requirements specified in Division 01.

B. Provide completely functioning communications systems.

C. Comply with FAR clause 52.236-21 in circumstance of a need for additional detail or conflict between drawings, specifications, reference standards or code.

D. The requirements described herein include the following:
   1. References
   2. Definitions
   3. Submittals
   4. Quality Assurance
   5. Delivery, Storage, and Handling
   6. Scheduling
   7. Warranty
   8. Product Substitutions
   9. Project Management and Coordination Services
   10. Permits and Inspections
   11. Field Quality Control
   12. Project Closeout and Record Documents

E. Related Items
   1. General and Supplementary Conditions: General provisions of Contract and Division 01 apply to Division 27.
   2. Consult other Divisions and Sections, determine the extent and character of related work, and coordinate Work of Division 27 with that specified elsewhere to produce a complete and operable installation.

1.2 REFERENCES

A. General
   1. Codes, standards, and industry manuals/guidelines listed by reference, including revisions by issuing authority, form a part of this specification section to extent indicated. Consider such codes and/or standards a part of this Specification as though fully repeated herein.
   2. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.
   3. Reference to codes, standards, specifications and recommendations of technical societies, trade organizations and governmental agencies shall mean that latest edition of such publications adopted and published prior to submittal of the bid unless otherwise specifically stated.

B. Codes: Perform Work and furnish materials and equipment under Division 27 in accordance with applicable requirements of the latest edition of governing codes, rules and regulations including but not limited to the following minimum standards, whether statutory or not:
   1. United States Department Of Labor (DOL) Occupational Safety and Health Administration (OSHA) Regulations (Standards - 29 CFR)
      a. Part 1910, “Occupational Safety and Health Standards”
      b. Part 1926, “Safety and Health Regulations for Construction”
   2. Texas Accessibility Standards (TAS)
   3. Texas Administrative Code
   4. National Fire Protection Agency (NFPA) 101 (Life Safety Code)
   5. Code of Federal Regulations (CFR) Title 47 “Telecommunication”, Chapter I “Federal Communications Commission (FCC)”:
      a. Part 15, Radio Frequency Devices & Radiation Limits
      b. Part 24, Personal Communications Services
      c. Part 27, Miscellaneous Wireless Communications Services
      d. Part 68, Connection of Terminal Equipment to the Telephone Network
   6. National Fire Protection Agency (NFPA)
      a. NFPA 70, “National Electrical Code” (NEC)
      b. NFPA 75, “Protection Of Information Technology Equipment”
      c. NFPA 262, “Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces”,
   7. 2015 International Building Code
   8. 2017 National Electric Code
   9. 2015 International Energy Code
   10. Other national, state, and local binding building and fire codes

C. Standards: Perform Work and furnish materials and equipment under Division 27 in accordance with the latest editions of the following standards as applicable:
   1. Underwriter's Laboratories (UL): Applicable listing and ratings, including but not limited to the following standards:
      a. UL 444, “Communications Cables”
      b. UL 497, “Protectors for Paired-Conductor Communication Circuits”
      c. UL 497A, “Secondary Protectors for Communications Circuits”
      d. UL 497B, “Protectors for Data Communications and Fire-Alarm Circuits”
      e. UL 1651, “Optical Fiber Cable”
      f. UL 1666, “Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts “
      g. UL 1690, “Data-Processing Cable “
      h. UL 1963, “Communications-Circuit Accessories”
      i. UL 2024A, “Optical Fiber Cable Routing Assemblies”
   2. ANSI/TIA/EIA-568 Series:
      a. “ANSI/TIA-568.0-D, Generic Telecommunications Cabling for Customer Premises, Ed. D, 09-2015”
      b. “ANSI/TIA-568.1-D, Commercial Building Telecommunications Cabling Standard, Ed. D, 09-2015”
      c. ANSI/TIA-568-C.2, “Balanced Twisted-Pair Telecommunication Cabling and Components Standard, Ed. C, Err. 04-2014”
      d. ANSI/TIA-568.3-D, “Optical Fiber Cabling And Components Standard, Ed. D, 10-2016”
      e. ANSI/TIA-568-C.4, “Broadband Coaxial Cabling and Components Standard, Ed. C, 07-2011”
   3. ANSI/TIA-569-B, “Commercial Building Standard for Telecommunications Pathways and Spaces”
   4. ANSI/TIA/EIA-598, “Optical Fiber Cable Color Coding”
   5. ANSI/TIA/EIA-606-A, “Administration Standard for Commercial Telecommunications Infrastructure”
   6. ANSI/J-STD-607-A, “Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications”
   7. ANSI/TIA/EIA-758, “Customer-Owned Outside Plant Telecommunications Cabling Standard”, including the following addenda”
   8. ANSI/TIA-1005, “Telecommunications Infrastructure Standard for Industrial Premises”

9. EIA testing standards
10. Insulated Cable Engineers Association (ICEA):
    a. ANSI/ICEA S-80-576-2002, “Category 1 & 2 Individually Unshielded Twisted Pair Indoor Cables for Use in Communications Wiring Systems”
    b. ANSI/ICEA S-83-596-1994, “Fiber Optic Premises Distribution Cable”
    c. ANSI/ICEA S-87-640-1999, “Fiber Optic Outside Plant Communications Cable”
    d. ANSI/ICEA S-90-661-2002, “Category 3, 5, & 5e Individually Unshielded Twisted Pair Indoor Cable for Use In General Purpose and LAN Communication Wiring Systems”
    e. ICEA S-102-700-2004, “ICEA Standard For Category 6 Individually Unshielded Twisted Pair Indoor Cables (With Or Without An Overall Shield) For Use In Communications Wiring Systems Technical Requirements”
    f. ICEA S-104-696-2001, “Indoor-Outdoor Optical Cable”
11. Building Industry Consulting Services International (BICSI) :
    a. Telecommunications Distribution Methods Manual (TDMM)
    b. Customer-Owned Outside Plant Design Manual
    c. Wireless Design Reference Manual (WDRM)
    d. Network Design Reference Manual (NDRM)

D. Make a copy of each document readily available during the course of construction for reference by field personnel.

1.3 DEFINITIONS

A. The Definitions of Division 01 shall apply to Division 27 sections.

B. In addition to those Definitions of Division 01, the following list of terms as used in this specification defined as follows:
1. “As directed”: As directed or instructed by the Owner, or their authorized representative
2. “Cabling”: A system comprised of cables, wire, cords, and connecting hardware [e.g., cables, termination apparatus, patch panels, blocks, connectors, outlets, labeling, etc]
3. “Connect”: To install required patch cords, equipment cords, crossconnect wire, etc. to complete an electronic or optical signal circuit
4. “Cord”: a length of cordage having connectors at each end. The term “Cord” is synonymous with the term “Jumper” and “Lead”
5. “Engineer”: MEPCE
6. “Furnish”: To purchase, procure, acquire, and deliver complete with related accessories
7. “General Contractor”: Manhattan/Byrne/3i
8. “Identifier”: A unique code assigned to an element of the Telecommunications infrastructure that links it to its corresponding record
9. “Install”: To set in place, join, unite, fasten, link, attach, set up or otherwise connect together and test before turning over to the Owner, parts, items, or equipment supplied by contractor or others. Make installation complete and ready for regular operation
10. “Owner/Owner’s Representative”: Fannin County
11. “Pigtail”: a length of cordage having connectors at one end
12. “Provide”: To furnish, transport, install, erect, connect, test and turn over to the Owner, complete and ready for regular operation

1.4 SYSTEM DESCRIPTION AND PROJECT CONDITIONS

A. In circumstances where the Specifications and Drawings conflict, the Drawings shall govern quantity and the Specifications shall govern quality.

1.5 SUBMITTALS

A. Submit required submittals to the General Contractor in the quantities and formats as required under the general contract. In the absence of requirements, provide as described in the following with reference to quantity and format.

B. Failure to comply with requirements in part or whole shall constitute grounds for rejection.

C. Submittal Description: Product Data
   1. Obtain written approval from the Engineer for the product data submittal prior to materials and equipment purchase order and prior to installation.
   2. Quantity: Submit product data as described in Division 01. In the absence of requirements given, submit four product data submittals.
   3. Format:
      a. Submit each product data on letter size (8.5" x 11") paper.
      b. Package product data using a 3-ring binder, plastic cover, or similar.
      c. Clearly label the cover and spine of each submittal with the following information (e.g., if in a 3-ring binder, insert the submittal information in the transparent front cover and spine pockets):
         1) Client Name
         2) Project Name and Address
         3) Project Submittal Number
         4) Submittal Name
         5) Specification Section Number
         6) Date of Submittal. Format: Month Day, Year
         7) Contractor Name
      d. Include a Table Of Contents at the beginning of the submittal that lists materials by article and paragraph number (e.g., "2.02 Equipment Racks").
      e. Include tabbed separators for improved navigation through the submittal.
   4. Content:
      a. Cover Letter: Include a cover letter stating that the submittal is in full compliance with the requirements of the Contract Documents. Sign (and stamped, if applicable) cover letter and list items and data submitted.
      b. Product Information: Include manufacturer's technical data, product literature, "catalog cuts", data sheets, specifications, and block wiring diagrams (if necessary) to clearly describe the product's characteristics, physical and dimensional information, electrical performance data, materials used in fabrication, material color & finish, and other relevant information such as test data, typical usage examples, independent test agency information, and storage requirements. Clearly indicate by arrows or brackets precisely what is being submitted on and those optional accessories, which are included and those which are excluded. At a minimum, include products listed in Division 27. Include relevant products that will be installed, which are not listed in the specifications.
      c. Resubmittals: Provide a cover letter with the resubmittal that lists the action taken and revisions made to each product submittal in response to Submittal Review Comments. No review shall take place for any resubmittal packages that is not accompanied by this cover letter. Failure to include this cover letter will constitute rejection of the resubmittal package.

D. Submittal Description: Shop Drawings
   1. Prior to the start of work, submit shop drawings and obtain written approval from the Engineer for the shop drawings submittal.
   2. Provide cable pulling plan in addition to other required shop drawings.
   3. Quantity and Media: Submit shop drawings as described in Division 01. In the absence of requirements given, submit four full-size sets of shop drawings on bond or "eco-bond".
   4. Format:
      a. Produce shop drawings using AutoDesk Revit, or other computer design application that can save files to AutoDesk Revit-compatible files.
      b. Use the same sheet size as the drawings of the Contract Documents.
      c. Use the project's title block – same as the drawings of the Contract Documents.
      d. Text: minimum of 3/32" high when plotted at full size.
      e. Use identical symbols as those in the drawings.
      f. Screen background information.
      g. Plot system components (devices, cable routes, etc.) and text at a sufficient line weight to stand out against background information.
      h. Label each sheet in the shop drawings set with the Specification Section Number (e.g., "271523").
      i. Scaling:
         1) Scale floor plans at 1/8"=1'-0"

2) Scale enlarged room plans at 1/4”=1’-0”
3) Scale wall elevations at 1”=1’-0”
4) Scale rack elevations at 1”=1’-0”

5. Content:
   a. Submit shop drawings if the proposed installation differs from the Contract Documents or the design intent.
   b. Cover Letter: Accompany each shop drawing submittal with a cover letter stating that the shop drawings have been thoroughly reviewed by the Contractor and are in full compliance with the requirements of the Contract Documents. Have the person who prepared the submittal sign (and stamped, if applicable) the cover letter and include a drawing index. Failure to comply with this requirement shall constitute grounds for rejection of submittal.
   c. Drawing Information: Shop drawing submittals shall consist of floor plans, enlarged room plans, wall and rack elevations, installation details, and other aspects of the system that differ from the Contract Documents or the design intent. Use the same scales as the Drawings (e.g., 1/4" = 1'-0" for enlarged room plans).
   d. Resubmittals: Accompany resubmittals with a cover letter that lists the revisions made to each drawing in response to Submittal Review Comments. Failure to include this cover letter will constitute rejection of the resubmittal package without review.

E. Submittal Description: As-Built Drawings
   1. Quantity and Media: Submit as-built drawings as described in Division 01. In the absence of requirements given, submit one full-size set of shop drawings on bond or “eco-bond” and submit one set of electronic files on DVD-ROM.
   2. Format:
      a. Produce as-built drawings using AutoDesk Revit, or other computer design application that can save files to AutoDesk Revit -compatible files.
      b. Use the same sheet size as the drawings of the Contract Documents.
      c. Use the project’s title block – same as the drawings of the Contract Documents.
      d. Text: minimum of 3/32” high when plotted at full size.
      e. Use symbols identical to the symbols shown on the Drawings.
      f. Screen background information.
      g. Plot system components (devices, cable routes, etc.) and text at a sufficient line weight to stand out against background information.
   3. Content:
      a. Submit as-built drawings that fully represent actual installed conditions and that incorporate modifications made during the course of construction.
      b. Floor Plans: Scale floor plans at 1/8”=1’-0”. Floor plans shall show:
         1) Locations and identifiers of telecommunications devices.
         2) Size, quantity, location, and routes of pathways (such as cable trays, cable basket, conduits 2” trade size or larger.,
      c. Rooms Drawings: Applicable rooms: EF, ER & TR. Room drawings shall show:
         1) Floor layouts – scaled at either 1/4”=1’-0” showing dimensioned placement of equipment cabinets/frames, rack bays, etc.
         2) Overhead layouts – scaled at either 1/4”=1’-0” showing dimensioned placement of overhead cable support (e.g., cable tray, cable runway, basketway, conduit sleeves, etc.)
         3) Rack elevations – scaled at 1”=1’-0”, showing placement of termination apparatus and other equipment installed onto rack bays
         4) Wall Elevations – scaled at 1”=1’-0”, showing dimensioned placement of termination apparatus (e.g., termination/crossconnect blocks)

F. Submittal Description: Operation and Maintenance (O&M) Manuals for Active Systems
   1. Quantity: Submit quantity of O&M Manuals as described in Division 01. In the absence of requirements given, submit four O&M Manuals.
   2. Format:
      a. Submit each O&M Manual in a white, 3-ring binder with front cover and spine clear pockets for insertion of the project information.

b. Clearly label the cover of each O&M Manual with the following information:
   1) Client Name
   2) Project Name and Address
   3) Manual Name (e.g., “Operation And Maintenance Manual for Telecommunications Cabling System”)
   4) Date of Submittal. Format: Month Day, Year (e.g., “January 1, 2010”)
   5) Contractor Name
c. Include a Table Of Contents at the beginning that lists the contents.
d. Include tabbed separators for improved navigation through the manual.

3. Content:
   a. Tabloid (17”x11”) prints of as-built drawings, as described above
   b. Manufacturer's original catalog information sheets for each component provided under applicable Section (typically, this is similar to the accepted product data submittal)
   c. Warranty certificate from the manufacturer and the Contractor
   d. Manufacturer’s instructions for system or component use
   e. Instructions and requirements for maintenance and warranty issues
   f. Contents shall include requirements and methods for maintaining installed products, and precautions against cleaning materials and methods detrimental to finishes and performance.

G. Submittal Description: Operation and Maintenance (O&M) Manuals for Passive Systems
1. Quantity: Submit quantity of O&M Manuals as described in Division 01. In the absence of requirements given, submit four O&M Manuals.
2. Format:
   a. Submit each O&M Manual in a white, 3-ring binder with front cover and spine clear pockets for insertion of the project information.
   b. Clearly label the cover of each O&M Manual with the following information:
      1) Client Name
      2) Project Name and Address
      3) Manual Name (e.g., “Operation And Maintenance Manual for Telecommunications Cabling System”)
      4) Date of Submittal. Format: Month Day, Year
      5) Contractor Name
   c. Include a Table Of Contents at the beginning that lists the contents.
   d. Include tabbed separators for improved navigation through the manual.
3. Content:
   a. Tabloid (17”x11”) prints of as-built drawings, as described above
   b. Manufacturer's original catalog information sheets for each component provided under applicable Section (typically, this is similar to the accepted product data submittal)
   c. Warranty certificate from the manufacturer and the Contractor

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications
1. Five continuous years, minimum, design and manufacture of the materials and equipment specified herein.
2. Manufacturer(s) of products and equipment specified herein shall demonstrate that they have a quality assurance program in place to assure that the specifications are met. Include in the program, at a minimum, provisions for:
   a. Incoming inspection of raw materials
   b. In-process inspection and final inspection of the cable product
   c. Calibration procedures of test equipment to be used in the qualifications of the product
   d. Recall procedures in the event that out of calibration equipment is identified.
3. Conform to government standards on quality assurance for applications within these specifications.

B. Materials
1. Materials, support hardware, equipment, parts comprising units, etc., shall be new, unused, without defects and of current manufacturer, materials
2. Use specified products and applications, unless otherwise submitted and approved in writing.

C. Regulatory Requirements
   1. Work and materials shall conform to the latest rules of National Board of Fire Underwriters wherever such standards have been established and shall conform to the regulations of the State Fire Marshal, OSHA and the codes of the governing local municipalities. Work under Division 27 shall confirm to the most stringent of the applicable codes.
   2. Provide the quality identified within these Specifications and Drawings when codes, standards, regulations, etc. allow Work of lesser quality or extent. The Contract Documents address the minimum requirements for construction.

D. Drawings
   1. Follow the general layout shown on the Drawings except where other Work may conflict with the Drawings.
   2. Drawings for the Work within this Division are essentially diagrammatic within the constraints of the symbology applied.
   3. The Drawings do not fully represent the entire installation for the Communications System. Drawings indicate the general route for the cables and the location of outlets. The Drawings might not expressly show every conduit, sleeve, hanger, etc., but a complete system is required.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Delivery
   1. Do not deliver products to the site until protected storage space is available.
   2. Coordinate materials delivery with installation schedule to minimize storage time at jobsite.
   3. Deliver materials in manufacturer's original, unopened, undamaged packaging and containers with identification labels (name of the manufacturer, product name and number, type, grade, UL classification, etc.) intact.
   4. Immediately replace equipment damaged during shipping at no cost to the Owner, so as not to impact the construction schedule.

B. Storage and Protection
   1. Store materials in clean, dry, ventilated space free from temperature and humidity conditions (as recommended by manufacturer) and protected from exposure to harmful weather conditions.
   2. Comply with manufacturer's storage requirements for each product. Comply with recommended procedures, precautions or remedies as described in the Material Safety Data Sheets (MSDS) as applicable.
   3. Maintain factory wrapping or provide a heavy canvas/plastic cover to protect units from dirt, water, construction debris, and traffic.
   4. Storage outdoors covered by rainproof material is not acceptable.
   5. Provide heat where required to prevent condensation or temperature related damage.

C. Handling
   1. Handle materials and equipment in accordance with manufacturer's written instructions. Handle with care to prevent damage, breakage, denting, and scoring.
   2. Do not install damaged materials and equipment. Replace damaged equipment at no cost to the Owner.

1.8 SCHEDULING

A. Unless otherwise specified, the construction schedules of the Sections within Division 27 may be combined into a single, overall schedule.

B. Do not proceed without written approval from the Owner or Owner’s Representative for schedule of this Work.

1.9 PROJECT MANAGEMENT AND COORDINATION

A. Project Management and Coordination Services
   1. Provide a project manager for the duration of the project to coordinate this Work with other trades. Coordination services, procedures and documentation responsibility include, but are not limited to, the items listed in this section.
   2. BIM Model Coordination:
      a. Resolve conflicts with other trades during design assist phase of the projects. Obtain the assistance/approval of the engineer where the design deviates substantially from the contract drawings.

B. Concurrent Installation
   1. The network will be installed concurrent with the work of Division 27. Coordinate your Work with the Owner's/network integrator's work. For example, coordinate scope and dates for rack and cabling (terminations) readiness to allow the network integrator to plan and schedule installation of the network equipment (for example, access switches).

C. Role of the Engineer
   1. The Owner has retained the Engineer's services through construction. During construction, the Engineer will work with and assist the Contractor as follows:
      a. Review product data and shop drawings submittals for general compliance with the contract drawings and specifications.
      b. Provide interpretation and clarification of project contract documents
      c. Reply to (and 'process') relevant Requests for Information (RFIs)
      d. Review changes as they arise, and confirm that the proposed solutions maintain the intended functionality of the system.
      e. Interpret field problems for Owner, and translate between Owner and Construction Team.
      f. Review the testing procedures to confirm compliance with industry-accepted practices.
      g. Observe the work for general compliance with the Contract Documents and to ensure that the installation meets the design intent of the system, and report progress to the Owner.

D. Use of CAD Files
   1. Should the Contractor require the Engineer's CAD files to produce shop drawings and/or as-built drawings, the Engineer requires the Contractor sign a CAD files release agreement.,

1.10 WARRANTY

A. Warrant products and labor provided will, under normal use and service, be free from defects and faulty workmanship for period of 5 years from the date of acceptance. During the warranty period the entire system shall be kept in operating condition at no additional material or labor costs to the Owner.

B. Render service within two business days of system failure notification. Note deviations or improvements to this service at the time of bid and obtain written acceptance from the Owner, or Owner's Representative.

C. Manufacturers of the major system components shall maintain a replacement parts department and provide testing equipment when needed. Provide complete replacement parts within two business days during the warranty period.

D. Conformance to certain government standards on quality assurance may be required for some applications outlined in these specifications.

PART 2 - PRODUCTS

2.1 GENERAL

A. Materials used shall present no environmental or toxicological hazards as defined by current industry standards and shall comply with OSHA and EPA standards, other applicable federal, state, and local laws.

B. Product numbers are subject to change by the manufacturer without notification. In the event a product number is invalid or conflicts with the written description, notify the Engineer in writing prior to ordering the material and performing installation work.

2.2 PRODUCT SUBMITTAL AT TIME OF BID

A. At the time of bid, include a list of major products in the Contract documenting the intended cabling system solution. Examples of major products may include: horizontal cable, modular jacks, faceplates, modular patch panels, backbone cable, termination block systems, fiber connectors, fiber patch panels.

2.3 SUBSTITUTIONS

A. Conform to the general requirements and procedure outlined in Division 01 in the Request For Substitution.

B. Only one substitution allowed for each product specified.

C. Where products are noted as "or equal", a product of equivalent design, construction, and performance will be considered. Submit product data – catalog cuts, product information, and pertinent test data –required to substantiate that the product is in fact equivalent to that specified. The burden of proof that the substituted product is equivalent to the specified product rests with the Contractor. Whenever material, process or equipment is specified in accordance with an industry specification (ANSI, TIA, etc), UL rating, or other association standard, present an affidavit from the manufacturer certifying that the product complies with the particular standard specification. When requested by the Engineer, submit supporting test data to substantiate compliance.

D. Manufacturers' names and model numbers used in conjunction with materials, processes or equipment included in the Contract Documents are used to establish standards of quality, utility and appearance. Materials, processes or equipment that, in the opinion of the Engineer, are equivalent in quality, utility and appearance will be approved as substitutions to that specified when “or equal” follows the manufacturers' names or model number(s).

E. When the Engineer accepts a substitution in writing, it is with the understanding that the Contractor guarantees the substituted product, component, article, or material to be equivalent to the one specified and dimensioned to fit within the construction according to contract documents. Do not provide substituted material, processes, or equipment without written authorization from the Engineer. Assumptions on the acceptability of a proposed substitution, prior to acceptance by the Engineer, are at the sole risk of the Contractor.

F. Approved substitutions shall not relieve the Contractor of responsibilities for the proper execution of the work, or from provisions of the specifications.

G. Pay expenses, without additional charge to the Owner, in connection with substitution materials, processes and equipment, including the effect of substitution on self, subcontractor's or other Contractor's work.

PART 3 - EXECUTION

3.1 PERMITS AND INSPECTIONS

A. Obtain and pay for permits and inspections required for the work.

B. Furnish materials and execute workmanship for this work in conformance with applicable legal and code requirements.

C. Perform tests required herein, or as may be reasonably required to demonstrate conformance with the Specifications or with the requirements of legal authority having jurisdiction.

D. Arrange and pay for review/inspection from compliance officials responsible for enforcement of applicable codes and regulations to establish that the work is in compliance with requirements of reference codes indicated herein.

3.2 EXAMINATION

A. Verify existing conditions, stated under other sections, are acceptable for installation in accordance with manufacturer's instructions.

3.3 FIELD QUALITY CONTROL

A. Staffing: Provide a qualified foreman to supervise the crew performing the work and who is present at the job site at times work is being performed.

B. Construction Meetings: Participate in construction coordination meetings throughout the course of construction to review the progress and to resolve issues and conflicts. Prepare and distribute meeting agenda for telecommunication issues prior to, and meeting notes after meetings, in a format acceptable to the Owner. Publish meeting notes within 3 business days following the meeting.

C. Scheduling: Perform the work within the approved construction schedule. Keep the construction schedule current, based on the results of the construction meetings. At minimum, schedule shall document critical due dates, tasks, and milestones. Submit revised schedules for approval within 3 business days whenever there are modifications.

D. Inspection: Inspect the work after installation. Keep areas of work accessible and notify code authorities, or designated inspectors, of work completion released for inspection. Document completion and inspection as required.

3.4 INSTALLATION

A. Complete work in a neat, high-quality manner, relative to common industry practices, and in accordance to NECA "Standard of Installation".

B. Complete work in conformance to applicable federal, state and local codes, and telephone standards.

C. Coordinate the entire installation throughout the construction team (general contractor and subcontractors).

D. Manufacturer's Instructions:
   1. Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions, and product carton instructions for installation.
   2. Maintain jobsite file of Material Safety Data Sheets (MSDS) for each product delivered to jobsite packaged with an MSDS.

E. Adjusting:
   1. Make changes and revisions to the system to optimize operation for final use.
   2. Make changes to the system such that defects in workmanship are corrected and cables and the associated termination hardware pass the minimum test requirements.

F. Protection
   1. Protect installed products and finish surfaces from damage during construction.

G. Repair/Restoration
   1. Replace or repair work completed by others that you deface or destroy. Pay the full cost of this repair/replacement.
   2. Repair defects prior to system acceptance.

3.5 CLEANING

A. Remove temporary coverings and protection of adjacent work areas. Remove unused, excess, and left over products, debris, spills, or other excess materials. Remove installation equipment.

B. Leave finished work and adjacent surfaces in neat, clean condition with no evidence of damage.

C. Repair or replace damaged installed products.

D. Legally dispose of debris.

E. Clean installed products in accordance with manufacturer's instructions prior to Owner's, or Owner's Representative's, final punch walk.

3.6 FINAL INSPECTION AND CERTIFICATION

A. Punch Walks and Punch Lists
   1. Punching the Work of individual Sections of Division 27 may be combined.
   2. Execute a punch walk with the Engineer and the Owner or Owner's Representative to observe Work.
   3. Develop a punch list for items needing correction. Issue this punch list to Engineer.
   4. Correct the Work as noted on punch list.
   5. Execute follow up punch walk with the Engineer and the Owner or Owner's Representative to verify punch list items have been corrected.

B. System Acceptance
   1. Complete corrections (punch list items) prior to submitting acceptance certificate.
   2. On completion of the acceptance test, submit system acceptance certificate to the Owner or Owner's Representative requesting their signature and return of the certificate. Issue copies of the signed certificate back to the Owner or Owner's Representative with copy to the Engineer.

C. Training

1. After acceptance, schedule a time convenient with the Owner, or Owner's Representative, for instruction in the configuration, operation, and maintenance of the system.
2. Provide 2 hours, minimum, UON in individual specification sections of on-site training by a factory-trained representative. Document dates and times of training, and submit a “sign in” sheet for individuals trained, as part of the close out documentation.

END OF SECTION

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SECTION 27 05 26

COMMUNICATIONS GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Communications Grounding Backbone and bonding of communications infrastructure and equipment to Communications Grounding Backbone.

B. Related Sections
   1. Comply with the Related Sections requirements of Section 27 00 00.

1.2 REFERENCES

A. Comply with the References requirements of Section 27 00 00.

B. In particular or addition to the codes and standards listed in Section 27 00 00, comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
   1. NFPA 70, “National Electrical Code”, particularly the following Articles:
      a. Article 250: Grounding
      b. Article 770: Optical Fiber Cables and Raceways
      c. Article 800: Communications Systems
      d. Article 810: Radio and Television Equipment
      e. Article 820: Community Antenna Television and Radio Distribution Systems
   2. Underwriters Laboratories, Inc. (UL) UL 467: Grounding and Bonding Equipment
   3. Electronic Industries Association/Telecommunication Industry Association:
      a. ANSI-J-STD-607-A-2002, “Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications”
      b. ANSI/TIA/EIA-606-A-2002, “Administration Standard for Commercial Telecommunications Infrastructure”
   4. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
      a. IEEE 467, “IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems”
      b. IEEE P1100, “IEEE Recommended Practice for Powering and Grounding Sensitive Electronic Equipment in Industrial and Commercial Power Systems”

1.3 DEFINITIONS

A. Definitions as described in Section 270000 shall apply to this section.

B. In addition to those Definitions of Section 270000, the following list of terms as used in this specification defined as follows:
   1. “BCT”: Bonding Conductor for Telecommunications
   2. “CM” and “cmil”: Circular Millionths of an inch
   3. “GE”: Grounding Equalizer Conductor
   4. “MBRGB”: Main Building Reference Grounding Busbar
   5. “TBB”: Telecommunications Bonding Backbone
   6. “TBC”: Telecommunications Bonding Conductor
   7. “TGB”: Telecommunication Grounding Busbar
   8. "THHN”: Thermoplastic High Heat-resistant Nylon-coated
   9. “TMGB”: Telecommunication Main Grounding Busbar

1.4 SYSTEM DESCRIPTION

A. Base Bid Work: The Work under this section includes furnishing materials, installation, and coordination through the General Contractor with other trades for a Communications Grounding Backbone and for bonding of telecommunications equipment and apparatus to the Communications Grounding Backbone.

B. Communications Grounding Backbone System: The Communications Grounding Backbone System contains grounding busbars, grounding conductors, bonding conductors, and connecting devices (including but not limited to pressure connectors, lugs, clamps, or exothermic welds). These components, upon completion of installation and testing, shall provide the means of a low impedance path to earth for unintentional and/or stray voltages or spurious signals present on telecommunications media and equipment. The Communications Grounding Backbone System will consist of the following aspects in addition to the grounding requirements in the electrical plans.
   1. TMGB: Locate the TMGB in the EF with the following connections:
      a. MBRGB, via BCT
      b. Each TBB
      c. Ground bushings installed on each entrance conduit opening within the space, via TBC
      d. Overhead cable support within the space, via TBC
      e. Dedicated power panel's ACEG within the space serving communication equipment, via TBC
      f. Metallic pathways (conduits, surface raceway, etc.) within the space, via TBC
   2. TBB: TBB(s) are the primary bonding conductor between the TMGB and other TGBs provided throughout a single building. The length of TBBs shall not exceed 500 feet. The TBB shall route from the EF through each of the TRs bonding each of the TGBs to the TMGB. Maintain TBB continuity and do not break continuity in order to bond to a TGB.
   3. GE: GE(s) are bonding conductors between TGBs (or other elements of the grounding backbone) on a common floor. The length of GEs shall not exceed 500 feet. One GE shall occur every three floors. Maintain GE continuity.
   4. TGB: Locate the TGB in each TR with the following connections:
      a. TBB
      b. Building steel, via TBC
      c. Each entrance conduit into the space, via TBC and ground bushings
      d. Overhead cable support within the space,, via TBC
      e. Panelboard's ACEG within the space serving telecommunication equipment, via TBC
      f. Metallic pathways (conduits, surface raceway, etc.) within the space, via TBC

C. Performance Criteria for the Grounding Backbone:
   1. Resistance from any point of the communication grounding backbone system to the ground electrode and to earth shall not exceed 20 Ohms.
   2. Field test resistance and document, both electronically and printed, measured values.

D. Bonding: Bonding consists of TBCs within telecommunications rooms from the TMGB and TGBs to the following components:
   1. Rack bay
   2. Overhead cable support and vertical cable support
   3. Wall-mounted termination equipment
   4. Conduit ground bushings
   5. Exit pathways
   6. Bonding jumpers between basketway, cable runway, and cable tray joints & splices, and between basketway/cable runway/tray and equipment racks. Note: Bonding jumpers are not required if tray splices are UL listed as a grounding conductor.

E. Conductor Gauge Criteria:
   1. Size BCT as the greater of either 2,000 cmil per linear foot up to 3/0 AWG or the largest TBB.
   2. Size TBB, GE, and TBCs as 6 AWG minimum, then as 2,000 cmil per linear foot up to 3/0 AWG.

1.5 SUBMITTALS

A. Comply with Submittal procedural, quantity, and format requirements of Section 27 00 00.

B. Submittal Requirements at Start of Construction:
   1. Product Data Submittal
   2. Shop Drawing Submittal(s), if the Contractor's installation intent differs from the Contract Documents or the deign intent

C. Substitutions
   1. Requests for substitutions shall conform to the general requirements and procedure outlined in Section 27 00 00.

D. Submittal Requirements at Closeout: Submit to the Owner at the time of project closeout the following and before certificate of final payment is issued.
   1. Test Report: Submit computer-generated test records of measured resistance values for inclusion into the Operation and Maintenance Manual.
   2. As-Built Drawings, consisting primarily of the Communications Grounding Backbone (not necessarily each bonded component or apparatus)

1.6 QUALITY ASSURANCE

A. Comply with Quality Assurance requirements of Section 27 00 00.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with Delivery, Storage and Handling requirements of Section 27 00 00.

1.8 WARRANTY

A. Warrant Work to perform as described within this Section for a period of 5 years. Correct deficiencies within 24 hours of notification.

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

A. Application: Suitable for indoor installation as a BCT, TBB, GE, and/or TBC.

B. Type: THHN (or THWN)

C. Conductor: 1/C, annealed copper, stranded

D. Gauge: Refer to conductor sizing criteria.

E. Insulation: thermoplastic/nylon or similar, green in color

F. Flame Resistance: Meet the flame resistance requirements of IEEE 383, CSA FT-4 and UL VW-1.

G. Print on the Insulation: insulation grade, conductor gauge, and applicable UL jacket listings.

2.2 SPLICE

A. Application: High-pressure compression type connectors shall be used for cable-to-cable and cable-to-ground rod connections.

B. Manufacturers:
   1. Panduit
      a. #HTCT250-250-1; "H-type" compression splice for #2 – 250MCM AWG
   2. Thomas & Betts
      a. #53000 series
   3. Or equal

2.3 CONNECTOR – “PARALLEL” TAP

A. Application: H-type thick wall compression tap, for making conductor–to–conductor (e.g., TBB-to-TBC) permanent connection (pig tailing, tapping, or splicing). Connectors shall be UL Listed.

B. Manufacturers:
   1. Panduit
      a. #HTCT2-2-1; “H-type” compression tap, run = #6-#2, tap = #2-#6.
      b. #HTCT250-2-1; “H-type” compression tap, run = #2-250MCM, tap = #6-#2
   2. Or equal

2.4 CONNECTOR – “C” TAP

A. Application: C-type copper thick wall compression tap, for making conductor–to–conductor (e.g., TBB-to-TBC) permanent connection (pigtailing, tapping, or splicing). Connectors shall be UL Listed.

B. Manufacturer:
   1. Panduit
      a. #CTAPF4-12-C; CTAP for #6 AWG run –to– #6 AWG tap
      b. #CTAPF2-12-C; CTAP for #2 AWG run –to– #6 AWG tap
      c. #CTAPF1/0-12-L; CTAP for 1/0 AWG run –to– #6 AWG tap
      d. #CTAPF2/0-12-Q; CTAP for 2/0 AWG run –to– #6 AWG tap
      e. #CTAPF3/0-12-Q; CTAP for 3/0 AWG run –to– #6 AWG tap
   2. Or equal

2.5 GROUNDING BUSBAR - TINNED

A. General: Busbar shall be UL listed.

B. Standards: Compliant to ANSI-J-607-A

C. Material: Solid copper, tinned cladding

D. Holes: Predrilled, compatible with standard NEMA bolt hole sizing and spacing and with ANSI-J-607-A recommendations for 2-hole lugs.

E. Mounting: Wall-mounted with standoffs. Standoffs shall insulate busbar from the mounting substrate.

F. Manufacturer:
   1. Panduit
      a. # GB4B0624TPI-1; busbar, 20”L x 4”W x ¼”T, TMGB hole pattern
   2. Or equal

2.6 CONNECTION TO STRUCTURAL STEEL

A. Application: Exothermic welds shall be used for cable-to-cable, cable-to-ground rod, and cable-to-structural steel.

B. Manufacturers:
   1. Cadweld
      a. Each particular type of weld shall use a kit unique to that type of weld
   2. Or equal

2.7 CONNECTOR – COMPRESSION LUG

A. Application: Conductor-to-busbar and/or –rack (or other flat surfaces) connection

B. Type: compression lug, standard or long barrel, two-hole (1/4 inch diameter 5/8 inch on center)

C. Manufacturers:
   1. Panduit

a. #LCC6-14JAW-L; for 6 AWG conductor
b. #LCC4-14ADW-L; for 4 AWG conductor
c. #LCC2-14AW-Q; for 2 AWG conductor
d. #LCC1-14AW-E; for 1 AWG conductor
e. #LCC1/0-14AW-X; for 1/0 AWG conductor
f. #LCC2/0-14AW-X; for 2/0 AWG conductor

2. Or equal

2.8 CONNECTOR – SPLIT-BOLT, MECHANICAL TYPE

A. Application: Conductor-to-conductor (or other round component) connection

B. Type: split-bolt mechanical connector, for #6 to #3 conductor

C. Material: high-strength copper alloy

D. Manufacturers:
1. Panduit
a. #SBC3-C
2. Or equal

2.9 GROUND BUSHING

A. Refer to for ground bushing requirements.

B. Plated malleable iron body with 150 degree Centigrade molded plastic insulating throat and lay-in grounding lug.

C. Manufacturers:
1. OZ/Gedney BLG
2. Thomas & Betts #TIGB series
3. Or equal.

2.10 LABELS

A. Labels for Busbars
1. Labels shall be machine-printable (such as by a laser printer or hand-held printer)
2. Printable Area: 2” x 0.5”, minimum.
3. Color: White.
4. Manufacturer:
a. Panduit
1) #C200X100FJJ; laser/ink jet labels for busbars, white
b. Or equal

B. Labels for Conductors
1. Labels shall be machine-printable (such as by a laser printer or hand-held printer)
2. Labels shall be adhesive-backed and have a self-laminating feature.
3. Printable Area: 1 inch wide x 0.5 inch high, minimum
4. Color: White.
5. Manufacturer:
a. Panduit
1) #S100X150YAJ; laser/ink jet labels for wire diameters 0.16” (#6) - 0.32” (#1/0), white
2) # S100X225YAJ; laser/ink jet labels for wire diameters 0.24” (#2) - 0.48” (#3/0), white
b. Or equal

2.11 MISCELLANEOUS

A. Wire Clamp
   1. Material: nylon, UV stabilized.
   2. Color: black
   3. Size: 0.25" holding diameter for 6 AWG; or size as required based on conductor size.
   4. Manufacturer:
      a. Richco Inc.
         1) #N4B-BLK
      b. Or equal

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with the Execution requirements of Section 27 00 00.

B. Work shall comply with the International Building Code, International Fire Code, National Electrical Code, UL 467, and ANSI-J-607-A standards, as well as local codes that may specify additional grounding and/or bonding requirements. If discrepancies between codes and/or standards arise, codes shall prevail, and then the more stringent requirement shall prevail, and as directed by the AHJ.

C. Install components to manufacturer's instructions and recommendations and as required per UL listing.

D. Identify grounding and bonding conductors and components according to local codes.

E. Terminations must be accessible for inspection and maintenance during the life of the system.

3.2 EXAMINATION AND PREPARATION

A. Prior to the start of this section's work, examine pathways and communications rooms for completeness, compatibility with the work of this section, and readiness for connections with the work of this section.

3.3 INSTALLATION

A. BCT, TBB, and GE Conductors
   1. Install BCT, TBB, and GE conductors in a manner to protect them from physical damage.
   2. When routing BCT, TBB, or GE conductors through metallic conduit 3 feet or longer, bond the conductor to the conduit at both ends using a #6 AWG bonding conductor as a pigtail, an irreversible connection (preferably exothermic weld) for the conductor-to-pigtail connection, and insulated ground bushings at the conduit ends.
   3. Install the BCT, TBB, or GE conductor without splices.
      a. In the event that a splice is necessary, notify the Project Manager in writing. Do not proceed with splicing work until the Project Manager has accepted in writing the installation of a splice.
      b. Locate the splice in a telecommunications space and ensure accessibility.
      c. Perform the splice using an exothermic weld and an irreversible compression-type connector.
   4. Connect grounding conductors to structural steel using exothermic welds. Each particular type of weld shall use a kit unique to that type of weld.

B. TMGB and TGB Busbars
   1. Mount busbars using insulating standoffs. If not noted on drawings, install busbars onto wall at 24 inches AFF located within 5 feet of backbone pathways or rack bay.

C. Panelboard Bonding
   1. Where a panelboard is located in the same communications room as a TMGB/TGB and serves that room, provide TBC between busbar and that panelboard's Alternating Current Equipment Ground (ACEG) bus (where equipped) or the enclosure.

D. Bonding
   1. Provide TBC and appropriate grounding hardware between the nearest TMGB/TGB and the equipment racks / rack bay, overhead cable support, vertical cable support, telecommunication conduits, primary pathways that enter/exit the room (if applicable), and other metallic telecommunication infrastructure components.
   2. Minimum size: #6. If longer than 100 feet, size TBCs based on length using 1000 cmil per foot, up to 2/0 AWG.
   3. Install TBCs in a manner that will protect them from physical and mechanical damage.
   4. Routing:
      a. Route TBCs in the shortest possible path, using right angles for turns and routed parallel to building lines. Route on outside edges of wall plywood. Do not cut across the middle of the plywood taking space away from other equipment or components.
      b. Utilize a minimum 1-foot bend radius.
   5. Connection to TMGB/TGBs:
      a. Thoroughly clean busbars prior to attaching connectors to the busbar.
      b. Fasten connectors (e.g., lugs) to the busbar using matching size cadmium bronze bolt, flat washer Belleville washer, and nut. Torque hardware set.
   6. Rack Bay Bonding
      a. Provide bonding the rack bay.
      b. Bond equipment racks, frames, frame bays, cabinets, server racks, and other similar support systems located within the same room or space as the TMGB/TGB to the busbar.
      c. Use approved connectors for TBC-to-rack, -frame, and -cabinet connections.
      d. Rack bays may be bonded in series using either of the following configurations:
         1) Series: Provide a TBC from the TGB to the rack closest to the busbar; then provide a TBC to the other racks in the rack bay in series using a common lug/connection per rack. The rack shall not be used as a 'conductor' in the series connection.
         2) String: Provide one 'main' TBC from the TGB along the length of the rack bay, and provide a pigtail from the 'main' TBC per rack. Use an irreversible connection (such as "C" tap) for the 'main'-to-pigtail connection.
   7. Overhead and Vertical Cable Support Bonding
      a. Bond overhead and vertical cable support located within the same room or space as the TMGB/TGB to the busbar.
      b. Provide either UL listed connectors and splice plates or UL Listed bonding strap to bond sections of overhead cable support for ground continuity. This requirement applies to cable tray, basketway, and runway sections within a single telecommunication room.
   8. Termination Field Bonding
      a. Provide bonding the termination blocks.
      b. Bond termination blocks to the TMGB/TGB within the same room or space. Termination blocks may be bonded in series, with the block closest to the TMGB/TGB bonded to the busbar.
   9. Metallic Raceway Bonding
      a. If TBC routes through conduit longer than 1 meter, bond metallic conduit to conductor at both ends.
      b. Bond metallic raceways for telecommunications cabling (conduit, cable tray, cable runway, and other metallic telecommunication infrastructure components) located within the same room or space as the TMGB or TGB to the nearest telecommunication grounding busbar.

3.4 LABELING

A. General Requirements
   1. Labeling, identifier assignment, and label colors shall conform to TIA/EIA-606-A Administration Standard and as approved by the Engineer and Owner before installation.
   2. Permanently label TBCs. Affix label as close as practical to each end of the conductor.

B. Label Format
   1. Provide permanent labels with machine-generated text; hand written labels will not be accepted.
   2. Labels on TBCs shall fully wrap around conductors with a self-laminating feature to provide permanent marking.

C. Identifier Assignment
   1. Separate label fields of the identifier with a hyphen.
   2. Assign identifiers according to current practice and as approved by the Engineer and Owner before installation.
   3. BCT and TBB
      a. First field: “BCT" or “TBB” (the conductor type).
      b. Second field: a unique sequential number, for example, “01”.
      c. Example: “TBB-01”
   4. GE
      a. First field: “GE” (the conductor type).
      b. Second field: floor number, for example, “06”.
      c. Third field: a unique sequential number, for example, “01”.
      d. Example: “GE-06-01”
   5. Ground Busbars
      a. First field: “TMGB” or “TGB” (the busbar type)
      b. Second field: the room’s identity (TR identifier’s suffix) where the busbar is installed; for example, “3A2.1”.
      c. Example: “TGB-3A2.1”
   6. TBC:
      a. First field: “TBC” (the bonding conductor type).
      b. Second field: The room identity where TBC exists; for example: “A1.1”.
      c. Third field: A unique sequential number; for example: “01”, “02”, etc.
      d. Fourth field: describe the device, equipment, component, or raceway being bonded.
      e. Example: “TBC-A1.1-01 (RACK BAY)”

3.5 GROUNDING BACKBONE RESISTIVITY MEASUREMENT

A. Measure ground resistance from the furthest ground busbar to earth; record measurement. Provide additional grounding electrodes, bonding, and other elements as required to comply with resistance limits specified in this Section.

B. Submit computer-generated records of measured resistance values to the Engineer and Owner for approval and for inclusion into the Operation and Maintenance Manual.

3.6 FINAL INSPECTION AND CERTIFICATION

A. Punch the Work of this Section compliant to the requirements of Section 27 00 00. Punching the Work of this Section may be combined with punching the rooms.

B. Comply with system acceptance and certification requirements of Section 27 00 00.

END OF SECTION

SECTION 27 05 28

COMMUNICATIONS BUILDING PATHWAYS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes pathway systems for low voltage cabling and wiring.

B. Related Sections
   1. Comply with related Sections 27 00 00 and 26 05 00.
   2. Section 26 05 26 Grounding and Bonding for Electrical Systems
   3. Section 26 05 33 Raceway and Boxes for Electrical Systems

1.2 REFERENCES

A. Comply with the latest edition of the following applicable Specifications and standards except as otherwise indicated or specified:

B. Federal Specifications (FS):
   1. FS WW-C-563: Electrical Metallic Tubing
   2. FS WW-C-566: Specification for Flexible Metal Conduit

C. American National Standards Institute, Inc. (ANSI):
   1. ANSI C80.3: Electrical Metallic Tubing, Zinc Coated
   2. ANSI/NEMA OS-1 Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports

D. Underwriters Laboratories, Inc. (UL):
   1. UL 514B: Conduit, Tubing and Cable Fittings
   2. UL 635: Insulating Bushings
   3. UL 797: Electrical Metallic Tubing – Steel
   4. UL 50: Enclosures for Electrical Equipment
   5. UL 514A: Metallic Outlet Boxes

E. ASTM International:
   1. ASTM A123 – Specifications for Zinc (Hot Galvanized) Coatings on Iron and Steel
   2. ASTM A510 – Specifications for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel
   3. ASTM A525 – General Requirements for Steel Sheet, Zinc-Coated Galvanized by the Hot-Dip Process
   4. ASTM B633 – Specifications for Electrodeposited Coatings of Zinc on Iron and Steel
   5. ASTM A653 – Specifications for Steel Sheet, Zinc-Coated (Galvanized) by Hot Dip Process
   6. ASTM A591 – Specifications for Electrodepositing Coatings of Zinc on steel wire or sheets

F. National Electrical Manufacturer Association (NEMA)
   1. NEMA VE 1 – Cable Tray Systems
   2. NEMA VE 2-2000 – Cable Tray Installation Guidelines

1.3 DEFINITIONS

A. Definitions as described in Section 27 00 00 shall apply to this section.

B. In addition to those Definitions of Section 27 00 00, the following list of terms as used in this specification defined as follows:
   1. “Cable Hanger”: A metal, most often steel, or fabric cable support device often shaped (section view) similar to the letter J. The device is available in different sizes supporting different quantities of cables, and is also available with different attachment hardware to be supported by different methods (e.g., wire support, beam flange clip, etc.).
   2. “Flat Bar”: Custom cable support product manufactured by CEAS, Inc.
   3. “Ladder Cable Tray”: A continuous, rigid, aluminum cable support and management system. Available in different sizes supporting different quantities of cables.
   4. “Wire Basket Cable Tray”: A continuous, rigid, welded steel wire mesh cable support and management system. Available in different sizes supporting different quantities of cables, and is also available with different attachment hardware to be supported by different methods.

1.4 SYSTEM DESCRIPTION

A. Base Bid Work

B. The work under this section shall include the planning and coordination (and other trades) of telecommunications system pathways, the furnishing of necessary materials, and the labor & associated services required to install telecommunications pathways.

C. The Telecommunications Pathways consist of the following subsystems:
   1. Cable Tray Systems
   2. Cable Hangers
   3. Electrical metallic tubing and fittings.
   4. Miscellaneous conduit fittings and products.
   5. Wall and ceiling outlet boxes.
   6. Pull and junction boxes.

1.5 SUBMITTALS

A. Comply with Submittal procedural, quantity, and format requirements of Section 27 00 00.

B. Submittal Requirements at Start of Construction:

C. Product Data Submittal

D. Shop Drawings Submittal: Consisting of proposed changes to pathway route plans.

E. Submittal Requirements at Close Out:

F. As-Built Drawings – primarily of the Communications Building Pathways.

G. Substitutions

H. Requests for substitutions shall conform to the general requirements and procedure outlined in Section 27 00 00.

1.6 QUALITY ASSURANCE

A. Comply with the quality assurance requirements of Section 27 00 00.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with Delivery, Storage and Handling requirements of Section 27 0000.

1.8 WARRANTY

A. Warrant Work to perform as described within this Section for a period of 5 years. Correct deficiencies within 24 hours of notification.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. B-Line

B. CEAS

C. STI

D. RANDL

E. FSR

F. Wiremold

G. Or equal.

2.2 CONDUIT – EMT TYPE

A. EMT conduit shall conform to ANSI C80.3 specifications and shall meet UL requirements.

B. EMT conduit shall be formed of cold rolled strip steel, electrical-resistance welded continuously along the longitudinal seam and hot dip galvanized after welding.

C. Manufacturers:
1. Alflex Corp
2. Allied Tube and Conduit Co
3. Anaconda
4. Appleton Electric Co
5. Occidental Coating Co. (OCAL)
6. OZ/Gedney
7. Spring City Electrical Manufacturing Co
8. Thomas & Betts Corp
9. Triangle PWC, Inc
10. Western Tube and Conduit Corp
11. Or equal

2.3 CONDUIT – COUPLERS

A. EMT
1. Set screw type couplings: Electroplated, steel or cast malleable iron, UL Listed concrete tight. Use set screw type couplings with four setscrews each of conduit sizes over 2 inches. Setscrews shall be of case hardened steel with hex head and cup point to firmly seat in wall of conduit for positive grounding.
2. Raintight couplings: Electroplate steel or cast malleable iron; UL Listed raintight and concrete tight, using gland and ring compression type construction.

2.4 CONDUIT – STRAPS

A. One-Hole and Two-Hole Straps
1. Application: Strap, used in conjunction ion with fasteners, to hold conduit in place.
2. Material: steel, malleable iron, or high tensile strength plastic straps (for inside building use) with malleable iron clamp-back spacer for surface mounted wall and ceiling applications.

B. Channel Straps
1. Application: Strap, used in conjunction ion with channel and (as applicable) fasteners, to hold conduit in place.
2. Material: steel, malleable iron, or high tensile strength plastic straps (for inside building use) with malleable iron clamp-back spacer for surface mounted wall and ceiling applications.

2.5 CONDUIT – MISCELLANEAOUS FITTINGS AND PRODUCTS

A. Watertight conduit entrance seals: Steel or cast malleable iron bodies and pressure clamps with PVC sleeve, neoprene sealing grommets and PVC coated steel pressure rings. Fittings shall be supplied with neoprene sealing rings between the body and PVC sleeve.

B. Watertight cable sealing bushings: One piece, compression molded sealing ring with PVC coated steel pressure disks, stainless steel sealing screws and zinc plated cast malleable iron locking collar.

C. Expansion fittings: Multi-piece unit comprised of a hot dip galvanized malleable iron or steel body and outside pressure bussing designed to allow a maximum of 4" conduit movement (2" in either direction). Furnish with external braid tinned copper bonding jumper. Unit shall be UL Listed for wet or dry locations.

D. Expansion/deflection couplings: Multi-piece unit comprised of a neoprene sleeve with internal flexible tinned copper braid attached to bronze end couplings with stainless steel bands. Coupling shall accommodate .75-inch deflection, expansion, or contraction in any direction, and allow 30-degree angular deflections. Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber jacket and stainless steel jacket clamps. Unit shall comply with UL467 and UL514B. Manufacturer shall be OZ/Gedney Type DX, Steel City Type EDF or equal.

E. Fire rated penetration seals:
   1. UL building materials directory classified.
   2. Conduit penetrations in fire rated separation shall be sealed with a UL classified fill, void or cavity material.
   3. The fire rated sealant material shall be the product best suited for each type of penetration, and may be a caulk, putty, composite sheet or wrap/strip.

F. Standard products not herein specified:
   1. Provide listing of standard electrical conduit hardware and fittings not herein specified for approval prior to use or installation, i.e. locknuts, bushings, etc.
   2. Listing shall include manufacturers name, part numbers, and a written description of the item indicating type of material and construction.
   3. Miscellaneous components shall be equal in quality, material, and construction to similar items herein specified.

2.6 WIRE BASKET CABLE TRAY (USER SPACE)

A. Provide cable tray (12” width minimum) sized as necessary to provide 60% free space for future needs.

B. Description: Continuous, rigid, welded steel wire mesh cable management system.

C. Mesh system permits continuous ventilation of cables and maximum dissipation of heat.

D. Continuous safety edge wire lip.

E. Wire mesh welded at all intersections.

F. UL Classification: UL#E556

G. Material: Carbon steel wire, ASTM A510, Grade 1008. Wire welded, bent, and surface treated after manufacture.

H. Electroplated Zinc Galvanized: Straight sections shall be made from steel meeting the minimum mechanical properties of ASTM A510 and shall be electro-plated zinc dichromate in accordance with ASTM B633 SC2.

I. Fittings: Field fabricated in accordance with manufacturer's instructions from straight sections.

J. Hardware shall include splice connectors and support components furnished by manufacturer.

K. Manufacturer:

1. B-Line
    a. FT4X12X10 EG, 4”H x 12”W x 118”L, Basket Tray
    b. FT4X18X10 EG, 4”H x 18”W x 118”L, Basket Tray
    c. FT4X24X10 EG, 4”H x 24”W x 118”L, Basket Tray
    d. FT6X18X10 EG, 6”H x 18”W x 118”L, Basket Tray
    e. FT6X24X10 EG, 6”H x 24”W x 191”L, Basket Tray
    f. FTBE4X12 EG 4”H X 12”H Blind End
    g. FTBE4X18 EG 4”H X 18”H Blind End
    h. FTBE4X24 EG 4”H X 24”H Blind End
    i. FTBE6X18 EG 6”H X 18”H Blind End
    j. FTBE6X24 EG 6”H X 24”H Blind End
    k. FTA100CC EG 1” Conduit Clip
    l. FTA125CC EG 1-1/4” Conduit Clip
    m. Drop Out EG, Basket Tray water fall
2. Or equal

2.7 CABLE HANGERS

A. Application: Suitable for indoor installation within ceiling space for the support of communications cables.

B. Manufacturer:
    1. CEAS Figure 200 Series Low Voltage Supports
    2. Or equal

2.8 FLAT BAR

A. Application: Suitable for indoor installation within ceiling space for the support of communications cables.

B. Manufacturer:
    1. CEAS Figure 224 Low Voltage Support
    2. Or equal (no known equal)

2.9 FIRE RATED PENETRATION ASSEMBLY

A. Penetration assemblies shall be UL Listed for the application.

B. Penetration assemblies shall meet or exceed the rating of the wall (or floor) being penetrated.

C. Manufacturer
    1. STI EZ-Path 44 Series
    2. Or equal (no known equal)

2.10 FIRE RATED /SMOKE BARRIER PENETRATION ASSEMBLY

A. Penetration assemblies shall be UL Listed for the application.

B. Penetration assemblies shall meet or exceed the rating of the wall (or floor) being penetrated.

C. Manufacturer
    1. STI EZ-Path 33 Series
    2. Or equal (no known equal)

2.11 OUTLET BOXES

A. Telecommunications outlet box shall be one-piece die formed or drawn steel, knockout type box of size and configuration indicated on the drawings.

B. Box size: 5-inch square by 2-7/8 inch deep shall be minimum

C. Listing: C ETL US

D. Manufacturer
   1. RANDL Industries
      a. TB-55057 Telecommunications Bracket Outlet Box
      b. TB-55017 Telecommunications Outlet Box
      c. TB-55058 Telecommunications Bracket Outlet Box
      d. TB-55018 Telecommunications Outlet Box
   2. Or equal

2.12 CONCRETE FLOOR BOXES – AV, POWER, AND DATA

A. Construction: Seam welded 14 gauge steel.

B. Fire Rating: Fire-rated per Underwriters Laboratories (UL) Record E171211; the steel box are not required to be "fire rated". When the box is installed within a concrete slab, the box will assume the fire rating of the slab.

C. Listing: UL Listed – Scrub Water Approved. (Carpet over poured concrete floors only)

D. Cover Finish: Coordinate with Architect.

E. Manufacturer:
   1. FSR Inc.
      a. FL-500P, Floor Box, 6 in depth
      b. FLGRD2 for slab thickness less than four inches
      c. FL-GRD4 for slab thickness more than four inches
   2. Or equal

2.13 CONCRETE FLOOR BOXES – DATA AND POWER

A. Construction: Seam welded 14 gauge steel.

B. Listing: UL Listed – Scrub Water Approved. (Carpet over poured concrete floors only)

C. Cover Finish: Coordinate with Architect.

D. Manufacturer:
   1. Wiremold
      a. RFB2-OG, two-compartment floor box, 6-1/2" W x 13-1/8" L x 3-7/16" D
      b. RFB22AB, internal communication bracket
   2. Or equal

2.14 POKE-THRUS – AV, POWER, AND DATA

A. Construction: Intumescent body with die-cast aluminum cover

B. Fire Rating: Device installed within a concrete slab or deck shall maintain the fire rating of the floor system.

C. Listing: UL Listed - Scrub Water Approved. (Carpet over poured concrete floors only)

D. Cover Finish: Coordinate with Architect.

E. Manufacturer:
   1. Wiremold 8AT Evolution Series; 8 inch diameter poke-thru
   2. Or equal (no known equal)

2.15 POKE-THRUS – POWER AND DATA

A. Construction: Intumescent body with die-cast aluminum cover

B. Fire Rating: Device installed within a concrete slab or deck shall maintain the fire rating of the floor system.

C. Listing: UL Listed - Scrub Water Approved. (Carpet over poured concrete floors only)

D. Cover Finish: Coordinate with Architect.

E. Manufacturer:
   1. Wiremold RC4 Series; high capacity dual service flush poke-thru
   2. Or equal (no know equal)

2.16 POKE-THRUS – FURNITURE FEED

A. Construction: Intumescent body with die-cast aluminum cover

B. Fire Rating: Device installed within a concrete slab or deck shall maintain the fire rating of the floor system.

C. Listing: UL Listed - Scrub Water Approved. (Carpet over poured concrete floors only)

D. Cover Finish: Coordinate with Architect.

E. Manufacturer:
   1. Wiremold 4FFATC Series; large dual service furniture feed
   2. Or equal (no known equal)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Contractor shall thoroughly examine Project site conditions for acceptance of conduit system installation to verify conformance with Manufacturer and Specification tolerances. Do not commence with installation until all conditions are made satisfactory.

3.2 APPLICATION

A. Wire basket cable tray: Shall be used concealed for interior low voltage cables run above suspended ceilings.

B. Ladder cable tray: Shall be used in telecom rooms for support of low voltage cables.

C. Electrical metallic tubing (EMT): Shall be used concealed for interior low voltage cables where run above non-accessible ceilings, in stud walls, furred spaces and crawl spaces.

3.3 INSTALLATION

A. Support pathway systems per manufacturer requirements or as required by structural calculations.

B. Interface with Other Work:
   1. Verify route prior to installation.
   2. Coordinate the installation of the cable pathway system with other trades.
   3. Do not support from ductwork, piping, or other equipment hangers.
   4. Install pathways so that cables do not touch or rest on other any other systems.

C. Installation clearances:
   1. Install systems to maintain a minimum clearance of four (4) feet from any motor.
   2. Install systems a minimum of six inches from fluorescent light fixtures, or other EMI sources. Power cables in EMT are acceptable.
   3. Refer to drawings for side and top access clearance requirements to cable basket.
   4. Refer to drawings for installation heights and clearances between cable basket and building structures.

D. Ladder and Wire Basket Cable Trays
   1. Install cable tray systems in accordance with manufacturer's instructions and recognized industry practices, and ensure that the installed system complies with requirements of the NEC and applicable portions of NFPA 70B, NEMA VE-2 "Cable Tray Installation Guidelines" and NECA's "Standards of Installation" pertaining to general electrical installation practices. Install cable basket system using splice connectors, support components, and other accessories by the same manufacturer.
   2. Splice system sections using UL classified connector bolt, supplied by the same manufacturer. Splicing assemblies shall be the bolted type using serrated flange locknuts.
   3. Bends shall have a minimum of a 12" bend radius.
   4. Provide radius shields at each bend/corner of "T" type intersections and cross intersections.
   5. Provide blind ends where cable tray termination is exposed (i.e. not at a wall)
   6. Ground system per NEC 70 Article 250. Provide approved connection bolt to join system sections such that the spine of the system is considered a bonding jumper. Properly bond system to approved ground, as per NEC Article 250. Provide external grounding strap at expansion joints, sleeves, crossovers, and at other locations where system continuity is interrupted.
   7. Test support systems to ensure electrical continuity of bonding and grounding connections, and to demonstrate compliance with specified maximum grounding resistance. See NFPA 70B, Chapter 18, for testing and test methods.
   8. Provided Cable Dropout in all locations where the cable transitions out of the tray more than 6". This includes transitions from all cable trays to equipment racks or other pathways.

E. Cable Hangers and Flat Bars
   1. Install hangers in accordance with recognized industry practices, to ensure that the installed system complies with requirements of the NEC, and applicable portions of NFPA 70B and NECA's "Standards of Installation" pertaining to general electrical installation practices.
   2. Provide dedicated supports at stud locations with a maximum of forty-eight (48") separation.
   3. Suspend wire or rod using components appropriate for the structure – e.g., powder-actuated clip fastener for wire, beam flange clip or angled flange clip for either wire or rod, or an embedded anchor for the threaded rod. Do not share support (wire/rod) with other trades. Do not support the hanger on ceiling grid support wires. Do not support the hanger from ductwork, piping, or other equipment hangers.
   4. Install hangers six inches (6"), minimum, from light fixtures or other EMI source. Install hangers between six inches (6") and twelve inches (12") above ceiling grid.

F. Conduit
   1. Locations of conduit runs shall be planned in advance of the installation and coordinated with ductwork, plumbing, ceiling and wall construction in the same areas and shall not unnecessarily cross other conduits or pipe, nor block access to mechanical or electrical equipment.
   2. Where practical, install conduits in groups in parallel vertical or horizontal runs and at elevations that avoid unnecessary offsets.
   3. All conduits shall be run parallel or at right angles to the centerlines of columns and beams.
   4. Conduits shall not be placed closer than 12 inches to a flue, parallel hot water, steam line or other heat producing source or three inches from such lines when crossing perpendicular to the runs.
   5. Exposed conduit installation shall not encroach into the ceiling height headroom of walkways or doorways. Where possible, install horizontal raceway runs above water and below steam piping.

6. In long runs of conduit, provide sufficient pull boxes inside buildings to facilitate pulling wires and cables, with spacing not to exceed 150 feet. Support pull boxes from structure independent of conduit supports. These pull boxes are not indicated on the Drawings.
7. Provide all reasonably inferred standard conduits fitting and products required to complete conduit installation to meet the intended application whether noted, indicated or specified in the Contract Documents or not.
8. Install conduit in accordance with Manufacturer's written instructions, as indicated on Drawings and as specified herein.
9. Minimum Conduit Size: Unless otherwise noted herein or on Drawings, minimum conduit size shall be 1-1/4".
10. Install conduits in complete runs before pulling in cables or wires.
11. Install conduit free from dented, bruises or deformations. Remove and replace any damaged conduits with new undamaged material.
12. Conduits shall be well protected and tightly covered during construction using metallic bushings and bushing "pennies" to seal open ends.
13. Clean any conduit in which moisture or any foreign matter has collected before pulling in conductors. Paint all field-threaded joints to prevent corrosion.
14. In all empty conduits or ducts, install a “True Tape” conduit measuring tape line to provide overall conduit length for determining length of cables/conductors for future use.
15. Conduit systems shall be mechanically and electrically continuous throughout.
16. Metallic conduit shall not be in contact with other dissimilar metal pipes (i.e. plumbing).
17. Make bends with standard conduit bending hand tool or machines. The use of any item not specifically designed for the bending of electrical conduit is strictly prohibited.
18. A run of conduit between terminations at wire pulling points shall not contain more than the equivalent of two quarter bends (180 degrees, total).

G. Outlet Boxes
1. Install device/outlet boxes in accordance with manufacturer's written instructions, as indicated on drawings, and as specified herein.
2. Install boxes at the locations and elevations indicated on the drawings. Adjustment as required by field conditions and as coordinated with electrical and other trades.
3. Leave no unused openings in any box. Install close-up plugs as required to seal openings.
4. Provide cast metal boxes with gasketed cast metal cover plates where boxes are exposed in damp or wet locations or located in hazardous areas.
5. Use conduit outlet bodies to facilitate pulling of conductors or to make changes in conduit direction only. Do not make splices in conduit outlet bodies.
6. Supports
7. Support boxes independently of conduit system.
8. Support boxes, mounted above suspended acoustical tile ceilings, directly from the structure above.

H. Floor Boxes
1. Install in accordance with manufacturer's instructions and in proper alignment with adjacent surfaces.
2. Contractor shall fill the space between the box and slab with a fire rated silicone acceptable to local code to prevent vapor passage from below the slab to above the slab.
3. If required by local fire code, apply a “spray-on fire retardant” to any exposed external areas of the steel boxes that penetrate the slab. There are 4 knockouts on the bottom of these series of floor boxes, punched in such a manner that the unused knockouts will also not allow passage of vapor from one zone to the next.
4. For data only floor box, install one communication mounting plate.
5. Protection
    a. Protect installed floor boxes until completion of project.
    b. Touch-up, repair or replace damaged floor boxes before Substantial Completion.

3.4 PENETRATIONS

A. Cut holes through concrete, masonry block or brick floors and floors of structure with a diamond core drill or concrete saw. Pneumatic hammer, impact electric, hand or manual hammer type drills are not allowed, except where permitted by the Structural Engineer as required by limited working space. Obtain the approval of the Structural Engineer prior to drilling through structural sections.

B. Sealing:
   1. Non-rated penetrations: Pack opening around conduits with non-flammable insulating material and seal with gypsum wallboard taping compound.
   2. Rated penetrations: Where conduits, wireways and other electrical raceways pass through fire rated partitions, walls, smoke partitions or floor, provide a UL classified fire stop system to provide an effective barrier against the spread of fire, smoke and gases. Completely fill and seal clearances between raceways and openings with the fire stop material.

C. Waterproofing:
   1. At floor, exterior wall and roof conduit penetrations, completely seal clearances around the conduit and make watertight.
   2. For roof penetrations, provide roof flashing, counter flashing and pitch-pockets.
   3. Provide membrane clamps and cable sealing fittings for any conduit that horizontally penetrates the waterproof membrane.
   4. Conduits entering the building within grade that horizontally penetrate a waterproof membrane shall fall away from and below the penetration on the exterior side a minimum of two times the conduit diameters.

3.5 TERMINATIONS AND JOINTS

A. Use raceway fittings that are of types compatible with the associated raceway and suitable for the use and location.

B. Raceways shall be joined using specified couplings or transition couplings where dissimilar raceway systems are joined.

C. Conduits shall be securely fastened to cabinets, boxes and gutters using two locknuts and an insulating bushing or specified insulated connectors. Where joints cannot be made tight, use bonding jumpers to provide electrical continuity of the raceway system. Where terminations are subject to vibration, use bonding bushings or wedges to assure electrical continuity. Where subject to vibration or dampness, use insulating bushings to protect conductors.

D. Conduit terminations exposed at weatherproof enclosures and cast outlet boxes shall be made watertight using specified connectors and hubs.

E. Raceway seal: Inject into wire filled raceways, a pre-formulated rigid 2 lbs. density polyurethane foam which expands a minimum 35 times its original bulk. Foam shall have the physical properties of water vapor transmission of 1.2 to 3.0 perms; water absorption less than 2% by volume, fungus and bacterial resistant. Foam shall permanent seal against water, moisture, insects and rodents. Install raceway sealing foam at the following points:
   1. Where conduits pass from warm locations to cold locations to prevent passage of water vapor (such as refrigerated spaces, constant temperature rooms, air-conditioned spaces, etc.).

3.6 SUPPORTS

A. Secure raceways and systems to building structures using approved fasteners, clamps and hangers spaced according to the NEC and as specified in structural drawings for the project.

3.7 FINAL INSPECTION AND CERTIFICATION

A. Punch the Work of this Section compliant to the requirements of Section 27 00 00.

B. Comply with system acceptance and certification requirements of Section 27 00 00.

END OF SECTION

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SECTION 27 08 00

COMMUNICATIONS SYSTEM COMMISSIONING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Systems and equipment Start-Up and Functional Performance Testing.

B. Validation of proper and thorough installation of Division 27 systems and equipment.

C. Generic Start-Up Documentation for Communications systems and equipment.

D. Development of final Start-Up Documentation for electrical systems and equipment.

E. System Start-Up and Turn-Over procedures.

F. Coordination and execution of Training Events.

1.2 GENERAL DESCRIPTION

A. This section defines responsibilities of the Communication Contractor to commission the Communication Systems.

B. Commissioning is a process to demonstrate that each system has been provided by the CM in strict accordance with the Contract Documents and that building systems perform interactively and reliably according to the design intent and the Owners operational needs, in a systematic process.

C. Commissioning Authority (CA) shall work with the Contractor and the design engineers to direct and oversee the Cx process and perform Cx Testing.

D. The Commissioning Plan outlines the Commissioning process and is part of the Construction Contract.

E. Commissioning shall be performed in accordance with the Contract Document requirements and related commissioning specification sections. All recommendations and suggested practices contained in these Commissioning Standards shall be considered mandatory with the most stringent between the Contract Documents or Standards being required. The Commissioning Standard shall be used as a reference for all aspects of Commissioning, and calibration of Commissioning instruments. Quality requirements provisions of the Commissioning Standard such as performance guarantees shall be part of this contract. For systems or system components not covered in these Commissioning Standards, Commissioning procedures shall be developed in the Related Sections. Where new procedures, requirements, etc., applicable to the Contract requirements set forth, the requirements and recommendations contained in these procedures shall be considered mandatory.

1.3 SCOPE

A. The following systems and equipment are included in the Scope of Commissioning for this project:

B. Communication Systems: The following Division 27 equipment and systems are subject to commissioning. All components and devices that make up these systems are included.

1.4 RELATED WORK AND DOCUMENTS

A. The Cx process references many related Sections, particularly Section 01 91 00 - General Commissioning. It is important for all Contractors subject to the Cx process to be familiar with the contract documents and industry standards.

B. Refer to Section 01 91 00 for a complete list of Sections on Related Work.

C. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.5 DEFINITIONS AND ABBREVIATIONS

A. Refer to Section 01 91 00 for a complete list of Definitions and Abbreviations.

1.6 REFERENCE STANDARDS

A. National Electric Code (NEC)

B. American Society for Testing and Materials (ASTM)

C. Electronics Industry Association/Telecommunications Industry Association (EIA/TIA)

D. Institute of Electrical and Electronics Engineers (IEEE)

E. International Electrical Testing Association (NETA)

F. National Electrical Manufacturers Associates (NEMA)

G. National Fire Protection Association (NFPA)

H. Underwriters Laboratory, Inc. (UL)

I. Refer to Section 01 91 00 for additional Reference Standards.

1.7 DOCUMENTATION

A. Documentation shall be as required in Section 01 91 00. In addition, Contractor shall also provide to the CA the following per the procedures specified herein, in the Cx Plan, and in other Sections of the specification:
   1. Factory Test Reports: Contractor shall provide any factory testing documentation or certified test reports required by the specifications. These shall be provided prior to Acceptance Phase. Factory Test Reports shall be provided in PDF electronic format.
   2. Field Testing Agency Reports: Provide all documentation of work of independent testing agencies required by the specification. These shall be provided prior to Acceptance Phase. Field Testing Agency Reports should be provided in PDF electronic format.

1.8 SEQUENCING AND SCHEDULING

A. Refer to Section 01 91 00.

1.9 COORDINATION MANAGEMENT PROTOCOLS

A. Coordination responsibilities and management protocols relative to Cx are initially defined in other sections and the Cx Plan, but shall be refined and documented in the Construction Phase Cx Kick-Off Meeting. Contractor shall have input into the protocols to be used and all Parties will commit to scheduling obligations. The CA will record and distribute.

1.10 CONTRACTOR RESPONSIBILITIES

A. Detailed Contractor responsibilities common to all Divisions are specified in other sections. The following are additional responsibilities or notable responsibilities specific to Division 27.

B. Construction Phase

C. Acceptance Phase
   1. Perform functional performance testing in presence of CA. Performance will generally include the following:
   2. Manipulate systems and equipment to facilitate testing while observed by the CA as dictated in Section 01 91 00. In some cases this will entail a 20% sampling. (It is noted that no sampling by subcontractors is permitted in prefunctional checklist execution.)
   3. Provide any specialized instrumentation necessary for functional performance testing.
   4. Subcontractor to furnish a set of red-lined drawings to the CA prior to the start of Functional Performance Testing.

5. By direction of CA during Functional Performance Testing, contractor is to test all operating modes, interlocks, control responses and responses to abnormal or emergency conditions and verify proper response of system.
6. Contractor provide technicians, instrumentation, specialized tools, and equipment to test functional performance.
7. Note that contractor is obligated to pretest equipment/systems using the published Functional Performance Test in advance of the Functional Performance Test witnessed by the CA.
8. The acceptance phase ends with the successful completion of all Functional Performance Testing and sign off by CA.

1.11 EQUIPMENT SUPPLIER RESPONSIBILITIES

A. Refer to Section 01 91 00.

1.12 CONTRACTOR NOTIFICATION AND SCHEDULING

A. Refer to Section 01 91 00.

1.13 START-UP DOCUMENTATION

A. Refer to Section 01 91 00.

1.14 EQUIPMENT NAMEPLATE DATA

A. Refer to Section 01 91 00.

1.15 FUNCTIONAL PERFORMANCE TESTING

A. Participating Parties
B. Communication System Contractor, and Construction Manager shall all participate in the all Functional Performance Testing.
C. Documentation, non-conformance, and approval of tests
   1. The CA shall witness and document the results of all Functional Performance Tests, Integrated System Test and Entire Facility Integration Tests.
   2. Non-Conformance
      a) The CA will record the results on the test form. All non-conformance issues shall be noted on an issues log.
      b) Corrections to non-conformance issues identified may be made during the tests at the discretion of the CA. In such cases, the issue and resolution will be documented on the procedure form.
      c) After the day's work, the CA sends the non-compliance reports as issues. The sub corrects the issue and responds with their corrective actions to the issue certifying the equipment is ready to be retested.
      d) The cost for the CA to witness a retest shall be the responsible subcontractor's. The Owner will back charge the CM and pay the CA for the retesting.
      e) The additional time for the CA to direct any retesting required because a specific component or system checklist or start-up test item, reported to have been successfully completed, but determined during testing to be faulty will be backcharged to the CM by the Owner.

1.16 FPT ACCEPTANCE CRITERIA

A. Acceptance criteria for tests are indicated in the specification Sections applicable to the systems being tested. Unless indicated otherwise, the criteria for acceptance will be that specified with the individual system, equipment, component, or device, which shall typically conform to applicable the referenced technical specifications.

1.17 TRAINING

A. Contractors, subcontractor, vendors, and other applicable Parties shall prepare and conduct training sessions on the installed systems and equipment they are responsible for and the individual Specifications.

1.18 SYSTEMS MANUAL AND O&M DOCUMENTATION CONTENT - PREPARATION AND LOGISTICS

A. Refer to Section 01 91 00 the individual Specifications.

PART 2 – PRODUCTS

2.1 INSTRUMENTATION

A. General: All testing equipment used by any Party shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified. Unless otherwise noted, all equipment shall be calibrated according to the manufacturer's recommended intervals. Calibration tags shall be affixed or certificates readily available.

PART 3 – EXECUTION

3.1 GENERIC START-UP DOCUMENTATION - GENERAL

A. Part III of this Section outlines 'generic' or minimally acceptable Start-Up Documentation (which are defined to include both 'Start-Up Checks' and 'Start-Up Tests') and individual systems training requirements for systems and equipment. These procedures are the direct responsibility of the Contractor as a basic element of validating that the installation is correct per normal quality control practices. These items shall provide a minimally acceptable guideline for required Contractor development of Start-Up Documentation. Contractor shall synthesize these minimum requirements along with their own internal quality control practices, those of the manufacturer, and any applicable codes and standards to develop specific and itemized final Start-Up Documentation specific to the equipment and systems installed on this project.

3.2 START-UP CHECKS COMMON TO ALL SYSTEMS

A. The following Start-Up verifications and procedures shall be considered common to all systems:
1. Checkout shall proceed from lower level devices to larger components to the entire system operation.
2. Verify labeling is affixed per specification and visible.
3. Verify prerequisite procedures are done.
4. Inspect for damage and ensure none is present.
5. Verify system is installed per the manufacturer's recommendations.
6. Verify system has undergone Start-Up per the manufacturer's recommendations.
7. Verify that access is provided for inspection, operation and repair.
8. Verify that access is provided for eventual replacement of the equipment.
9. Verify that record drawings, submittal data and O&M documentation accurately reflect the installed systems.
10. Verify all recorded nameplate data is accurate.
11. Verify that the installation ensures safe operation and maintenance.
12. Verify specified replacement material/attic stock has been provided as required by the Contract Documents.
13. Verify all monitoring and ensure all alarms are active and set per Owner's requirements.
14. Complete all nameplate data and confirm that ratings conform to the design documents.

END OF SECTION

SECTION 27 08 11

COMMUNICATIONS TWISTED PAIR TESTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Testing of Communications Twisted Pair Cabling for both Backbone and Horizontal Cabling subsystems.

B. Related Sections
   1. Comply with the Related Sections paragraph of Section 27 00 00.
   2. Section 27 13 13 - Communication Twisted Pair Cabling

1.2 REFERENCES

A. Comply with the References requirements of Section 27 00 00.

1.3 DEFINITIONS

A. Refer to Definitions of Section 27 00 00, Section 27 13 13

B. In addition to those Definitions of Section 27 00 00, the following list of terms as used in this specification defined as follows:
   1. "CAT6A": Shall mean Augmented Category 6 cabling, per ANSI/TIA-568-C.2
   2. "CAT5E": Shall mean Enhanced Category 5 cabling, per ANSI/TIA-568-C.2
   3. "Channel": Shall mean a testing configuration which includes the Permanent Link and the line cord (at the workstation), the equipment cord, and, if a full crossconnection is implemented, a patch cord and the crossconnect termination/connecting apparatus.
   4. "Connect": Shall mean install all required patch cords, equipment cords, cross-connect wire, etc. to complete an electrical or optical circuit.
   5. "Cord": Shall mean a length of cordage having connectors at each end. The term "Cord" is synonymous with the term "Jumper" and "Lead".
   6. "Permanent Link": Shall mean the 'permanent' portion of the Horizontal cabling to each outlet with the test cords de-embedded from the measurements; this includes cable, consolidation point (if used), termination/connecting apparatus in the IDF and the connector at the outlet.
   7. "System Cord": Shall mean the cord used in the operating transmission circuit.
   8. "Test Cord": Shall mean the cord certified for use in testing, as described in this section.

1.4 SYSTEM DESCRIPTION

A. Refer to Section 27 00 00, and Section 27 13 13for addition system description information.

B. Work Provided Under Other Sections
   1. Backbone twisted pair cabling
   2. Horizontal twisted pair cabling

C. Base Bid Work
   1. Testing of a completed communication infrastructure cabling system, which includes:
      a. Submittals

b. Testing of the twisted pair cabling as follows:

Table 270811-1.1: Tests For UTP Cabling

Subsystem	Type	Test	Configuration	Notes
Backbone	OSP	*see “Notes”	-	Wire map & length
Backbone	ISP/Riser	*see “Notes”	-	Wire map & length
Horizontal	CAT6A	Category 6A	Permanent Link	Per EIA-568-C.2, 6.3
Horizontal	CAT5E	Category 5e	Permanent Link	Per EIA-568-C.2, 6.3

c. Record Documents, including test results.

1.5 SUBMITTALS

A. Comply with the Submittal requirements of Section 27 00 00.

B. Submittal Requirements at Start Of Construction:
   1. Testing Procedures Submittal, describing step-by-step procedures used by the field technicians.
   2. Product Submittal, including cut sheets of testing equipment to be used (note all software/ firmware versions as applicable).
   3. Schedule Submittal, consisting of proposed schedule of work. This schedule may be combined with the schedule developed for Division 27.

C. Submittal Requirements at Closeout:
   1. Record Documents:
      a. Submit one hard copy of warranty certificate.
   2. Format – Soft Copy:
      a. “Burn” onto one CD-ROM test report files as native data format (for example, an *.FLW file from a Fluke tester); if not possible to submit in native format, then issue test results as an exported Microsoft Excel compatible format.
      b. Include onto CD-ROM ‘Viewer’ software necessary to view, sort, filter, and print individual and summary test results from test results native format.
      c. Clearly label the CD-ROM with the following information:
         1) Client Name
         2) Project Name and Address
         3) CD-ROM Name (e.g., “Test Reports for Horizontal Cabling System”)
         4) Date of Submittal – date format: <month> <day>, <year> (e.g., “January 1, 2020”)
         5) Contractor Name
      d. Include a Table Of Contents at the beginning that lists the contents
      e. Organize the test reports by Backbone Cabling / Horizontal Cabling, by building, by floor, and by IDF.
      f. Sort reports in ascending cable ID order
      g. Include tabbed separators for improved navigation through the manual

1.6 QUALITY ASSURANCE

A. Comply with the Quality Assurance requirements of Section 27 00 00.

B. Under no circumstances shall any cable’s and/or conductor’s test results be substituted for another’s. If an instance of falsification is confirmed, the Contractor is liable for a complete retest of the cabling system at no additional cost to the Owner. This includes the retaining the services of a neutral party to observe all retesting.

1.7 WARRANTY

A. Warrant the validity of the test results.

PART 2 - PRODUCTS

2.1 BACKBONE TWISTED PAIR CABLING TESTER

A. Areas of Test Measurement (minimum): Wire Map (continuity, opens, shorts, crossed pairs, split pairs): Siemon test unit, with 25-pair adapter, or equal.

2.2 CATEGORY 6A HORIZONTAL CABLE TESTER

A. Equipment shall meet TIA/EIA-568-C.2-10 testing requirements. Equipment shall meet TIA/EIA-568B.2 Addendum 1 requirements for Level III accuracy. Equipment shall meet ISO/IEC Class C, D, E, and F.

B. Test Standards (minimum): TIA Category 6A (per TIA/EIA-568C.2 Addendum 1); ISO/IEC 11801 Class C and D; ISO/IEC 11801-2000 Class C and D, 1000Base-T, 100Base-TX; IEEE 802.3 10Base-T; ANSI TP-PMD; IEEE 802.5

C. Areas of Test Measurement (minimum): Wire Map; Length; Insertion Loss; Near End Crosstalk (NEXT) loss, at both master unit and remote unit; ; Power Sum NEXT (PSNEXT) loss, at both master unit and remote unit;; ; Return Loss (RL), at both master unit and remote unit; Propagation Delay and Delay Skew; Attenuation-to-Crosstalk Ratio (ACR), at both master unit and remote unit; Power Sum ACR (PSACR), at both master unit and remote unit; Characteristic Impedance; DC Loop Resistance; and calculations for Power Sum ANEXT (PSANEXT) and Power Sum AFEXT (PSANEXT) loss, and for Power Sum Alien Attenuation-To-Crosstalk Ratio Far-End (PSAACRF) loss

D. Equipment: Fluke Networks
   1. Versiv series test kit (main unit, remote unit, CAT6A permanent link adapters, CAT6A channel adapters, accessories), loaded with the latest firmware version.

PART 3 - EXECUTION

3.1 SCHEDULING

A. Prepare a construction schedule based on the schedule developed in Section 271313 and Section. Prepare updated schedules when changes in the schedule occur.

3.2 FIELD QUALITY CONTROL

A. Calibrate test sets and associated equipment per the manufacturers printed instructions at the beginning of each day's testing and after each battery charge. Fully charge the test sets prior to each day's testing to ensure proper operation.

B. Ensure test equipment and test cords are clean and undamaged during testing activities. Per the Engineer's discretion, halt testing activity and clean testing equipment, test cords, and related apparatus.

C. Permanently record test results.

3.3 BACKBONE TWISTED PAIR CABLING TESTING REQUIREMENTS AND PROCEDURES

A. Precautions
   1. Adhere to the equipment manufacturer's instructions during all testing.
   2. Prior to any testing activity or any measurements taken, ensure the test equipment is at room temperature – approximately 70 degrees F (e.g., if necessary, bring the test equipment in from outdoors and let it set for about 15 minutes or for however long it takes to bring the test equipment to reach room temp).
   3. Fully charge power sources before each day's testing activity

B. Testing Requirements
   1. Test backbone multipair cabling per “Base Bid Requirements” in Part 1 of this Section.
   2. The installation will be accepted when testing has indicated availability of 100% terminated pairs.

C. Testing Procedures
   1. Test continuity and wire map for all pairs.
   2. Test length for 2% of pairs of each cable. Pairs shall be from different 25-pair binder groups.

D. Record Documents:
   1. Cable and pair identifiers of the test reports shall match the identifiers as labeled in the field – i.e., use the same ID on the cable label/termination label as what appears on the test reports.
   2. Measurements shall carry a precision through no significant decimal place.
   3. Each test report shall contain the following information (not necessarily in this order):
      a. Project name
      b. Cable identifier, pair number(s)
      c. Date measurement were obtained
      d. Operator (company and name)
      e. Test equipment model and serial number(s)
      f. Measurement results

3.4 HORIZONTAL CATEGORY 6A TESTING PROCEDURES

A. Precautions
   1. Adhere to the equipment manufacturer’s instructions during all testing.
   2. Prior to any testing activity or any measurements taken, ensure the test equipment is at room temperature – approximately 70 degrees F (e.g., if necessary, bring the test equipment in from outdoors and let it set for about 15 minutes or for however long it takes to bring the test equipment to reach room temp).
   3. Fully charge power sources before each day’s testing activity

B. Test Equipment Set Up
   1. Set up the tester to perform a full CAT6A test, as a Permanent Link configuration.
   2. If the tester has the capability, set the cable type as product-specific setting. If not, set as generic CAT6A.
   3. Set the tester to save the full test results (all test points, graphs, etc.).
   4. Save the test results with the associated cable link identifier.
   5. Calibrate the test set per the manufacturer’s instructions.

C. Acceptable Test Result Measurements
   1. Overall Test Results:
      a. The Owner shall accept only individual test results that result in a Pass.
      b. Links which report a Fail, Fail* or Pass* for any of the individual tests shall result in an overall link Fail.
      c. Any reconfiguration of link components required as a result of a test Fail, must be re- tested for conformance.
      d. Remove and replace any cabling links failing to meet the criteria described in this specification, at no cost to the Owner, with cables that prove, in testing, to meet the minimum requirements.
   2. Wire Map: Correctly terminate all pairs of the cabling link at both ends. Provide only continuous pairs. No exceptions.
   3. Length: Ninety-four meters is the maximum acceptable electrical length measurements for any cabling link measured under a Permanent Link configuration, including test cords.
   4. Insertion Loss: The acceptable insertion loss measurements for any CAT6A cabling link is that which is no greater than that listed in ANSI/EIA-568-C.2, 6.3.
   5. Worst Pair-to-Pair Near End CrossTalk (NEXT) Loss: The acceptable worst pair-to-pair NEXT loss for any CAT6A cable is that which is no greater than that listed in ANSI/EIA-568-C.2, 6.3.

6. Power Sum NEXT Loss: The acceptable power sum PS-NEXT loss for any CAT6A cable is that which is no greater than that as listed in ANSI/EIA-568-C.2, 6.3.
7. Worst Pair-to-Pair ELFEXT and FEXT Loss: The acceptable worst pair-to-pair ELFEXT and loss for any CAT6A cable is that which is no greater than that listed in ANSI/EIA-568-C.2, 6.3.
8. Return Loss: The acceptable return loss measurements for any CAT6A cable is that which is no greater than that listed in ANSI/EIA-568-C.2, 6.3.
9. Propagation Delay and Delay Skew: The acceptable propagation delay and delay skew measurements for any CAT6A cable is that which is no greater than that listed in ANSI/EIA-568-C.2, 6.3.

D. Records
1. Permanently record test results.
2. Export all of the numerical test results to a single spreadsheet in Microsoft Excel® (*.xls) or (*.xlsx) file format.
3. Submit test results at the conclusion of the testing to the Engineer for approval. Engineer will check these test reports for a format acceptable to the Owner, or Owner's Representative.
4. For each Horizontal CAT6A test, record the following information:
    a. Project name and address
    b. Testing Company's and Operator's name
    c. Date of measurement
    d. Test equipment, including the following:
        1) Manufacturer, model, and serial number
        2) Date and time of last calibration
    e. Identification number of cable
    f. Overall test result

END OF SECTION

SECTION 27 11 00

COMMUNICATIONS EQUIPMENT ROOMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Buildout of communications equipment rooms.

B. Related Divisions and Sections
   1. Comply with the Related Sections paragraph of Section 27 00 00.
   2. Drawings, general provisions of the Agreement, and Division 01 apply to this Section.
   3. Consult other Divisions, determine the extent and character of related work, and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable system.
   4. Comply with cable tray installation in Section 27 05 28

C. Unit Pricing:
   1. Unit prices shall include material, labor, shipping, tax, markups (overhead, profit, job expenses, bonding), labeling, records, and as-built drawings.

1.2 REFERENCES

A. Comply with the References requirements of Section 27 00 00.

B. In additional to those codes, standards, etc., list in Section 27 00 00, comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
   1. ANSI/EIA-310-D-1992, “Racks, Panels And Associated Equipment”

1.3 DEFINITIONS

A. Definitions as described in Section 27 00 00 shall apply to this section.

1.4 SYSTEM DESCRIPTION

A. General: Communications rooms shall fall into one of the following space titles:
   1. Entrance Facility/EF
   2. Telecommunications Room/TR

B. Room Functions:
   1. Entrance Facility (EF) will serve the following functions:
      a. Act as minimum point of entry (MPOE) for telecommunications utility (e.g., AT&T)
      b. House telecom utility’s termination field(s) and interface between telecom utility’s facilities and premises facilities
      c. Main entrance point for all communications conduit entering the building
   2. Main Distribution Facility (EF) will serve the following functions:
      a. Houses network equipment (i.e. core switch/router, processing eqmt/servers) and voice system equipment (i.e. VoIP system)
      b. House interbuilding and intrabuilding twisted pair and fiber optic backbone cabling and main crossconnect field
      c. Houses network equipment (i.e. access switches) serving the horizontal cabling
      d. Houses horizontal termination field – for voice/data/CATV – outlets served from this room (refer to floor plans for area served)
      e. House voice backbone crossconnect field and data backbone crossconnect field

3. Telecommunications Room (TR) will serve the following functions:
    a. House intrabuilding twisted pair and fiber optic backbone cabling from EF
    b. House horizontal termination field – both voice and data – of outlets served from this room (refer to drawings for area served).
    c. House network equipment (i.e. access switch) serving users of the room's service area

C. Work Covered Under Other Sections
1. Plywood backboards
2. Bonding
3. Grounding busbars
4. Power and cooling
5. Conduit, device boxes, and sleeves

D. Base Bid Work
1. The Work under this section includes materials, accessories, fasteners, etc., and the labor and associated services required for the buildout / fit-up of telecommunications equipment rooms, and includes coordination through the General Contractor with other trades
2. In general, the Work includes the following:
    a. Submittals
    b. Rack bays (equipment racks, vertical management sections, anchoring)
    c. Cable, wire and patch cord management
    d. Overhead cable support
    e. Racks and Cabinets
    f. Seismic bracing
    g. Identification tags and labeling
    h. Record Documents
    i. Warranty

E. Coordination Requirements
1. Electrical: Coordinate layout with electrical contractor to ensure proper placement of lighting, sequencing of power service to rack bay, and other issues related to electrical trade.
2. Owner: Coordinate room-ready requirements and schedule with Owner (to allow Owner to plan and execute installation of telecommunications/network equipment).

1.5 SUBMITTALS

A. Comply with the Submittal requirements of Section 27 00 00.

B. Quantity: Furnish quantities of each submittal as noted in Section 27 00 00.

C. Submittal Requirements at Start of Construction:
1. Product Data Submittal
2. Shop Drawings Submittal: Consisting of any proposed changes to room plans.
3. Sample Submittal: Submit sample of equipment rack label.
4. Schedule Submittal: Submit proposed schedule of work (this schedule may be combined with the schedule developed for Division 27.

D. Submittal Requirements at Close Out:
1. As-Built Drawings Submittal

E. Substitutions
1. Requests for substitutions shall conform to the general requirements and procedure outlined in Section 27 00 00.

1.6 QUALITY ASSURANCE

A. Comply with Quality Assurance requirements of Section 270000.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with Delivery, Storage and Handling requirements of Section 270000.

1.8 WARRANTY

A. Warrant Work to perform as described within this Section for a period of 1 year. Correct deficiencies within 24 hours of notification.

PART 2 - PRODUCTS

2.1 EQUIPMENT RACK

A. Application: Suitable for the support of termination apparatus, cable and cord management apparatus, network equipment, and other similar equipment, within a telecommunications room.

B. Include all accessories and hardware necessary for proper installation.

C. Seismic gusset kits and dust cover shall be installed on all racks.

D. Equipment racks shall be clearly labeled with unique 2-digit serial number reset to 01 for each TR. Numbering of racks shall start with rack at furthest wall and increment working towards the door. The label shall consist of machine Printed Numbers minimum 2 inches high.

E. Within the front of the vertical manager there should be a vertical 2" x 2" fingered fiber duct (with cover) and 2" x 4" downspout transition with cover. Within the rear of the vertical manager, there should be two PDU power strips.

F. Within the equipment racks, four (4) large ring panels for horizontal cable management shall be installed. There shall be a minimum of one 4RMU locking drawer per TR.

G. Material: High strength, lightweight 6061-T6 aluminum, extrusion construction.

H. Channel:
   1. Size: 3" deep, with flanges on each side ("double sided")
   2. Flange: 1.265" wide by 0.25" thick, with mounting holes
   3. Mounting Holes: Threaded, spaced at 5/8" - 5/8" - 1/2", compatible with ANSI/EIA-310-D
   4. Threading: #12-24 rolled, compatible with ANSI/EIA-310-D
   5. RMU Markings: The RMU markings shall be permanently stamped on the 'outside' of both flanges on both channels.

I. Assembled 4-Channel Racks:
   1. Racks shall be complete with 4 mounting channels, 2 base angles (3.5" high by 6" deep by .375" thick), 2 top angles (1.5" high by 1.5" deep by .375" thick), 1 bottom 'center pan', and 1 top 'center pan'.
   2. Racks shall be 7'-0" high (overall) by 19" mounting width (20.25" wide overall), 28" from front mounting plane to back mounting plane, and shall contain 58 EIA mounting spaces.
   3. Manufacturer:
      a. CPI 15251-X15 #12-24, 4 post Adjustable Rail QuadraRack including all necessary accessories required for proper installation.
      b. PDU: Provide with Dual Vertical Power Strip Manager
      c. PDU: Vertical PDU; Metered; 120/208V; 30A; 3 Phase WYE; 68.5"L (1740 mm); (24) 5-20R Receptacles; 120V; (3) Magnetic Circuit Breakers; 20A; with Surge Protection; L21-30P Input; (3) Local Meters;

J. Assembled 2-Channel Racks:
   1. Racks shall be complete with 2 mounting channels, 2 base angles (3.5" high by 6" deep by .375" thick), and 2 top angles (1.5" high by 1.5" deep by .375" thick)

2. Racks shall be either 7'-0" high or 7'-0" high (overall) by 19" mounting width (20.25" wide overall), and shall contain 58 and 45 EIA mounting spaces, respectfully.
3. Manufacturer:
    a. CPI 55053-703, 2 post Standard Rack, 45 RMU, Grounded, UL Listed, Black
    b. PDU: Provide with Dual Vertical Power Strip Manager
    c. PDU: Vertical PDU; Metered; 120/208V; 30A; 3 Phase WYE; 68.5"L (1740 mm); (24) 5-20R Receptacles; 120V; (3) Magnetic Circuit Breakers; 20A; with Surge Protection; L21-30P Input; (3) Local Meters;

K. Load Rating: 1,000 lbs, when evenly distributed for the height of the rack

L. Finish: Black, powder coat

2.2 EQUIPMENT CABINET (SECURITY)

A. Application: Suitable for the support of network equipment, IT equipment, termination apparatus, cable & cord management apparatus, common communications equipment, and other similar equipment.

B. Frame Material: High strength, lightweight 6061-T6 aluminum, extrusion construction.

C. Manufacturer:
1. CPI
    a. #NNN-23EC5-1 N Series with locking doors – 7' Tall
    b. #35086-E05; PDU/Power Strip Lashing Bracket
2. Or equal

2.3 VERTICAL MANAGEMENT SECTIONS

A. Application: Suitable for cable routing, cord routing, and cord slack storage vertically (between the top and bottom) within a rack bay.

B. The vertical management section shall be double-sided (i.e., the management section having covered cable guides on the front and flip-retainers on the rear).

C. Size & Capacity: The section between racks shall be 10" wide and the sections on the ends of the rack isle shall be 6" wide. 7'-0" high by 6" or 10" wide, with extra deep storage in the front and rear.

D. Mounting: The vertical management section having matching bolt holes for attachment to the rack.

E. Color: black (guides and cover).

F. Manufacturer:
1. CPI Evolution g2 Cable Management System
    a. 9'-0"H x 6"W, double sided, extended depth, black
    b. 9'-0"H x 10"W, double sided, extended depth, black

2.4 HORIZONTAL MANAGEMENT PANEL

A. Application: Suitable for installation into equipment rack for horizontal cord management. The horizontal management panel shall match (and fully integrate with) the vertical management sections.

B. The horizontal management panel shall be single-sided.

C. Size: 1U and 2U high by 19" mounting wide.

D. Color: black (guides and cover).

E. Manufacturer:
1. CPI Evolution Horizontal Cable Management System
    a. horizontal management panel, single sided, 2U, black
    b. horizontal management panel, single sided, 1U, black
2. Or equal

2.5 HORIZONTAL BLANKING PANEL

A. Application: Suitable for installation into equipment cabinets to block airflow from the cold side of the cabinet and the hot side chimney return.. .

B. Mounting: Installs without tools or screws in square holes with or without cage nuts.

C. Size: 1U and 2U high by 19" mounting wide.

D. Color: black

E. Manufacturer:
   1. Panduit/CPI
      a. 1U blanking panel, black
      b. 2U blanking panel, black
   2. Or equal, no known equal

2.6 CABLE RUNWAY

A. Cable Runway Straight Sections
   1. Application: Suitable for the support & management of telecommunications (and other low voltage) cables, either overhead or mounted vertically on a wall, within Telecommunications Room. Also overhead equipment rack bracing.
   2. Construction: Constructed of two longitudinal side elements – "stringer", with elements periodically crossing between stringers – "rung"; Rungs spaced 12" on center, and welded to stringer.
   3. Material (both stringer and rung): Steel tube, rectangular, 1-1/2" by 3/8" by 0.65" wall thickness.
   4. Size: Sized to provide 60% free capacity after all install.
   5. Manufacturers:
      a. CPI
         1) #10250-712; 12"W cable runway, black
         2) #10250-718; 18"W cable runway, black
         3) #10250-724; 24"W cable runway, black
      b. Or equal

B. Cable Runway Sweep Fittings
   1. Application: Suitable for the support & management of telecommunications cables, overhead.
   2. Material (both stringer and rung): Steel tube, rectangular, 1-1/2" by 3/8" by 0.65" wall thickness.
   3. Manufacturer:
      a. CPI
         1) #10822-712; horizontal sweep fitting for 12" wide cable runway, black
      b. Or equal

C. Cable Runway Installation Accessories
   1. Application: Installation accessories for use with cable runway.
   2. Manufacturer:
      a. CPI
         1) #16301-001; butt splice kit
         2) #11302-701; junction splice ("T") kit
         3) #10608-001; vertical wall bracket kit
         4) #10642-001; end caps
         5) #11421-718; wall angle support kit for 18" wide cable runway, black
         6) #11421-724; wall angle support kit for 24" wide cable runway, black
         7) #11312-718; triangle support kit for 12" and 18" wide cable runway, black
         8) #11770-718; end closing kit for 18" wide cable runway, black
         9) #11770-724; end closing kit for 24" wide cable runway, black
         10) #12100-712; Runway radius drop out, cross member
         11) #10596-706; Cable Retaining Post

b. Or equal

2.7 CABLE TRAY

A. Application: Suitable for the support & management of telecommunications (and other low voltage) cables, overhead within Telecommunications Room. Also overhead equipment rack bracing.

B. Type & Material: aluminum “Redi-Rail” with removable and movable rungs.

C. NEMA Rating: 12C

D. Knockout Type: 1”

E. Dimensions:
1. Depth and width –Provide as necessary to provide a maximum of 30% fill. Provide all additional supports, transitions, angles, connections, etc. necessary for complete installation in general areas as indicated on plans. Contractor to provide complete shop drawings prior to ordering and installation.
2. Rung spacing = 9”
3. Bend radius of fittings = 12”

F. Manufacturer:
1. Cooper B-Line:
a. #H16A Series, Redi Rail
2. Or equal, no known equal

2.8 FIBER TROUGH

A. Application: Suitable for the support & management of telecommunications (and other low voltage) fiber cables, overhead within Telecommunications Room. Also overhead equipment rack bracing.

B. Type & Material: Channel, Duct Slotted Wall Channel

C. Manufacturer:
1. Panduit:
2. Or equal

2.9 LABEL PLATES, FOR EQUIPMENT RACKS

A. Label plate shall be suitable to affix onto top angle of equipment rack or onto the top front of a frame/cabinet.

B. Label plate shall be ‘engrave-able’ stock melamine plastic laminate substrate.

C. Size (minimum): 4-inch high by 6 inches long by 1/16-inch thick

D. Color: black

E. Lettering shall be white, engraved, 2-inch high

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with the Execution requirements of Section 27 00 00.

3.2 EXAMINATION AND PREPARATION

A. Prior to installation, verify equipment rooms are suitable for the construction scope of this section. Schedule work to prevent damage caused by other trades during the course of that other construction.

B. Prepare surfaces, such as floors, for permanent installation of products, such as racks.

3.3 INSTALLATION

A. Rack/Cabinet Bays
   1. Provide 7-foot high rack bays in telecommunications rooms.
   2. Equipment Racks and Cabinets
      a. Provide parts and accessories required to complete each rack. Completely assemble racks, according to manufacturer's instructions.
      b. Anchoring/Bracing
         1) Anchor racks to the structural floor at four points.
         2) Brace racks overhead to overhead cable support.
   3. Vertical Management Sections
      a. Provide vertical management sections.
      b. Bolt vertical management sections to the equipment racks at the points designed by the manufacturer and per the manufacturer's installation instructions.
   4. Tolerances:
      a. Equipment Rack: Verify dimensions to establish proper clearances as follows:
         1) Front: 40" clearance from channel's front mounting flange.
         2) Back: 57" clearance from channel's back mounting flange.
      b. Provide the correct amount of space between each rack for proper installation (according to manufacturer's written instructions) of the vertical management sections.
   5. Horizontal Management Panels
      a. Provide horizontal management panels. If not shown, provide one management panel above each patch panel and on below the bottom patch panel in each rack bay where patch panels occur.
      b. Provide fasteners and parts required to complete the installation.
   6. Accessories
      a. Furnish rack mounting screws – Turn over 1 bag of screws per Telecom Room, to the owner at the end of the project.

B. Overhead Cable Support
   1. Provide support devices (e.g., brackets and threaded rod with strut) for overhead cable management system; install per the manufacturer's instructions and fastened to the wall or ceiling using appropriate fasteners.
   2. Provide parts required for complete installation (e.g., mounting brackets, splice kits, hardware, etc.).
   3. Tolerances
      a. Install overhead cable support centered over the equipment rack, or as shown on the Drawings.
   4. Interface with Other Work: Coordinate the installation of the overhead cable support with other trades. Trapeze supports and 'hanger rods' ("all-thread"), for example, may be shared to lower overall construction cost.
   5. Provide cable retaining post every 18" along cable runway pathways.
   6. Provide cable drop outs at any point cables transition to or from the cable pathway.

C. Vertical Cable Support
   1. Provide cable runway installed vertically for use to support cables routing vertically within telecommunications rooms.
   2. Provide parts required for complete installation (e.g., vertical mounting brackets, bolts, etc.).
   3. Install the cable runway such that the rungs are facing outward (the greater distance from the rung to the stringer edge is facing inward

D. Vertical Power Strips in Cabinets/4-Post Frames
   1. Provide two vertical power strips per cabinet, 4-post. Install the power strips at the back of the cabinets, one on each side. Install the power strips to the rear rails of the 4-post relay racks, one on each side. Provide fasteners and parts required to complete the installation.
   2. Route the input cords within designated cable management and provide cord fasteners to prevent movement of the input cord. Plug the input cord into the receptacle designated by the Owner / Owner's Representative.
   3. Provide temperature modules in the following locations.
      a. TR Racks – Provide one temperature module in each room. Mount module to the front rail in the middle a rack that is centrally located in the room).

E. Blanking Panels
   1. Provide blanking panels in all unused spaces in Network and Server cabinets.
   2. Coordinate with the owner before blanking panel installation.
   3. Provide 570 2U blanking panels and 380 1U blanking panels. Turn over all unused blanking panels to the owner at the end of the project.

3.4 LABELING

A. General Requirements: Labeling and identifier assignment shall conform to TIA/EIA-606-A Administration Standard and as approved by Owner before installation.

B. Equipment Rack Label Requirements: Provide one label plate per rack and cabinet/frame. Permanently affix label plate and position as shown on the Drawings; if not shown on the Drawings, center the label plate on the rack's front top angle or the cabinet's top front frame.

C. Identifier Assignment
   1. Equipment Racks
      a. Prefix: "RACK"
      b. First field: the TR room identity; for example: "02.S".
      c. Second field: the rack number; for example: "01".
      d. Example; "RACK 02.S-01"

3.5 FINAL INSPECTION AND CERTIFICATION

A. Punch the Work of this Section compliant to the requirements of Section 27 00 00.

B. Comply with system acceptance and certification requirements of Section 27 00 00.

END OF SECTION

SECTION 27 13 13

COMMUNICATIONS TWISTED PAIR CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Backbone and horizontal twisted pair cabling

B. Related Sections
   1. Comply with the Related Sections requirements of Section 27 00 00
   2. 27 08 11 Communication Twisted Pair Testing

1.2 REFERENCES

A. Comply with the References requirements of Section 27 00 00.

1.3 DEFINITIONS

A. Refer to Section 27 00 00 for Definitions.

B. In addition, define the following list of terms as used in this specification as follows:
   1. “ALVYN”: sheath type consisting of corrugated polymer-coated aluminum shield with and adhered flame retardant jacket
   2. “ARMM”: Bell system cable type (shielded riser)
   3. “CAT3”: Category 3 [UTP] performance grade
   4. “CAT5E”: Category 5 Enhanced [UTP] performance grade
   5. “CAT6”: Category 6 [UTP] performance grade
   6. “CAT6A”: Category 6 Augmented [UTP] performance grade
   7. “Channel”: End to end transmission path; e.g., the entire portion of the horizontal cabling to each outlet consisting of the Permanent Link, line cord (at the workstation), patch cord, and, if a full crossconnection is implemented, the crossconnect termination/connecting apparatus and equipment cord.
   8. “CMP”: Communications Media Plenum [NEC plenum rating]
   9. “CMR”: Communications Media Riser [NEC riser {non-plenum} rating]
   10. “FEP”: Fluorinated Ethylene Propylene
   11. “FTP”: Foiled Twisted Pair
   12. “ISP: - Inside Plant Cabling
   13. “OSP” Outside Plant Cabling
   14. “PE”: Polyethylene
   15. “Permanent Link”: Test configuration for a horizontal cabling link excluding patch cords, equipment cords, and line cords; e.g., the ‘permanent’ portion of the horizontal cabling to each outlet consisting of cable, consolidation point (if used), termination/connecting apparatus in the TRs and the connector at the outlet.
   16. “PIC” Plastic Insulated Conductor
   17. “PVC”: PolyVinyl Chloride
   18. “PVDF”: Polyvinylidene fluoride
   19. “UTP”: Unshielded Twisted Pair

1.4 SYSTEM DESCRIPTION

A. Work Covered Under Other Sections
   1. Pathways: The communications pathways (cable tray, conduits, stubs, etc.) work will be covered under another Section. Refer to the Drawings for size/capacity and route information.

2. Rooms: Build out (e.g., backboards, overhead and vertical cable runway, etc.) of the telecommunications rooms will be covered under another Section. Refer to the Drawings for build out information.

B. Base Bid Work
   1. Provide engineering, labor, materials, apparatus, tools, equipment, and transportation required to make a complete working communications Backbone and Horizontal Twisted Pair Cabling System installation described in this Section and shown on related Drawings. Consider Backbone and Horizontal Cabling as shown on Drawings as base bid work, unless otherwise noted. This includes terminations at both ends.
   2. In general, the base bid work includes:
      a. Submittals
      b. Backbone and Horizontal cables, terminations, and outlets
      c. Cable management
      d. Patch cords and crossconnections
      e. Cable identification tags and system labeling
      f. Record Documents
      g. Warranty

1.5 SUBMITTALS

A. Comply with the Submittals article of Section 27 00 00 for procedural, quantity, content, and format requirements.

B. Substitutions
   1. Conform to substitutions requirements and procedure in Section 27 00 00.

C. Submittal Requirements at Start of Construction:
   1. Product Data Submittal, indicating conformance with NEC, UL, TIA/EIA listings, certifications and specifications.
   2. Sample Submittal, consisting of the following components:
      a. Type “A” Outlet Sample – one fully configured outlet including faceplate, modular jacks, and label
      b. Cable Label Sample
   3. Schedule Submittal, consisting of proposed schedule of work. This schedule may be combined with the schedule developed for 27xxxx series Sections
   4. Shop Drawings Submittal, consisting of proposed changes to cable routing, or termination locations/configurations

D. Submittal Requirements at Closeout:
   1. As-Built Drawings
   2. Cable ID –to– Office Number Key: Submit a “cable ID-to-Office number key” as an electronic file in an MS-Excel spreadsheet file format containing a list of every cable identifier associated with the final office number
   3. Crossconnection records/cut sheets
   4. O & M Manuals per section 27 00 00

E. Posted Documentation
   1. Post one full size plot of as-built drawings, specifically the floor plans and (as applicable) reflected ceiling plans, within TR’s such that show the TR’s serving area. Coordinate location with Owner.

1.6 QUALITY ASSURANCE

A. Comply with Quality Assurance requirements of Section 27 00 00.

B. Contractor Qualifications
   1. In addition to the Contractor Qualifications requirements of Section 27 00 00, the Contractor shall be certified by the manufacturer to provide the cabling system (proposed, submitted, and approved) and to provide an extended warranty. Submit satisfactory evidence of certification in the form of a current letter or certificate from the manufacturer as part of the bid.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with the Delivery, Storage and Handling requirements of Section 270000.

1.8 WARRANTY

A. The horizontal cabling system, as specified in this section, shall carry a 15-year (minimum) extended system warranty. This extended warranty shall cover parts and labor for the duration of the extended warranty. This extended warranty shall also cover electrical performance of cabling system to the specific category per ANSI/TIA/EIA-568-C performance criteria for horizontal cabling.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

1. Panduit cabling system
2. CommScope SYSTIMAX
3. Belden cabling system
4. Berktek/Ortronics cabling system

2.2 SUBSTITUTIONS

A. Comply with the Substitutions requirements of Section 270000.

2.3 BACKBONE UNDERGROUND CABLES

A. Application:
   1. Cable shall be suitable for outdoor installations, within underground conduit.
   2. Each and every cable run shall be a continuous single cable, homogenous in nature.
   3. Cable type shall be twisted pair PIC, filled core, with an “ASP” sheath and compatible with Bell System type “ANMW” or RUS type “PE89”.

B. Conductors:
   1. Annealed solid copper, 24 AWG
   2. Fully insulated conductors consisting of an inner layer of expanded polyolefin, covered with an outer layer (skin) of solid polyolefin.
   3. Conductors twisted into pairs. Twisted pairs are stranded into 25-pair bundles and into units (and super units, if required by pair count).
   4. Color Coding: Twisted pairs and units (supper units, if necessary) individually color-coded to industry standards (ANSI/ICEA Publication S-80-576, and EIA-230).

C. Core and Sheath:
   1. Cable core shall have a tape applied longitudinally (wrapped around its entirety).
      a. Tape Material: non-hydroscopic polypropylene film, or equivalent
   2. Cable core and sheath shall be flooded with filling compound to protect against moisture penetration.
      a. Filling compound: “FLEXGEL”, or equivalent
   3. Sheath Type: “ASP”. Sheath shall consist of a shield and an outer jacket.
      a. Shield: Dual corrugated tape of inner aluminum and outer steel longitudinally applied, with a locking overlap.
      b. Jacket: PE, bonded to shield

D. Manufacturers:
1. General Cable
a. 24 AWG, ANMW type, black
2. Or equal

2.4 BACKBONE ISP UTP, PLENUM (CMP) RATED (FOR USE IN RETURN AIR PLENUMS)

A. Application:
1. Suitable for indoor installation, between floors in vertical riser system, under access flooring, and through overhead ceiling space (in cable tray, conduit, & hangers).
2. Each and every cable run shall be a continuous single cable, homogenous in nature. Splices are not permitted anywhere.
3. UTP. CAT3

B. Conductors and Insulation:
1. Annealed solid copper, 24 AWG
2. Fully insulated, consisting of a flame-retardant PVC or other thermoplastic.
3. Conductors shall be twisted into pairs. Twisted pairs shall be stranded into 25-pair bundles.
4. Color Coding: Twisted pairs and units individually color-coded to industry standards (ANSI/ICEA Publication S-80-576, and EIA-230).

C. Core and Sheath:
1. Cable sheath shall consist of an overall flame-retardant PVDF, or equivalent, jacket.

D. Cable shall be NEC rated as CMP, and UL listed as such.

E. Electrical performance of the twisted pairs and overall cable shall comply with TIA/EIA-568-A requirements for Category 3 UTP cabling.

F. Manufacturers:
1. General Cable
a. CAT3 UTP Cable, white
b. Or equal

2.5 BACKBONE ISP UTP, RISER (CMR) RATED (TO BE USED WHERE CODE ALLOWS)

A. Application:
1. Suitable for indoor installation, between floors in vertical riser system, under access flooring, and through overhead ceiling space (in cable tray, conduit, & hangers).
2. Each and every cable run shall be a continuous single cable, homogenous in nature. Splices are not permitted anywhere.
3. UTP CAT3.

B. Conductors and Insulation:
1. Annealed solid copper, 24 AWG
2. Fully insulated, consisting of a flame-retardant PVC or other thermoplastic.
3. Conductors shall be twisted into pairs. Twisted pairs shall be stranded into 25-pair bundles.
4. Color Coding: Twisted pairs and units individually color-coded to industry standards (ANSI/ICEA Publication S-80-576, and EIA-230).

C. Core and Sheath:
1. Cable sheath shall consist of an overall flame-retardant PVC, or equivalent, jacket.

D. Cable shall be NEC rated as CMR, and UL listed as such.

E. Electrical performance of the twisted pairs and overall cable shall comply with TIA/EIA-568-A requirements for Category 3 UTP cabling.

F. Manufacturers:
1. General Cable

a. CAT3 UTP Cable, gray
b. Or equal

2.6 HORIZONTAL CABLE – CAT6A UTP, PLENUM (CMP) RATED (FOR USE IN RETURN AIR PLENUMS)

A. Application: Suitable for indoor installation, within ceiling space in primary and secondary pathways, within access/raised floor space.

B. Conductors:
1. Insulated Conductors: 23 AWG solid copper, fully insulated with a flame retardant thermoplastic material (material = FEP, or equivalent).
2. Twisted Pairs: Two insulated conductors "twisted" into a "pair" (twisted pair) with individually color-coded twisted pairs to industry standards (ANSI/ICEA Publication S-80-576-1994, and EIA-230).

C. Cable Sheath:
1. Outer Jacket: seamless outer jacket (material = LS-PVC, or similar) applied to and completely cover the internal components (twisted pairs).
2. Flame Rating: NEC (Article 800) rated as CMP, and UL listed as such.

D. Electrical Performance: Meet or exceed TIA/EIA-568-C.2, ISO 11801 Class E Edition 2.1, and IEEE Std. 802.3an channel requirements for supporting 10GBASE-T.

E. Color: See color table in Part 3 for cable colors

a. Manufacturer:

1) Panduit
a) #PUP6A04IG-UG; CAT6A 4 pair UTP cable "10Gig", CMP – Gray

2.7 HORIZONTAL CABLE – CAT6A UTP, RISER (CMR) RATED (TO BE USED WHERE CODE ALLOWS)

A. Application: Suitable for indoor installation, below ceiling space in cable tray between server room cabinets.

B. Conductors:
1. Insulated Conductors: 23 AWG solid copper, fully insulated with a flame retardant thermoplastic material (material = HDP, or equivalent).
2. Twisted Pairs: Two insulated conductors "twisted" into a "pair" (twisted pair) with individually color-coded twisted pairs to industry standards (ANSI/ICEA Publication S-80-576-1994, and EIA-230).

C. Cable Sheath:
1. Outer Jacket: seamless outer jacket (material =-PVC, or similar) applied to and completely cover the internal components (twisted pairs).
2. Flame Rating: NEC (Article 800) rated as CMR, and UL listed as such.

D. Electrical Performance: Meet or exceed TIA/EIA-568-C.2, ISO 11801 Class E Edition 2.1, and IEEE Std. 802.3an channel requirements for supporting 10GBASE-T.

E. Color: See color table in Part 3 for cable colors

a. Manufacturer:

1) Panduit
a) #PUR6A04IG-UG; CAT6A 4 pair UTP cable "10Gig", CMP – Gray

2.8 HORIZONTAL CABLE – CAT5E UTP, PLENUM (CMP) RATED (FOR USE IN RETURN AIR PLENUMS)

A. Application: Suitable for indoor installation, within ceiling space in primary and secondary pathways, within access/raised floor space.

B. Conductors:
1. Insulated Conductors: 24 AWG solid copper, fully insulated with a flame retardant thermoplastic material (material = FEP, or equivalent).
2. Twisted Pairs: Two insulated conductors "twisted" into a "pair" (twisted pair) with individually color-coded twisted pairs to industry standards (ANSI/ICEA Publication S-80-576-1994, and EIA-230).

C. Cable Sheath:
1. Outer Jacket: seamless outer jacket (material = LS-PVC, or similar) applied to and completely cover the internal components (twisted pairs).
2. Flame Rating: NEC (Article 800) rated as CMP, and UL listed as such.

D. Electrical Performance: Meet or exceed TIA/EIA-568-B requirements for CAT5E UTP cabling.

E. Color: See color table in Part 3 for cable colors

a. Manufacturer:

1) Panduit
a) #PUP5504BU-UY; CAT5E 4 pair UTP cable "TX5500", CMP – Blue #PUP5504VL-UY; CAT5E 4 pair UTP cable "TX5500", CMP – Violet

2.9 HORIZONTAL CABLE – CAT5E UTP, RISER (CMR) RATED (TO BE USED WHERE CODE ALLOWS)

A. Application: Suitable for indoor installation, below ceiling space in cable tray between server room cabinets.

B. Conductors:
1. Insulated Conductors: 24 AWG solid copper, fully insulated with a flame retardant thermoplastic material (material = HDP, or equivalent).
2. Twisted Pairs: Two insulated conductors "twisted" into a "pair" (twisted pair) with individually color-coded twisted pairs to industry standards (ANSI/ICEA Publication S-80-576-1994, and EIA-230).

C. Cable Sheath:
1. Outer Jacket: seamless outer jacket (material =-PVC, or similar) applied to and completely cover the internal components (twisted pairs).
2. Flame Rating: NEC (Article 800) rated as CMR, and UL listed as such.

D. Electrical Performance: Meet or exceed TIA/EIA-568-B requirements for CAT5E UTP cabling..

E. Color: See color table in Part 3 for cable colors

a. Manufacturer:

1) Panduit
a) #PUR5504BU-UY; CAT5E 4 pair UTP cable "TX5500", CMP – Blue
b) #PUR5504YL-UY; CAT5E 4 pair UTP cable "TX5500", CMP – Yellow
c) #PUR5504VL-UY; CAT5E 4 pair UTP cable "TX5500", CMP – Violet

2.10 HORIZONTAL CABLE – CAT6 OSP/UNDERGROUND

A. Application: Suitable for outdoor installation, within underground pathways (conduit, pullboxes).

B. Conductors:
1. Insulated Conductors: 23 AWG solid copper, fully insulated with a thermoplastic material (material = PE, or equivalent).
2. Twisted Pairs: Two insulated conductors "twisted" into a "pair" (twisted pair) with individually color-coded twisted pairs to industry standards (ANSI/ICEA Publication S-80-576-1994, and EIA-230).

C. Core & Sheath:
1. Twisted pairs shall lie individually within a polyolefin fluted center member.
2. Filled: Cable core and sheath flooded with filling compound to protect against moisture penetration. Filling compound: "FLEXGEL", or equivalent.
3. Outer Jacket: seamless outer jacket (material = PE, or similar) applied to and completely cover the internal components (twisted pairs), embedded with UV inhibitors, and black in color.

D. Electrical Performance: Meet or exceed TIA/EIA-568-B.2-1 and ISO/IEC 11801 requirements for CAT5e UTP cabling.

E. Manufacturer:
1. General Cable
a. CAT6 4 pair UTP cable OSP

2.11 MODULAR PATCH CORDS – CAT6A 10 GIG RATED

A. Application: Suitable for indoor installation within a telecommunications room or workstation environment.

B. Cords assembled from a single, continuous length of cordage, homogenous in nature, and terminated at both ends via 8 position modular plugs. Splices are not permitted anywhere.

C. Cordage
1. Insulated Conductors: 24AWG solid copper, fully insulated with a flame retardant thermoplastic material (such as PVC, or equivalent).
2. Twisted Pairs: Two insulated conductors "twisted" into a "pair" (twisted pair), and individually color coded.
3. Unshielded sheath and flame-retardant polyvinyl chloride (PVC) jacketed.
4. Flame Rating: NEC CM (or higher) rated, and UL listed as such.

D. Electrical Performance: Meet or exceed TIA/EIA-568-C.2, ISO 11801 Class E Edition 2.1, and IEEE Std. 802.3an channel requirements for supporting 10GBASE-T.

E. Length: Refer to Outlet Schedule for length requirements.

F. Color: See color table in Part 3 for patch cord colors

G. Manufacturer:
1. Panduit
a. #UTP6ASDxxx; TX6A 10Gig UTP Patch Cords.

2.12 MODULAR PATCH CORDS – CAT5E RATED

A. Application: Suitable for indoor installation within a telecommunications room or workstation environment.

B. Cords assembled from a single, continuous length of cordage, homogenous in nature, and terminated at both ends via 8 position modular plugs. Splices are not permitted anywhere.

C. Cordage
1. Insulated Conductors: 24 AWG stranded copper, fully insulated with a flame retardant thermoplastic material (such as PVC, or equivalent).
2. stranded

3. Twisted Pairs: Two insulated conductors “twisted” into a “pair” (twisted pair), and individually color coded.
4. Unshielded sheath and flame-retardant polyvinyl chloride (PVC) jacketed.
5. Flame Rating: NEC CM (or higher) rated, and UL listed as such.

D. Electrical Performance: Meet or exceed TIA/EIA-568-B requirements for CAT5E UTP cabling.

E. Length: Refer to Outlet Schedule for length requirements.

F. Color: See color table in Part 3 for patch cord colors

G. Manufacturer:
   a. Panduit# UTPCHxxx; TX5e UTP patch cords.

2.13 CROSSCONNECT WIRE

A. Crossconnect wire shall be suitable for installation within a telecommunication facility and fully compatible with the termination apparatus specified within this Section.

B. Crossconnect wire shall be manufactured from a single, continuous length of insulated wire, homogenous in nature. Splices are not permitted anywhere. Factory splices of insulated conductors are expressly prohibited.

C. Conductors:
   1. Insulated Conductors: 24 AWG conductors of solid copper. Fully insulated conductors with a flame retardant thermoplastic material (such as PVC, or equivalent).
   2. Twisted Pairs: Two insulated conductors “twisted” into a “pair” (twisted pair), individually color-coded.

D. Manufacturer:
   1. General Cable
      a. # 7023864; crossconnect wire, 1 pair, Whi-Red / Red-Whi
      b. # 7023708; crossconnect wire, 1 pair, Whi-Blu / Blu-Whi
   2. Or equal

2.14 TERMINATION APPARATUS – “110 BLOCK” TYPE (EF ROOM)

A. Application:
   1. Termination apparatus shall be “110 block” type.
   2. Termination apparatus shall be suitable for installation within a telecommunication facility for the termination of the backbone twisted pair cables specified within this Section.
   3. Termination apparatus shall be vertically oriented and suitable for wall-mount and/or rack-mount installations.
   4. Termination apparatus, accompanied by the quantity of management panels, shall provide for both horizontal and vertical routing of cords and crossconnect wires, as shown on the drawings.

B. Manufacturer:
   1. Panduit
      a. # P110KT9005Y; 110 Block kit, 900 pair, 5-pair based
   2. Or equal

2.15 TERMINATION APPARATUS – MODULAR FACEPLATE PATCH PANELS

A. Application: Modular patch panels shall be suitable for installation within a telecommunication room for the termination of the Horizontal Cables specified herein. Modular patch panels shall be horizontally oriented for a rack-mounted configuration. Modular patch panels shall be capable of supporting, organizing, labeling and patching/ crossconnecting between the horizontal termination field and the equipment termination field. Modular patch panels shall be supplied with an integrated strain relief bar in the rear of the panel for cable management.

B. 48-port angled patch panel with labels, supplied with twelve factory installed CFFPL4 type front removable snap-in faceplates.

C. Manufacturer:
1. Panduit
a. #CPPLA48WBLY; Mini-Com Modular Faceplate Patch Panels
b. #SRB19BLY: Strain Relief Bar/Manager
2. Or equal
a.

2.16 BEP PROTECTOR – FOR DATA CIRCUITS

A. Application: Protectors suitable for installation within a telecommunication facility for the termination of the Horizontal OSP/Underground cables intended for data circuits.

B. Protector shall be UL 497 listed.

C. Solid-state protection with clamping voltage of 16VDC

D. Protector shall have a 4-pair capacity (minimum) with 110-type input and 110-type output

E. Manufacturer:
1. CommScope SYSTIMAX
a. #760028373; OSP protector, CAT6 rated, 2-cable capacity
b. #760033951; OSP protector, CAT6 rated, for PoE circuits, 2-cable capacity
2. Or equal

2.17 BEP PROTECTOR – FOR ANALOG VOICE CIRCUITS

A. Application: Protectors suitable for installation within a telecommunication facility for the termination of the Horizontal OSP/Underground cables intended for analog (voice) circuits.

B. Protector shall be UL 497 listed.

C. Solid-state protection with clamping voltage of 235VDC

D. Protector shall have a 4-pair capacity (minimum) with 110-type input and 110-type output

E. Manufacturer:
1. CommScope SYSTIMAX
a. #760031708; OSP protector, CAT6 rated, for analog voice circuits, 2-cable capacity
2. Or equal

2.18 SPLICE CLOSURES AND ACCESSORIES

A. Splice Closure – Building Entrance Type
1. Application: Splice closure system shall be suitable for indoor installation within an entrance facility for splicing between OSP and ISP cable.
2.2. Closure:
a. Re-enterable
b. Through-splice or butt-splice configurations will be accepted.
c. Solid sleeve, or slip sleeve acceptable.
d. End caps shall accept eight single collared or having multiple holes.

B. Manufacturer:
1. 3M Telecom Systems
a. #5-26, up to 600 pair, solid closure
b. #5DS-26, up to 600 pair, split closure
c. #C5-100-6, end caps to be sized to cable entry and exits

d. #4460; shield bond connector for cables 100-pair or larger
e. #4460-D; shield bond connector for cables 100-pair or smaller
f. #25T Ground Braid or #25T Ground Braid with Eyelets

2. Or equal

2.19 SPLICE MODULES

A. Splice Module – 710 Dry Straight Type
1. Application: Cable transition (OSP to ISP) in telecom rooms.
2. Modules shall accept mixed solid wire gauges (26 AWG – 19 AWG) and mixed insulation types (PIC, PVC, pulp or paper) up to maximum insulation outside diameter of (.70).
3. Manufacturer:
a. 3M Telcom Systems
1) #3M710-SD1-25; 25-pair 710 dry straight splicing module
b. Or equal

B. Splice Module – 710 Filled Straight Type
1. Application: In-line or branch splicing of OSP cables in underground vaults or manholes.
2. Modules shall accept mixed solid wire gauges (26 AWG – 19 AWG) and mixed insulation types (PIC or PVC) up to maximum insulation outside diameter of (.70).
3. Modules shall be 'filled' with water resistant compound.
4. Manufacturer:
a. 3M Telcom Systems
1) #3M710-SC1-25; 25-pair 710 filled straight splicing module
b. Or equal

2.20 BEP TERMINAL – SWIVEL STUB INPUT, 110 OUTPUT

A. Application: BEP terminal shall be suitable for indoor installation, within a telecom room (such as an Entrance Facility or 'MPOE'). BEP terminals shall provide termination of the backbone twisted pair cables specified within this Section, shall protect premises equipment against induced voltages and stray currents, and shall accept '5-pin' protector modules specified within this Section.

B. Configuration: BEP terminal shall be designed for a wall-mounted configuration, and shall have the capacity to accept 100-pair incoming and outgoing pairs.

C. Input: 100-pair 26 AWG UTP 'fusible' swivel stub. Output: 110 type punch down.

D. Manufacturer:
1. CommScope SYSTIMAX
a. #489ACC1-100; 100-pair BEP terminal, swivel stub input, 110 output
2. Or equal

2.21 BEP MODULES – '5-PIN' TYPE, WITH SNEAK CURRENT PROTECTION

A. Application: suitable for installation into BEP terminals specified herein.

B. Type: standard 5-pin type overvoltage device, solid state.

C. DC Breakdown Voltage: 220 V; response time: <100 nsec.

D. Sneak Current: heat coil type, 1 A; response time: < 15 sec.

E. Manufacturer:
1. CommScope SYSTIMAX
a. #4C1S; solid-state module, 220V – 300V breakdown voltage with sneak current protection, black
2. Or equal

2.22 MODULAR CONNECTOR / 8-POSITION JACK – CAT6A 10GIG RATED

A. Application: Modular connectors shall be 8-position modular jacks, and shall be compatible with the specified CAT6 and CAT6A UTP 4-pair cables both electrically and physically.

B. Mechanical Performance: Modular connectors shall meet or exceed TIA/EIA-568-C.2 5.7.

C. Electrical Performance: Modular connectors shall meet or exceed TIA/EIA-568-C.2 6.8 and ISO/IEC 11801 requirements for CAT6A UTP cabling.

D. Wiring: Modular connectors shall be T568B wired.

E. Manufacturer:
1. Panduit
a. #CJ6X88TGIG; Mini-Com TX6A 10 Gig UTP Jack Modules CAT6A RJ45, 10 Gb/s, 8-position, 8-wire universal module" jack, white

2.23 WORK AREA OUTLETS

A. Faceplates for Standard Flush-Mount Outlets
1. Application: Faceplates shall be suitable for indoor installation for standard 1-gang and 2-gang flush-mount devices.
2. Faceplates shall have 2, 3, 4, or 6 ports, and shall include required accessories, such as icons, blank inserts, label windows and labels.
3. Color: White
4. Manufacturer:
a. Panduit
1) #; faceplate, 1-gang, 1 port, white
2) #; faceplate, 1-gang, 2 port, white
3) #; faceplate, 1-gang, 4 port, white
4) #; faceplate, 1-gang, 6 port, white

B. Surface Outlets
1. Application: Surface outlets shall be suitable for indoor installation for surface-mount device and shall be fully compatible with the specified modular connectors/jacks.
2. Color: White
3. Manufacturer:
a. CommScope SYSTIMAX
1) #M101SMB-B-262; surface outlet box, 1 port, white
2) #M202SMB-262; surface outlet box, 2 ports, white
3) #M202 Plenum SMB-262; surface outlet box, 2 ports, plenum rated, white
4) #M204SMB-262; surface outlet box, 4 ports, white
b. Or equal

C. "Poke-Thru" Floor Outlets
1. Adapters that are fully compatible with both the "poke-thru" type floor outlets and the specified connectors / connector accessories.
2. Manufacturer:
a. Wiremold
1) #CM2-U2ATT; bezel adapter, accepts 2 SYSTIMAX M-Series connectors
2) #CM2-U1ATT; bezel adapter, accepts 1 SYSTIMAX M-Series connectors
b. Or equal

D. Faceplates for Furniture Feeds
1. Application: Suitable for indoor installation for standard 1-gang flush-mount device box with round opening allowing cables to freely exit (towards furniture system entry).
2. Color: TBD by owner once furniture is chosen
3. Manufacturer:

a. TBD once furniture is chosen

2.24 CABLE LABELS

A. Labels shall be machine printable with a laser printer, ink jet printer, thermal transfer printer, or hand-held printer.

B. Label shall fully wrap around the cable's jacket, shall be adhesive-backed labels, and shall have a self-laminating feature

C. Size: 1" x 0.5" printable area, minimum

D. Color: white

E. Manufacturer:
   a. Panduit
      1) #S100X150YAJ; cable labels, 1.0" x 1.5", for cable diameters 0.16"-0.32", white
      2) #S200X225YAJ; cable labels, 2" x 2.25", for cable diameters 0.24"-0.48", white
      3) #S200X400YAJ; cable labels, 2" x 4", for cable diameters 0.32"-0.95", white
   b. Or equal

2.25 MISCELLANEOUS COMPONENTS

A. Velcro Cable Ties
   1. Width: .75".
   2. Color: Velcro cable ties the same color as the cable to which it is being applied.
   3. Manufacturers:
      a. Panduit "Tak-Ty" series cable ties
      b. Panduit
         1) #HLS-15R-0; black, 15' roll, cut to length.
      c. Or Equal

B. Plenum Cable Ties
   1. Application: for use in plenum or air handling spaces
   2. Color: maroon or other distinctive non-white color
   3. Manufacturer:
      a. Panduit
         1) #PLT1M-xxxx
         2) #PLT2S-xxxx
         3) #PLT3S-xxxx
      b. Or equal.

2.26 OSP DUCT PLUGS

A. Multi-Port Duct plugs
   1. Manufacturers:
      a. Tyco
         1) #40B167S; 4-inch triplex plug
         2) #40Q136S; 4-inch quadplex plug
      b. Carlon
      c. Condux
      d. Or equal

B. Port/Cable plugs, for securing one cable per duct plug port.
   1. Manufacturer:
      a. Tyco
         1) #10S035S; simplex plug for one fiber optic cable in 1-inch ID port
         2) #11S057SB; simplex plug for one fiber optic cable fiber in 1¼-inch ID port

3) #10D104U; blank port plug for 1-inch ID port
4) #12D148U; blank plug for 1¼-inch ID port

b. Carlon
c. Or equal

C. Blank Duct Plug for 4" Conduit
1. Manufacturer
a. Tyco
1) # JM-BLA-40D402U; blank duct plug for 4" conduits
b. Carlon
c. Or equal

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with the Execution requirements of Section 270000.

3.2 EXAMINATION AND PREPARATION

A. Rooms: Prior to installation, verify equipment rooms are suitable to accept the horizontal cables and terminations.

B. Pathways: Prior to installation verify that pathways and supporting devices, provided under other sections, are properly installed, and that temporary supports, devices, etc., have been removed. Verify dimensions of pathways, including length (for example, "True Tape" the conduits).

C. Cable Integrity: Prior to installation, verify the cable's integrity – both sheath and conductors. Documentation of pre-installation testing is not a close out requirement, and is the responsibility of the Contractor.

3.3 INSTALLATION

A. Backbone Cable Installation and Routing
1. Cable runs shall have continuous sheath continuity, homogenous in nature. Splices are not permitted anywhere.
2. Placement
a. Place cables within designated pathways.
b. Maintain a minimum bend radius of 6 times the cable diameter during and after installation.
c. Maintain pulling tension within manufacturer's limits.
d. Place and suspend cables in a manner to protect them from physical interference or damage. Place cables with no kinks, twists, or impact damage to the sheath. Replace cables if damaged during installation
e. Place a pull rope along with cables where run in conduit and spare capacity still exists in the conduit. Tie off ends of the pull rope.
3. Routing
a. When routing horizontally within telecommunications rooms, utilize the overhead cable support. When routing vertically within telecommunications rooms, utilize the vertical cable support and provide cable ties every 24 inches on center using.
b. Route cables a minimum of 6" away from power sources to reduce interference from EMI.
c. Termination
d. Provide 15 feet cable slack loop at each end of the run. Store slack in overhead cable support or as noted on Drawings.
e. Properly relieve strain from cables at termination points per manufacturer's instructions.
f. Terminate twisted pairs onto the termination apparatus in accordance with manufacturer's latest instructions and TIA/EIA-568-B standard installation practices.

g. Perform post-installation testing as described in the Telecommunication Testing specification.

B. OSP Interbuilding Backbone Cable
   1. Cable runs shall have continuous sheath continuity, homogenous in nature, between either termination points or designated splices points. Only splices as noted on the Construction Documents are permitted.
   2. Placement
      a. Place cables within designated pathways.
      b. Maintain a minimum bend radius of 6 times the cable diameter during installation.
      c. Maintain pulling tension within manufacturer's limits. Only use UL approved cable-pulling compounds when necessary to reduce pulling tensions.
      d. Protect cable during installation. Place and suspend cables in a manner to protect them from physical interference or damage. Place cables with no kinks, twists, or impact damage to the sheath. Replace cable if damaged during installation.
      e. Neatly dress and organize cables in the cable routing facilities, and fastened to support devices via tie wraps.
      f. Place a pull rope along with cables where run in conduit and spare capacity still exists in the conduit. Tie off ends of the pull rope.
   3. Routing:
      a. When routing horizontally within telecommunications rooms, utilize the overhead cable support; route backbone cables to avoid crossing over horizontal cabling or horizontal cabling crossing backbone cabling. When routing vertically within telecommunications rooms, utilize the vertical cable support and provide cable ties every 24 inches on center using.
      b. Route cables a minimum of 6" away from power sources to reduce interference from EMI.
   4. Termination
      a. Provide 15 feet cable slack loop at each end of the run. Store slack in overhead cable support or as noted on Drawings.
      b. Properly strain relieve cables at designated points per manufacturer's instructions.
      c. Terminate copper pairs at both ends on the specified <BEP> <termination apparatus>. Perform terminations in accordance with manufacturer's instructions and TIA/EIA-568-B standard installation practices.
   5. Labeling
      a. Provide labels on each end of the cable, no more than 4" from where the cable enters the specified splice closure or termination apparatus.
      b. Place labels such that they are visible by a technician from a normal stance

C. Duct Plugs
   1. Provide blank plugs in unused ducts.
   2. Provide multi-port duct plugs at duct ends with cables.
   3. Provide cable plugs for each cable. Secure each twisted pair cable at each telecommunications vault, building entrance, and MPOE/ER with a cable plug sized depending upon the outside diameter of the cable.
   4. Provide blank port plug in each used duct port.

D. Horizontal Cable Installation and Routing
   1. Cable runs shall have continuous sheath continuity, homogenous in nature. Splices are not permitted anywhere.
   2. Place cables within designated pathways, such as cable tray,, cable hangers, etc. Do not fasten (such as with cable ties) or attach cables to other building infrastructure (such as ducts, pipes, conduits, etc), other systems (such as ceiling support wires, wall studs, etc), or to the outside of conduits, cable trays, or other non-approved pathway systems.

3. Place and suspend cables and conductors during installation and termination in a manner to protect them from physical interference or damage. Place cables with no kinks, twists, or impact damage to the sheath. Replace cables damaged during installation or termination at no additional cost.
4. Maintain minimum cable length of 15 meters from the termination in the TR to the termination at the user's faceplate (permanent link).
5. No cable length shall exceed 90 meters from the termination point in the TR to the termination point at the work area (permanent link).
6. Route cables at 90-degree angles, allowing for bending radius, along corridors for ease of access.
7. Do not exceed manufacturer's limits for pulling tension.
8. Do not use cable-pulling compounds for indoor installations.
9. Maintain a minimum bend radius of 6 times the cable diameter during and after installation.
10. Route cables under building infrastructure (such as ducts, pipes, conduits, etc); Do not route cables over building infrastructure. The installation shall result in easy accessibility to the cables in the future.
11. Place cables 6", minimum, away from power sources to reduce interference from EMI.
12. For 3" trade size conduits and larger, place a pull string along with cables where run in pathways and spare capacity in the pathway remains. Tie off ends of the pull string (to prevent the string from falling into the conduit).
13. Neatly dress and organize cables using designated cable routing facilities, and fasten to support devices via tie wraps or Velcro-type straps.
14. When exiting the primary pathway (such as cable tray) to the work area, exit via the top of the pathway. Secure the cables to the pathway using an approved cable tie.

E. Cable Routing and Dressing within the TR
1. Place cables within the overhead cable support and, when routing vertically, fasten the cables onto wall-mounted vertical cable support every 24 inches on-center using cable ties.
2. At the rack bay, route cables into the back of the vertical management sections. Divide the cables equally between both sides of an equipment rack such that a cable does not travel past the midpoint of the rack prior to termination.
3. Provide 10 feet, minimum, sheathed cable slack – length not to exceed permanent link maximum length requirement. Place the slack in the overhead cable support.

F. Termination in the TR/ER
1. Provide termination apparatus and accessories required for a complete installation. Install and assemble termination apparatus, accessories and associated management apparatus according to the manufacturer's instructions.
2. Properly strain relieve cables to and at termination points per manufacturer's instructions.
3. Terminate cables and twisted pairs in accordance with manufacturer's latest installation requirements and ANSI/TIA-568-C.0 standard installation practices. Terminate cable pairs onto the termination apparatus. Terminate twisted pairs compliant to T568Bwiring, per ANSI/TIA-568-C.0.
4. Modular Patch Panels and Horizontal Management Panels
    a. Provide quantity of modular patch panels in the TR rooms to support termination of cables served from respective TR. Provide quantity of horizontal management panels as shown on the drawings.
    b. In the ER, provide one 2U horizontal manager in each server cabinet and one 2U horizontal manager between each patch panel in the network patching cabinets plus one manager at the top and bottom of each patching cabinet.
    c. Install and assemble modular patch panels and horizontal management panels according to the manufacturer's instructions.
    d. Install the patch panels and the horizontal management panels as shown on the Drawings.
5. Termination Sequence

a. Backbone Cables: Terminate the backbone multipair cables to the modular patch panels 2 pairs per port. Terminate the 1st pair to pins 5/4 and the 2nd pair to pins 3/6 of the 1st port, etc. Leave pairs 25, 50, 75, and 100 open/unterminated.
b. Horizontal Cables: Terminate the cables in sequential order using the link's identifier starting at the top left and completing a panel before moving to the next panel below.

G. Cable Routing and Dressing at the Work Areas
1. Provide 10 feet, minimum, sheathed cable slack – length not to exceed permanent link maximum length requirement. Place the slack within ceiling space neatly on a cable hanger
2. Routing to Furniture-feeds
a. Route cables from primary or secondary pathway within ceiling through the furniture-feed pathway (stub within wall) into opening at bottom of furniture. Exercise caution to prevent scraping, cutting, or other damage to cable's jacket.
b. Provide spiral wrap around cables from furniture-feed pathway to point where cables enter furniture.
c. Route cables from under-floor through pre-cut access floor panel into opening at bottom of furniture. Exercise caution to prevent scraping, cutting, or other damage to cable's jacket.

H. Termination at the Work Areas
1. Provide device components, connectors, and accessories required for a complete installation. Install and assemble connectors, jacks, adapters, termination apparatus, accessories and associated management apparatus according to the manufacturer's instructions.
2. Provide six inches, minimum, sheathed cable slack behind each workstation outlet faceplate. Coil the slack cable inside the raceway, within the wall, or in the junction box (if used), per the cabling manufacturer's installation standards.

3. Terminate cables and twisted pairs in accordance with manufacturer's latest installation requirements and ANSI/TIA-568-C.0 standard installation practices. Terminate cable pairs onto the connector compliant to T568B wiring, per ANSI/TIA-568-C.0.

I. Termination Apparatus (MPOE/EF)
1. Install the termination apparatus such that the bottom row of terminations is at a height as shown on the Drawings. If no height is shown, install bottom at 24" AFF (+/- 3").
2. Provide accessories required for a complete installation.
3. Mount blocks plumb and square.

J. Building Entrance Splicing Systems
1. Provide entrance splice system as shown on the Drawings, including closure, end caps, splice modules, grounding components, and accessories required for a complete installation. Install splice closure and splice modules per manufacturer's instructions using tools intended for the purpose.
2. Size enclosure based on splice bundle diameter, and size ends caps based on largest cable.
3. Include required accessories, such as collars, grommets, bushings, bonding connectors, etc. for a complete installation.
4. Thoroughly clean and separate binder groups prior to installing splice modules.
5. Apply sealant (such as B-sealant) to the end of the cable where the pairs exit the cable sheath – this to prevent water-blocking gel from leaking out the cable's sheath.
6. Provide labels on each splice module and binder group in splice closure.
7. Grounding and Bonding
a. Bond splice enclosure and cable shield to closet busbar using bonding conductor per manufacturer's instructions and/or TIA-607 requirements.
b. Provide 6 AWG bonding conductor up to 25 feet in length; if longer than 25 feet, size bonding conductor as 1000 circular mils per foot.
8. Fill unused end cap entry holes with appropriate plug (intended for purpose).
9. Attach splice enclosure to vertical cable runway on wall with metal straps.

K. Building Entrance Protection
   1. Provide BEP system as shown on the Drawings, including terminals, modules, and accessories required for a complete installation. Install BEP per manufacturer's instructions.
   2. Install BEP terminals plumb and square, and at height shown on Drawings. If no height is shown, install such that bottom row is at 24" AFF (+/- 3").
   3. Grounding and Bonding
      a. Bond BEP terminal to TMGB in accordance with NEC Article 800, and follow the installation requirements described in Article 800.
      b. Provide 6 AWG bonding conductor up to 25 feet in length; if longer than 25 feet, size bonding conductor as 1000 circular mils per foot.
   4. 4. Labeling
      a. Provide and permanently affix label on the terminal's cover.
      b. Provide label in the label holder at the terminal's "outgoing" connection.
   5. Provide quantity of protector modules to completely populate terminals..

L. Perform post-installation testing as described in the Telecommunication Testing specification (refer to Section 270811). Replace terminations and connectors not passing the required media test.

M. Patching Cords
   1. Provide the following number of fiber optic patch cords
      a. 125% of all ports = 1 MM Station Patch Cord per port
      b. 125% of all ports = Network Patch Cord per port
   2. Neatly dress patch cords within the horizontal and vertical management components. Store cord slack within the vertical management section.
   3. Provide the appropriate length patch cord at each location so there is not an abundance of slack or the patch cord is not pulled tight.
   4. The owner and engineer will provide a patch cord cut sheet at a later time.
   5. Label both ends of each installed patch cord
   6. Turn over all unused patch cords to the owner at the end of the project

3.4 LABELING

A. General Requirements
   1. Labeling, identifier assignment, and label colors shall conform to ANSI/TIA/EIA-606-A Administration Standard and as approved by the Owner before installation.
   2. Permanent labels with machine-generated text (hand written labels will not be accepted).

B. Label Formats
   1. Horizontal Cable Labels
      a. Text Attributes: Black, 1/8" high, minimum, or #12 font size.
      b. Install labels on both ends of cables no more than 4" from the edge of the cable jacket. Install labels such that they are visible by a technician from a normal stance.
   2. Backbone Cable Labels
      a. Text Attributes: Black, 1/8" high, minimum, or #12 font size.
      b. Install labels on both ends of cables no more than 4" from the edge of the cable jacket. Install labels such that they are visible by a technician from a normal stance.
   3. Patch Panel Labels
      a. Use modular patch panel labels included in the product packaging. Request approval by the Engineer for other labels.
      b. Use a label color for the respective field type, per TIA/EIA-606.
      c. Text Attributes: Black, 3/32" high, minimum, or #10 font size.
   4. Termination Block Labels
      a. Use labels included in the product packaging. Any deviation from this requirement must be approved in writing by the Owner.
      b. Use a label color for the respective field type, per TIA/EIA-606-A.
      c. Text Attributes: Black, 3/32" high, minimum, or #10 font size.

5. Outlet Labels
    a. Use outlet labels included in the product packaging. Any deviation from this requirement must be approved in writing by the Owner.
    b. Label Background: White.
    c. Text Attributes: Black, 1/8" high, minimum, or #12 font size.
    d. Install label in the top label window. Leave the bottom label window blank.

C. Identifier Assignment
1. General: Separate label fields as specified by Owner.
2. Horizontal Cables
    a. Request standard from the Owner at the time of installation
3. Outlets
    a. Request standard from the Owner at the time of installation
4. Individual Ports at the Outlets
    a. Request standard from the Owner at the time of installation
5. Individual Termination Positions at Termination Blocks
    a. Request standard from the Owner at the time of installation
6. Individual Ports at Patch Panels
    a. Request standard from the Owner at the time of installation

3.5 FINAL INSPECTION AND CERTIFICATION

A. Punch the Work of this Section compliant to the requirements of Section 27 00 00.

B. Remove cables and replace with new those failing to meet the indicated standards and not passing the testing requirements of Section 270811 with no impact to cost and schedule. The Owner, will not accept the installation until testing has indicated a 100% availability of all cables and conductors. Any deviation from this requirement must be approved in writing by the Owner.

C. Comply with system acceptance and certification requirements of Section 27 00 00.

END OF SECTION

SECTION 27 21 33

COMMUNICATIONS WIRELESS ACCESS POINTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Wireless Access Points (radios in wireless network access system) to support multiple wireless services

B. Related Sections
   1. Comply with the Related Sections requirements of Section 27 00 00.

C. This section includes technology that is rapidly changing. This specification will serve as a basis of design but shall not be ordered until owner approves. Owner reserves the right to request the latest technology at the time of approval in which case a credit for the basis of design system will be given to the owner for components, equipment or systems not used. Credit shall be actual bid price without any deductions of any kind including restocking fees.

1.2 REFERENCES

A. Comply with the References requirements of Section 27 00 00.

B. In particular or addition to the codes and standards listed in Section 27 00 00, comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
   1. Federal Communications Commission (FCC) Title 47 of the Code of Federal Regulations (CFR):
      a. Part 15: Radio Frequency Devices
      b. Part 24: Personal Communications Services
      c. Part 27: Miscellaneous Wireless Communications Services

1.3 DEFINITIONS

A. Definitions as described in Section 27 00 00 shall apply to this section.

B. In addition to those Definitions of Section 27 00 00, the following list of terms as used in this specification defined as follows:
   1. “AP”: Wireless Access Point (aka: AP)
   2. “AWS”: Advanced wireless services
   3. “LBS”: Location based services
   4. “PCS”: Personal communications service
   5. “RFID”: Radio frequency identification
   6. “RSSI”: Received signal strength indication
   7. “WVoIP”: Wireless Voice over IP
   8. “WiMAX”: Worldwide Interoperability for Microwave Access

1.4 SYSTEM DESCRIPTION

A. Work Covered Under Other Sections
   1. Cabling
   2. Conduit, device boxes, and sleeves
   3. Power

B. System Description
   1. The wireless access point system, herein “System”, shall provide 802.11a/b/g/n RF coverage throughout designated interior space. The System shall support LAN/WiFi wireless services. The System shall be implemented with proven state-of-the-art technology that can seamlessly integrate with the rapid evolution of wireless technologies and business applications.
   2. The System shall reliably provide wireless service levels at compatible frequency throughout the specified coverage area.

C. Design Criteria
   1. Frequency Ranges: The System shall provide Wireless LAN/WiFi services utilizing both the 2.4 GHz and 5 GHz standard 802.11ac Wave 2 frequencies spectrums
   2. The System shall provide 802.11ac Wave 2 coverage meeting or exceeding performance criteria outlined below and in the Integrator supplied Predictive Wireless Report.
   3. The System shall provide 802.11ac Wave 2 coverage at levels outlined below in the following areas of the building(s) – herein specified coverage areas:
      a. Floor areas
      b. Basement
      c. Stairwells
      d. Elevators
      e. General Use spaces (break rooms, staff rooms)
      f. Restrooms
   4. The System shall be able to simultaneously support the following wireless services, applications, and/or technologies:
      a. 802.11ac Wave 2 (2.4 and 5.8Ghz) / WiFi – data
      b. WVoIP phones
      c. Personal communication devices
   5. The System shall have the capability for separate control over each frequency (aka channels) to allow the ability to adjust and control power levels without disturbing other services.
   6. The System shall support multiple services in a modular architecture so services can be added or removed without requiring new infrastructure, without readjustment of signal power levels, or disturbing existing services.
   7. The System shall enable services to be added without requiring additional cable plant or antenna systems.
   8. The System shall not impede any management features or functionality of any attached network and/or device management system. The System shall allow for proactive management and end-to-end alarming of active electronics. The System shall be able to engage with 3rd party SNMP-based element management systems and provide fault management information.
   9. The System shall have the ability to locate wireless 802.11 rogue AP’s, clients, and other 802.11ac Wave 2 devices within the defined coverage areas.
   10. The System shall not have co-channel interference stronger than -85dBm within 90% of the specified 802.11 coverage areas for WiFi.
   11. Signal strength shall be measured with a predetermined industry standard tool such as Airmagnet calibrated test equipment (or equivalent). The System shall deliver signal at the following levels:
      a. WiFi -85 dBm or stronger within 100% of the specified coverage areas for all systems, services, applications, and/or technologies.
      b. WiFi -58dBm or stronger within 90% of the specified coverage areas for Wi-Fi signals with an RSSI without creating undesirable side-effects such as co-channel interference.
   12. The System shall provide sufficient capacity to support a minimum of 8 wireless clients per AP throughout the specified coverage areas for Wi-Fi.
   13. The System shall support multicast technology throughout the specified coverage areas for Wi-Fi.
   14. The System shall provide sufficient multiple AP signal strength within coverage areas for RFID / WVoIP / LBS.
   15. The wireless infrastructure should be configurable to have Multiple Virtual WLANs to control access and QoS unique to each Service Set Identifier (SSID/VLAN).

16. The System shall support WiFi management applications and advanced AP features provided by the selected AP manufacturer.
17. To maintain performance as usage increases, the System shall have dynamic mechanisms for adding AP capacity and segmenting the WiFi coverage into smaller areas.
18. The System must be FCC certified with the specific access points that are to be deployed.
19. The System shall maintain a balanced link budget with the downlink (AP-to-client device) limited to match an assumed uplink (client device-to-AP) signal strength of 30mW.

D. Base Bid Work
1. The Work under this section includes furnishing materials, installation, and coordination through the General Contractor with other trades for a complete, operational, and balanced System. Furnish necessary materials, accessories, fasteners, etc., and the labor and associated services required to provide the System specified herein.
2. Necessary equipment include:
   a. Wireless Access Points
   b. Controllers
   c. POE+ Switches
   d. All necessary cabling
   e. All necessary mounting hardware
   f. All necessary accessories
3. The Work of this Section includes the following (described in greater detail in Part 3):
   a. Project management services
   b. Detailed System Design
   c. Installation and system balancing
   d. Manage Integration with 802.11 Wireless Network Integrator
   e. Manage Integration with WVoIP Integrator
   f. System acceptance testing and turn over to Owner

E. Work Provided Under another Section
1. Communications Pathways, such as backbone conduits and primary pathways
2. Communications Rooms, including equipment support, power, cooling, and grounding

1.5 SUBMITTALS

A. Comply with Submittal procedural, quantity, and format requirements of Section 270000.

B. Submittal Requirements Prior To Start Of Construction:
1. Product Data Submittal
2. Shop Drawings Submittal: Shop drawings shall include the following information:
   a. System or functional block/line diagrams
   b. Plans indicating equipment, antenna, and/or component locations, cable routes, and other installation information
   c. Coverage plans, showing the design RF coverage (signal strength) for each frequency band required in 1.04 B.3
   d. Expected density plans, indicating the WiFi client device-to-AP ratio
   e. Channel plans, indicating the channel separation and interference amongst the defined coverage areas. This information will include channels, power settings, and percent interference above the -85dBm for the defined WiFi coverage areas
   f. Equipment and/or wall / rack elevations, showing equipment layout, space requirements and integration with other systems
   g. Installation details for antenna mounting, specialty cable hangers, and other components unique to the System, and other information that depicts the intended installation

C. Submittal Requirements Prior To Acceptance Testing:
   1. Acceptance Testing Procedures Submittal: describes in detail the procedure for testing the System's performance and balancing the System's signal strength, including a description of the test data (or an example of the test report). The Contractor shall demonstrate the desired services have been successfully deployed and tested. Specifically, the APs must be deployed with the Wireless Operators criteria and approval.

D. Submittal Requirements at Close Out:
   1. As-Built Drawings Submittal
   2. Operations and Maintenance Manual (refer to Section 27 00 00 for contents)
   3. Integration of components and pathways into the Building Information Model (BIM)

E. Substitutions
   1. Requests for substitutions shall conform to the general requirements and procedure outlined in Section 270000.

1.6 QUALITY ASSURANCE

A. Comply with Quality Assurance requirements of Section 27 00 00.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with Delivery, Storage and Handling requirements of Section 27 00 00.

1.8 WARRANTY

A. Warrant Work and System to perform as described within this Section for a period of 1 year, including components, electronics, etc., and coverage. Correct deficiencies within 24 hours of notification.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Cisco
   1. Controller: Cisco 8540 Wireless Controller based system with the following features:
      a. Master/Local
      b. Each controller will have Access Point License for all APs
      c. Policy Enforcement Firewall Module License sufficient for all wireless users
      d. Wireless Intrusion Protection Module for all AP's
      e. 1 year maintenance
   2. Access Points: Cisco Aironet™ 4800
   3. POE+ Switches (Provide with 40% additional ports for future growth.)
      a. Cisco Catalyst 9300 Series POE+ Switches

B. Or equal system

2.2 SUBSTITUTIONS

A. Comply with the Substitution requirements of Section 27 00 00.

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with the Execution requirements of Section 27 00 00.

3.2 EXAMINATION AND PREPARATION

A. Prior to the start of this Section's installation Work, examine Communications Rooms and Pathways for completeness, compatibility with the Work of this section, and readiness for connections with the Work of this section.

3.3 INSTALLATION

A. Project Management Services: The Contractor shall assign a single-point-of-contact to this project with overall responsibility for communications and ultimate delivery of contracted materials, installation, performance criteria, and services – "PM". This PM shall be responsible for interfacing with the Owner, General Contractor, Engineer, and their own subcontractors. The PM shall present the design iterations to the Owner, coordinate cable routes with the Engineer, coordinate on-site construction activities with the General Contractor, shall manage the process to coordinate bringing wireless operators into the facility, and shall close out the project with the Owner.

B. Detailed System Design: The Contractor shall use the requirements of this Section to complete the detailed design of the System. Design shall include computer RF modeling and site surveys. The detailed design shall deliver the pre-construction submittals, including iterations for the Owner's review and sign-off. The Contractor shall be able to show design RF signal levels to sub-room precision for all rooms within the defined coverage areas.

C. Installation: The Contractor shall coordinate the installation and schedule with the Owner and General Contractor prior to the start of installation activities. Once the Owner and General Contractor have accepted the coordination and schedule, the Contactor may proceed with installation.

D. System Balancing: The Contractor shall balance the System component (e.g., antenna) signal strength to the device signal levels.

E. Active Survey: The Contractor shall perform an active wireless survey demonstrating performance according to the design criteria of Part 1 (above). From this survey, produce an active survey report, including floor plans.

3.4 CONNECTIONS TO SYSTEM

A. Manage Integration of Wireless Services and Applications: The Contractor shall coordinate the integration of 802.11 wireless services with the Network Integrator, such as wireless LAN access points and telemetry applications. The Contractor shall provide equipment and components required to support the wireless services and to make adjustments to the System necessary for full operation.

B. The Contractor will coordinate access control and authentication with the Network Integrator and Owner to ensure access control and authentication is enabled and functional.

3.5 LABELING

A. General Requirements
   1. Labeling, identifier assignment, and label colors shall conform to TIA/EIA-606-A Administration Standard and as approved by Owner's Representative before installation.
   2. Permanently label equipment, components, and cables. Affix label as close as practical to each end of cables.
   3. Coordinate labeling and identifier assignment with the Engineer or Owner. Submit a labeling plan to the Engineer for approval prior to labeling work.

B. Label Format
   1. Provide permanent labels with machine-generated text; hand written labels will not be accepted.
   2. Labels on cables shall fully wrap around conductors with a self-laminating feature to provide permanent marking.

3.6 SYSTEM ACCEPTANCE TESTING AND TURN OVER TO OWNER

A. Complete the acceptance testing as prescribed in the accepted Testing Procedures submittal.

B. Present the completed System and wireless services to the Owner, including functionality, features, ongoing maintenance, and warranty procedures. Demonstrate to Owner and Engineer system operation, including signal strength at select locations. Turn over at least 1 set of both electronic records and printed records, per the Owner's request.

3.7 EXTENDED SUPPORT SERVICES

A. Provide support services for 12 months following the Owner's acceptance of the System (for services such as integration of additional wireless operators).

3.8 FINAL INSPECTION AND CERTIFICATION

A. Punch the Work of this Section compliant to the requirements of Section 27 00 00.

B. Comply with system acceptance and certification requirements of Section 27 00 00.

3.9 SYSTEM TRAINING

A. Comply with training requirements of Section 27 00 00.

B. For this System, provide 40 hours of on-site training and support for Owner.

END OF SECTION

SECTION 27 4116

INTEGRATED AUDIO/VIDEO SYSTEMS AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES:

A. General provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section. Reference AV drawings for additional information.
B. The work of this section also includes:
   1. Required licenses, insurance and permits including payment of charges and fees
   2. Verification of dimensions and conditions at the job site
   3. Preparation of submittal information
   4. Pick-up of Owner Furnished Equipment (OFE) and incorporation into project if applicable.
   5. Development and implementation of AV control system software code and control panel layouts, which will become the property of the Owner
   6. Installation in accordance with the contract document, manufacturer's recommendation, and in conformity with applicable codes and authority having jurisdiction (AHJ)
   7. Extension of electrical service, including ground, to equipment locations if required
   8. Final tests and adjustments, written report, and documentation
   9. Instruction of operating personnel
   10. Provision of manuals
   11. Maintenance services and warranty.

1.2 RESPONSIBILITY

A. All materials, equipment, transportation, and labor necessary to achieve a complete and functionally working system as shown or inferred on the Drawings and in the Specifications. Supply accessories and minor equipment items (such as, but not limited to: power strips, adapters, connectors, mounting hardware, etc.) needed for a complete system, even if not specifically mentioned in these Specifications or on the associated Drawings, without claim for additional payment.
B. Notwithstanding any detailed information in the Contract Documents, it is the responsibility of the Contractor to supply a full working, tested, and calibrated system. Notify the Architect of any discrepancies in part numbers or quantities before bid. Failing to provide such notification, supply items and quantities according to the intent of the Specification and Drawings, without claim for additional payment.
C. Specifications and drawings are complementary. Work called for by one is binding as if called for by both. Any discrepancies between specifications and drawings shall be brought to the attention of the Architect for clarification during the bidding period. No allowance shall subsequently be made to the Contractor by reason of his failure to have brought said discrepancies to the attention of the Architect.
D. Execute all work in accordance with the National Electrical Code (NEC), the National Electrical Safety Code, the Occupational Safety and Health Act (OSHA) and all applicable State and Local codes, ordinances, and regulations. If a conflict develops between the contract documents and the appropriate codes and is reported to the Architect prior to bid opening, the Architect will prepare the necessary clarification. Where a conflict is reported after contract award, propose a resolution of the conflict and, upon approval, perform Work.

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Section 1: Submittals.
B. Section 11: Projection Screens.
   1. Screens and installation of screens.

C. Section 16: Electrical Work Division 16: Electrical Work.
   1. Conduit, wireways, floor boxes (back box & cover), wall boxes, pull boxes, junction boxes, AC power circuits and ground wiring.

1.4 REFERENCES

A. Published specification standards, tests or recommended methods of trade, industry or governmental organizations apply to Work in this section where cited below:
   1. American National Safety Institute (ANSI)
   2. American Society of Testing and Materials (ASTM)
   3. Electronics Industries Association (EIA)
   4. Federal Communications Commission (FCC)
   5. National Electrical Manufacturer's Association (NEMA)
   6. National Electrical Code (NEC)
   7. Underwriters Laboratories (UL)
   8. Occupational Safety and Health Administration (OSHA)
   9. Building Industry Consulting Service International (BICSI)
   10. Davis and Davis, Sound System Engineering (2nd Edition), Howard W. Sams, 1987
   11. Giddings, Audio System Design and Installation (ASDI), Howard W. Sams, 1990
   12. AV Installation Handbook Second Edition: The Best Practices for Quality Audiovisual Systems, Infocomm, 2009

1.5 DEFINITIONS

A. In addition to those Definitions of Division1, the following list of terms as used in this specification shall be defined as follows:
   1. Furnish - To purchase, procure, acquire, and deliver complete with related accessories.
   2. Install – To set in place, join, attach, link, set up or otherwise connect together and test until complete before turning over to the Owner, all parts, items, or equipment supplied by Contractor.
   3. Provide – To furnish and install.

1.6 DESCRIPTIONS AND REQUIREMENTS

A. The following is intended to further describe the Work and clarify design intent and is not an exhaustive description of the systems.

B. JP Courtroom Room 113:
   1. This courtroom will have a sound system with microphones located at the Judge, Clerk, Witness, Plaintiff, and Jury locations. Carefully route all wiring under the desktop, provide access holes as required in millwork.
   2. Sound will be heard via desktop and overhead loudspeakers. The Judge, Witness, Plaintiff and Clerk will have a small desk mounted loudspeaker. The Jury box and gallery will receive sound via overhead loudspeakers.
   3. Microphones will be auto-mixed and routed using a mix-minus format that prevents the signal from a microphone from being routed to nearby loudspeakers.
   4. Microphones and auxiliary audio sources are connected to an audio recorder for archiving and playback purposes for the court. When in record mode, the audio recorder will not playback into courtroom loudspeakers..
   5. A portable audio/video system will be provided for display of a OFE laptop computer, Bluray player, document camera, or auxiliary HDMI video input. The display and rack mounted equipment will be contained within a roll around cart system. Connectivity into the sound system is via wall plate next to the jury box.
   6. Control of the sound system is provided from a table top control panel located at the Judge's desk. Control functions are to be grouped in a logical and reasonable arrangement. The system should be capable of:
      a. Transport control of audio recorder
      b. Speech audio volume - up/down/mute with bar graph for each microphone.
      c. Program audio volume to loudspeakers- up/down/mute with bar graph

d. System power – on/off

7. Control of the portable audio/video system is via TV manufacturer's remote and input button on the HDMI video switcher.
8. To comply with ADA requirements for the hearing impaired, an IR transmitter and receiver system will be provided. The assistive listening system will receive a composite mix of all sound system inputs.
9. Audio processing equipment is located in an equipment rack which is located in room 108.

C. Courtroom 207:

1. Two motorized front projection screens shall be available for display video images from two video projectors located on lifts that will drop down from the bottom of the balcony.
2. A Blu-ray player will be provided within the podium as well as a HDMI video source located on a connectivity plate on the surface of the podium.
3. Desk monitors, showing the same image as the projection screens, will be located at the following positions; Judge, Clerk, Witness and Court Reporter. Images will be able to be sent to the Judge's monitor for prior review before being released to all displays. Carefully route all wiring under the desk, provide access holes as required in millwork.
4. This courtroom will have a sound system with microphones at the Podium, Defendant, Plaintiff, Judge, Witness, and Jury locations. A wall plate, located in the area where the portable court bench will be placed, provides connectivity for five additional microphones. Carefully route all wiring under the desk, provide access holes as required in millwork. Three additional microphones will be available for times when the court bench is in place. The two table top microphones normally used for the defendant and the plaintiff can be relocated for a total of five microphones for the court bench.
5. All sound for the gallery will be heard via overhead loudspeakers. Sound for the Jury will be heard via 5 small surface mounted speakers on the front wall of the Jury box.
6. The Judge, Witness, Clerk, Court Reporter, Defendant, and Plaintiff tables will have small local speakers that will be attached to the tabletop. Carefully route all wiring under the desk, provide access holes as required in millwork.
7. Microphones will be auto-mixed and routed using a mix-minus format that prevents the signal from a microphone from being routed to nearby loudspeakers.
8. Microphones and auxiliary audio sources are connected to an audio recorder for archiving and playback purposes for the court. When in record mode, the audio recorder will not playback into courtroom loudspeakers.
9. The video system will be capable of displaying the following sources: Podium input plate HDMI and Blu-ray player located within the Podium. Plaintiff and Defendant HDMI connections mounted under the table. Carefully route all wiring under the desk, provide access holes as required in millwork.
10. Control of the in-room system is via a table top control panel located at the Judge's desk and the Clerks desk. Control functions are to be grouped in a logical and reasonable arrangement. The system should be capable of:
    a. Transport control of audio recorder.
    b. Source selection to be displayed on video projectors
    c. Speech audio volume - up/down/mute with bar graph for each microphone
    d. Program audio volume to loudspeakers- up/down/mute with bar graph
    e. System power – on/off
    f. Video Projector on/off
    g. Screen up/down
    h. Audio system mute during sidebar
    i. Video system mute – only allows signal to be sent to Judges monitor for review
11. To comply with ADA requirements for the hearing impaired, an IR transmitter and receiver system will be provided. The assistive listening system will receive a composite mix of all sound system inputs.
12. The equipment rack for switcher, amplifiers and processing equipment shall be located in room 108.

1.7 SUBMITTALS

A. Provide submittals in the quantity specified in General Conditions.
   1. Provide the following in one submission for approval within thirty days of issuance of Notice to Proceed and prior to commencement of Work:
   2. Provide an equipment list and manufacturer's data sheets on product to be incorporated within the Work in specification order. Submit bound originals of:
      a. Manufacturer's Products technical data for each product in sufficient detail to facilitate proper evaluation to the products suitability for incorporation within the Work.
      b. Each submittal shall include a unique number and be numbered in consecutive order.
      c. Provide a complete table of contents with the following information:
      d. Project title and number
      e. Submittal number. In the case of a re-submittal, use the original submittal number immediately followed by the suffix "R" immediately followed by a unique number and be numbered in consecutive order.
      f. Date of submission.
      g. Referenced addendum or change order number as applicable.
      h. Where a data sheet shows more than one product, indicate the model being proposed with an arrow or other appropriate symbol.
      i. Bind submittal in titled three ring D style binders sized for 150 percent of the material. Maximum size: three inch spine. Use multiple volumes as required. Separate major grouping with labeled binder tabs.
      j. Provide 3"x3" example of lectern laminate finish with submittals.
   3. Shop Drawings:
      a. Schematic: Detailed wiring diagrams showing interconnection of components and products, wiring and cabling diagrams depicting cable types and designators, and device designators. Provide connector designations and terminal strip identification, along with color codes for cables connecting to these devices. Give each component a unique designator and use this designator consistently throughout the project.
      b. Equipment: Location of equipment in racks, consoles, or on tables, with dimensions; wire routing and cabling within housings; AC power outlet and terminal strip locations.
      c. Equipment: Location of equipment in the spaces in plan view.
      d. Full fabrication details of any custom enclosures and millwork indicating size, material, finish and openings for equipment.
      e. Projector mounting details: Include hardware types and load capacity.
      f. Loudspeaker mounting details: Include hardware types and load capacity.
      g. Fabricated Plates and Panels: Provide complete drawings on custom fabricated plates or panels. Drawings shall include dimensioned locations of components, component types, engraving information, plate material and color, and bill of material.
      h. Drawings executed at an appropriate scale, but not smaller than 1/8 inch = 1'–0".
      i. Labeling: Equipment and cabling labeling scheme. Include font sizes and styles, explanation of scheme, and designator schedule.
   4. Schedules: Wiring schedule showing source and destination of wiring and indicating which wiring is in conduit.
   5. Custom Control Software programming for review. It is anticipated that the Owner will have a significant role in originating and reviewing certain software items although it is the Contractor's responsibility to develop this.
   6. Any other pertinent data generated which is necessary to provide the Work.

B. Contract close-out submittals:
   1. Submit four bound originals of the following Project Record Manual information after substantial completion but prior to final inspection:
   2. Products Data: Products actually incorporated within the Work:

a. Manufacturer's data sheet for each type of Product by manufacturer and model or part number unless specified otherwise herein.
b. Supply manufacturer’s serial numbers for each Product.
c. For custom circuits or modifications, a description of the purpose, capabilities, and operation of each item.
d. Manufacturer’s maintenance and care instructions.
e. Separately bind list by manufacturer and model or part number of Products incorporated within the Work, arranged in alpha numeric order. When applicable, bind Manufacturer's warranty statements separately

3. Record drawings: Final rendition of Shop Drawings depicting what is actually incorporated within the Work. Drawings executed at an appropriate scale, but not smaller than 1/8 inch = 1’–0”.
4. Test Reports: Recorded findings of Commissioning.
5. System Operation and Instructions: Prepare a complete and typical procedure for the operation of the equipment as a system, organized by subsystem or activity.
   a. Describe the operation of system capabilities.
   b. Assume the intended reader of the manual to be technically inexperienced and unfamiliar with this facility.
6. Maintenance Instructions, including maintenance phone number(s) and hours; maintenance schedule; description of products recommended or provided for maintenance purposes, and instructions for the proper use of these products.
7. Any other pertinent data generated during the Project or required for future service.
8. Segregate documents into separate binders containing data relevant to operational, maintenance, and warranty issues. Appropriately duplicate data within the separate bindings when it will reasonably clarify procedures, e.g., operational data in maintenance binding.
9. Bind Project Record Manual in titled three ring D style binders sized for 150 percent of the material. Maximum size: three inch spine. Use multiple volumes as required. Separate major grouping with labeled binder tabs

C. Resubmission Requirements:
1. Make any requested corrections or change in submittals required. Resubmit for review until no exceptions are taken.
2. Indicate any changes that have been made other than those requested.

1.8 QUALITY ASSURANCE

A. Provide as part of bid package documents that support the following qualifications:
1. Firm experienced in the provision of systems similar in complexity to those required for this project.
2. No less than three years experience with equipment and systems of the specified types.
3. Experience with at least three comparable scale projects within the last two years.
4. Be a franchised dealer and service facility for the manufacturer’s products furnished.
5. Maintain a fully staffed and equipped service facility with full time field technicians.
6. Have at least one supervisory employee having completed and certified InfoComm CTS-I. Supply copy of current certification.
7. At the request of the Owner, demonstrate that:
   a. Adequate plant and equipment is available to complete the work.
   b. Adequate staff with commensurate technical experience is available.

B. Work: Perform Work in compliance with the applicable standards listed herein and governing codes and regulations of the authorities having jurisdiction and the Contract Documents.
1. Drawings and specification requirements govern where they exceed Code and Regulation requirements.
2. Where requirements between governing Codes and Regulations vary, the more restrictive provision applies.

3. Nothing in the Contract Documents grants authority or permission to disregard or violate any legal requirements.

C. Coordinate exact location and installation of equipment, power, grounding, and raceway requirements with the Construction Manager.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Ship Products in its original container, to prevent damaging or entrance of foreign matter.

B. Handling and shipping in accordance with manufacturer's recommendation.

C. Provide protective covering during construction, to prevent damaging or entrance of foreign matter.

D. Replace at no expense to Owner, Products damaged during storage, handling or the course of construction.

1.10 PROJECT CONDITIONS

A. Verify conditions on the job site applicable to this work. Notify Construction Manager in writing of discrepancies, conflicts, or omissions promptly upon discovery.

B. The Drawings diagrammatically show cabling and arrangements of equipment fitting the space available without interference. If conditions exist which make it impossible to install work as shown, recommend solutions and/or submit drawings to the Construction Manager for approval, showing how the work may be installed.

1.11 WARRANTY

A. Warrant labor and Products for one year following the date of substantial completion to be free of defects and deficiencies, and to conform to the drawings and specifications as to kind, quality, function, and characteristics. Repair or replace defects occurring in labor or Products within the Warranty period without charge.

B. This warranty is in addition to any specific warranties issued by manufacturers for greater periods of time.

C. Provide an additional 1 year warranty which will commence at the close of the specified first year warranty.

D. Within the warranty period, answer service calls within eight (8) hours, and correct the deficiency within forty eight (48) hours.

E. Provide Owner with the name and telephone number of the person to call for service. This information to be part of Project Record Drawings.

F. Thirty days prior to the end of the warranty period provide a complete checkout of all system components. Repair or replace any defective equipment discovered during the testing. Correct any defects in wiring or other functional problems reported by Owner. Warranty replacement and service of equipment shall not apply to Owner furnished equipment (OFE). Coordinate inspection visit with the Owner.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Model numbers and manufacturers included in this specification are listed as a standard of function, performance, and quality.

B. Refer to General and Special Conditions for equipment substitution procedure.

2.2 GENERAL

A. Products quantity is as required. If a quantity is given, provide at least the given amount.

B. Products shall be new, free from defects and listed by UL when an applicable UL Standard exists. Provide Products of a given type from one manufacturer.

C. Regardless of the length or completeness of the descriptive paragraph herein, provide Products complying with the specified manufacturer's published specifications.

D. Take care during installation to prevent scratches, dents, chips, etc.

2.3 MANUFACTURERS AND PRODUCTS

A. If a specified product has been discontinued by a manufacturer, provide the replacement model (as certified by the manufacturer) at no additional cost.

B. Where required provide manufacturer’s rack mount adapter or one manufactured by Middle Atlantic or Winsted.

2.4 MICROPHONE

A. Millwork Microphone with Shock Mount (DM, Type 1):
   1. For millwork mounted microphones
   2. Unidirectional polar pattern
   3. 12” Long semi rigid shaft terminated in a male 3 pin XLR
   4. Coordinate installation with millwork provider
   5. Acceptable Product:
      a. Shure MX412S/C

B. Table Mounted Microphone (TM, Type 1):
   1. Unidirectional polar pattern
   2. 12” Long semi rigid shaft terminated in a male 3 pin XLR
   3. Acceptable Product Includes:
      a. Shure MX412D/C

C. Stand Mounted Microphone (SM, Type 1):
   1. Cardioid polar pattern handheld microphone with stand adapter for securely mounting microphone.
   2. Additional mic cables are provided for use at different distances from the wall plate.
   3. Acceptable Product Includes:
      a. Shure SM58 w/ Atlas MS25E Microphone floor stand

D. Wireless Microphone (WRLS, Type 1):
   1. 24-Bit digital audio quality
   2. AES 256-bit encryption for secure transmission

3. Acceptable Product Includes:
    a. Shure QLXD24/SM58 w/ Shure UA834WB, Shure UABIAST

2.5 SOURCE EQUIPMENT

A. Blu-ray Player (BR, Type 1):
1. HDMI Output
2. DVD Upscaling via HDMI
3. RS232 controllable.
4. Optical, Coaxial Digital Output
5. Acceptable Product:
    a. Denon DN-500BD

B. Audio Recorder (REC, Type 1):
1. 16- or 24-bit digital recorder at up to 48 kHz
2. RS-232 or network controllable
3. Frequency response: 10Hz to 20 kHz
4. Rack mountable in 1U
5. Recorders to be labeled on the front of the deck with lamicoid labels “Courtroom”, and “JP Courtroom”
6. WAV or MP3 files stored on SD card
7. Provide with one 8GB CF card for each recorder.
8. Acceptable Product:
    a. Denon DN-700R

C. Document Camera (DOC CAM, Type 1):
1. VGA x 2, HDMI, C-Video
2. 20x optical Zoom lens
3. 12x Digital Zoom
4. One-Touch synchronous audio video recording
5. Compatible with USB flash drives, expandable to 4TB
6. Folds down to a height of six inches (15 cm)
7. Output Resolutions:XGA, SXGA, WXGA, 1080p
8. Provide with cable assembly long enough to allow placement on cart flip-up shelf
9. Acceptable Product:
    a. Lumens PS752

2.6 AUDIO SIGNAL PROCESSING

A. DSP (DSP, Type 1):
1. Processor shall be a stand-alone unit, rack mountable, capable of providing a fully-functional system with analog inputs and analog outputs, without the need for a dedicated, on-line computer system.
2. Frequency response: 20 Hz – 20 kHz, ± 0.5 dB.
3. Sixteen (16) switchable balanced mic or line level
4. 128 Channel (64×64) Dante™
5. Acceptable Product consisting of the following as required:
    a. Symetrix Prism 16 x 16
    b. Accessories

B. DSP (DSP, Type 2):
1. Processor shall be a stand-alone unit, rack mountable, capable of providing a fully-functional system with analog inputs and analog outputs, without the need for a dedicated, on-line computer system.
2. Frequency response: 20 Hz – 20 kHz, ± 0.5 dB.
3. Eight (8) switchable balanced mic or line level

4. 128 Channel (64×64) Dante™.
5. Acceptable Product consisting of the following as required:
    a. Symetrix Prism 8 x 8
    b. Accessories

C. Audio Mixer (MIX, Type 1):
1. 2 channel audio mixer.
2. Acceptable Product:
    a. RDL ST-MX2 w/ RDL PS-24AS

D. DSP Manufacturer Software:
1. Provide 12 months of on-site software upgrades from date of final acceptance.
2. DSP Software Setup:
3. The DSP system and control software shall be operational 30 days prior to the first use of the installed system.
4. Provide site specific configuration and programming for the DSP software.
5. Coordinate user interface, software functionality, and menu screens with Architect's Consultant. Reference submittal requirements.
6. Provide ongoing software upgrades and maintenance for 12 months from date of final acceptance.
7. Software to be configured for the following uses:
    a. Automatic volume control of microphones in system
    b. Muting of individual microphones (Judge, Defendant, Plaintiff, etc.)
    c. Mixing, summing, processing for each loudspeaker zone and assisted listening system
    d. Reference Control system section for specific functionality

2.7 POWER AMPLIFIERS

A. Power Amplifier (PA, Type 1):
1. 70 Volt 2 Channel Power Amp - 500 Watts per channel
2. Frequency Response: 20 Hz – 20 kHz ±1 dB
3. Acceptable Product:
    a. Crown CDi1000

B. Power Amplifier (PA, Type 2):
1. 2 Channel Power Amp - 80 Watts per channel
2. Frequency Response: 20 Hz – 20 kHz ±1 dB
3. Acceptable Product:
    a. JBL CSA280Z with rack mount kit

C. Power Amplifier (PA, Type 3):
1. 8 Channel Power Amp - 125 Watts per channel
2. Frequency Response: 20 Hz – 20 kHz ±1 dB
3. Acceptable Product:
    a. Crown CT8150

2.8 LOUDSPEAKERS AND ACCESSORIES

A. Ceiling-mounted Loudspeaker (SP, Type 1):
1. Coaxially mounted 6.5 in woofer with 1" tweeter
2. Frequency response: 50 Hz – 20 kHz
3. Sensitivity: 91dB SPL, one watt, one meter
4. 70V taps at, 60W, 30W, 15W, 7.5W
5. Acceptable Product:
    a. JBL Control 47HC

B. Ceiling-mounted Loudspeaker (SP, Type 2)
   1. Coaxially mounted 6.5 in woofer with 1” tweeter
   2. Frequency response: 50 Hz – 20 kHz
   3. Sensitivity: 91dB SPL, one watt, one meter
   4. 70V taps at, 60W, 30W, 15W, 7.5W
   5. Acceptable Product:
      a. JBL Control 47C/T

C. Hot Spot Loudspeaker (SP, Type 3)
   1. Dual ceramic 5 in drivers
   2. Frequency response: 170 Hz – 13 kHz
   3. Sensitivity: 90dB SPL, one watt, one meter
   4. Acceptable Product:
      a. Galaxy Audio HS7

D. Micro Spot Loudspeaker (SP, Type 4)
   1. Ceramic 5 in driver
   2. Frequency response: 150 Hz – 15 kHz
   3. Sensitivity: 88dB SPL, one watt, one meter
   4. Acceptable Product:
      a. Galaxy Audio MS5

E. Hot Spot Loudspeaker (SP, Type 5)
   1. Dual ceramic 5 in drivers
   2. Frequency response: 170 Hz – 13 kHz
   3. Sensitivity: 90dB SPL, one watt, one meter
   4. Acceptable Product:
      a. Galaxy Audio HS7 w/ Galaxy MSA-1, Atlas MS-12CE

2.9 ASSISTIVE LISTENING SYSTEM:

A. Assistive Listening System Transmitter (ALS, Type 1):
   1. Configuration: Single-channel.
   2. Audio Input: Balanced, microphone or line level, 3-pin XLR.
   3. Provide power supply.
   4. Provide 1-RU rack mount bracket.
   5. Acceptable product to include:
      a. Listen Tech LS-100-01-GY.
      b. Listen Tech LR-4200-IR (Quantity: 8)

B. Assistive Listening System Radiators: (ALS, Type 2)
   1. Configuration: Single channel.
   2. Acceptable product:
      a. Listen Tech LA-140

C. ADA Requirement Signage:
   1. Coordinate location of ADA sign with Architect (Quantity 2)

2.10 VIDEO PROJECTION EQUIPMENT

A. Video Projector (VP, Type 1):
   1. 3 LCD laser light source
   2. Brightness 12000 ANSI lumens
   3. Native resolution 1920 x 1200
   4. Control communications RS-232
   5. Field verify throw distance to determine the appropriate required lens
   6. Acceptable Product:

a. Epson Pro L1505UNL w/ Bretford A2642-E5 height adjustable projector cart

2.11 VIDEO DISPLAY EQUIPMENT

A. Desktop Monitor (MON, Type 1):
1. 15” LCD
2. Panel resolution 1920 x 1080
3. Contrast 800:1
4. Acceptable Product:
   a. ELO 1502L (E045538)

B. Flat Panel Monitor (MON, Type 2):
1. 65" diagonal LCD monitor with LED backlighting
2. Minimum native resolution 1920 x 1080
3. RS232 or IR controllable
4. HDTV Tuner
5. HDMI, External Speaker, USB 2.0, Optical Audio out,
6. Acceptable Product:
   a. LG Electronics 65UV340C

C. Flat Panel Monitor (MON, Type 3):
1. 75" diagonal LCD monitor with LED backlighting
2. Minimum native resolution 1920 x 1080
3. RS232 or IR controllable
4. HDTV Tuner
5. HDMI, External Speaker, USB 2.0, Optical Audio out,
6. Acceptable Product:
   a. LG Electronics 75UV340C w/ Chief XPA1UB cart

2.12 VIDEO SWITCHING AND PROCESSING EQUIPMENT

A. DM Video/Audio Matrix (DM MTX, Type 1):
1. 8 x 8 modular configuration.
2. Input modules can accept: HDMI, DVI/RGB, analog video, and fiber.
3. Output modules can accept shielded CAT5e/6, or fiber.
4. Supports resolutions up to and including 3840x2160.
5. Control communication via Ethernet.
6. Acceptable Product Crestron DM-MD 8x8 to include:
   a. Crestron DMC-4K Input Cards
   b. Crestron DMC-4K Output Cards

B. DM Transmitter (DMTX, Type 1):
1. Converts HDMI to DM cable.
2. Acceptable Product:
   a. Crestron DM-4K-100-C-1G

C. DM Transmitter (DMTX, Type 2):
1. Converts HDMI to CAT5e/6.
2. Acceptable Product:
   a. Crestron DM-TX-4K-202-C w/ Crestron MP-WP181-C

D. DM Receiver and Room Controller (DMRX, Type 1):
1. Converts CAT 5e/6 to HDMI with serial and relay control.
2. Acceptable Product:
   a. Crestron DM-RMC-4K-SCALER-C.

E. DM Receiver (DMRX, Type 2):

1. Converts DM cable to HDMI with serial and relay control.
2. Acceptable Product:
    a. Crestron DM-RMC-4K-100-C-1G.

F. 1:4 HDMI to DM 8G Splitter (DMDA, Type 1)
1. Converts and splits a single HDMI signal to feed four DM 8G outputs
2. Acceptable Product:
    a. Crestron DM-DA4-4K-C w/ Crestron PW-4830DUS

G. High Definition Video Scaler (SCALER, Type 1)
1. High-definition scaler with HDMI in/out, and audio embedding/de-embedding
2. Acceptable Product:
    a. Crestron HD-SCALER-HD-E

H. HDMI Switcher (HDMI SW, Type 1)
1. Four input switcher for HDMI resolutions up to 4K
2. Acceptable Product:
    a. Extron SW4 HD 4K (60-1484-01) w/ Extron RSU 129 (60-190-01)

I. HDMI Audio Extractor (HAE, Type 1)
1. HDMI audio de-embedding with analog stereo audio output
2. Acceptable Product:
    a. Extron HAE 100 4K (60-1542-01)

2.13 CONTROL SYSTEM

A. Remote Control System (RCS, Type 1)
1. Control Processor
2. Rack mountable in 1RU
3. 3-Series control processor
4. Isolated control subnet
5. Acceptable Product:
    a. Crestron CP3N

B. Remote Control System (RCS, Type 2)
1. Control Processor
2. 3-Series control processor
3. POE powered
4. Acceptable Product:
    a. Crestron RMC3

C. Touch Panel (TP, Type 1):
1. 7” Active Matrix Color Touch Screen
2. Resolution 1024 x 600 pixels
3. POE powered
4. Acceptable Product:
    a. Crestron TSW-760 w/ Crestron TSW-760-TTK, Crestron MP-WP183

D. Network Switch (SWITCH, Type 1):
1. 16 Port Managed PoE+ Switch
2. Rack mount with rear ports
3. Acceptable Product:
    a. Crestron CEN-SWPOE-16

E. Software:
1. Owner shall retain all rights and non-exclusive ownership to custom software, including original source code. Supply printouts of all source codes as well as back-up copies of un-compiled code on suitable electronic storage medium.

2. All commercial software used, shall be registered to Owner, in Owner's name. Owner to be supplied with all software documentation including copies of software registration.
3. All software shall be written with remark statements which document function of subroutines and program requirements.
4. Deliver final disk copies of the configured software within 30 days after notice to proceed.
5. Provide one-year of on-site software upgrades from date of substantial completion.
6. Submit complete software “code” on disk format for approval.
7. Initial and final software configuration to be included. The cost to configure the software is a part of this contract. Software configuration involves extensive interviews with Construction Manager.

F. Graphical User Interface (“GUI”) and Machine Control:
1. The manufacturer of the hardware and software is to develop the GUI and machine software control. The development is to be done in four phases.
2. During the first phase, development of the GUI panel layouts and machine functions are to be established. Participants of the development are this Contractor, the Architect’s Consultant via teleconference, and the Owner. This requires multiple meetings with these principles and is an interactive and iterative process.
3. During the second phase, the Contractor produces the initial GUI and machine software control filling the requirements developed during the first phase. This also requires multiple meetings with this Contractor, the Architect’s Consultant via teleconference, and the Owner and is an interactive and iterative process.
4. Upon completion of the second phase, install the control software within the AV Control Systems and inspect the systems for performance compliance. During this process the Contractor debugs the AV Control Systems software code as required to ensure a properly functioning system. At the end of this phase the Contractor is to provide written notification that their product is operating properly and that the functions and configurations established in Phase One and Two are working and have been properly implemented.
5. During the fourth phase, the Contractor, the Architect’s Consultant, and the Owner inspect the operational aspects of the Systems and develop final software configurations. Upon completion of final configuration, this Contractor installs and debugs the final Control Systems software code as required to ensure a properly functioning system as established during the fourth phase.

2.14 EQUIPMENT HOUSING & ACCESSORIES

A. Floor Equipment Rack (ER-108):
1. Provide EIA frame and panel type with a minimum of 77.125 inches of 19 inch wide panel gang-able enclosure.
2. Fully welded construction solid sides
3. 14-gauge steel tops & bottoms, 16-gauge seamless steel sides
4. Provide drilled and tapped mounting rails, front and rear.
5. Provide four spare keys of each type.
6. Housing color to be durable black textured powder coat finish.
7. Acceptable Product:
   a. Middle Atlantic MRK-4431 w/ Vented Front Door LVFD-44, Side Panels SPN-44-312, Fan Top MW-4QFT-FC, PD-1020J-IG

B. Multimedia Lectern (Courtroom 208 and Courtroom 113):
1. 44”H x 30”W x 25”D Wood Veneer Lectern with the following features:
   a. Removable front access panel
   b. Laptop shelf
   c. Lockable, Heavy duty casters
   d. LIGHT-18 - Task light
   e. FM3 - Digital clock / timer
   f. Front Rack rails

g. No front door
h. Cable port cutout for microphone
i. Cable port on bottom of lectern for floor box cabling

2. Coordinate wood veneer color of Lectern with Architect
3. Acceptable Product Includes:
   a. Video Furniture International PD3004

C. Portable Audio / Video Systems Cart (JP Courtroom 113):
1. Cart Dimensions: 42” High (without Monitor) x 29” Deep x 46” Wide
2. Built in handles for easy maneuvering
3. Rear Door for equipment access
4. Ships fully assembled
5. Tinted Tempered Glass Doors with VSX cut-out
6. Acceptable Product:
   a. Video Furniture International C2736-42 Cart with PM-S Single LCD Mount, SH-FL folding laptop shelf and RMT12 12RU Rack Frame Kit

D. Rack Drawer (DRAWER):
1. Spring loaded latch.
2. Black powder coat finish.
3. Acceptable Product:
   a. Middle Atlantic TD series.

E. Computer Rack Shelf (SHELF):
1. Black textured powder coat finish
2. Acceptable Product:
   a. Middle Atlantic U1

F. Blank Rack Panels (BLANK):
1. Flanged construction.
2. 16 Gauge steel.
3. Black powder coat finish.
4. Acceptable Product:
   a. Middle Atlantic SB series.

G. Floor Box (FB, FB-1, FB-2, FB-3):
1. Size: 8”.
2. Cover: Floor box to have a die cast hinged door.
3. Reference detail drawings for plate configuration.
4. Coordinate cover finish with Architect
5. Acceptable Product includes the following:
   a. Legrand Evolution 8AT w/ Legrand 68REC, Legrand 682A

H. Floor Box (FB-4):
1. Size: 3” deep
2. Cover: Floor box to have a die cast hinged door.
3. Reference detail drawings for plate configuration.
4. Coordinate cover finish with Architect**
5. Acceptable Product includes the following:
   a. FSR FL-500P-3-B w/ FL-500P-BLK-C

I. Power Strip (As required):
1. Provide a 20 Amp power system
2. 12 isolated ground AC outlets
3. Acceptable Product:
   a. Middle Atlantic PD-1220J-IG (where appropriate)

J. Power Strip:
   1. Rack mountable in 1U
   2. Provide one unit in full height rack
   3. Acceptable products:
      a. MiddleAtlantic PD-915R

K. Equipment Rack Screws:
   1. Install rack mounted equipment with black 10-32 star post security screws with flat nylon washers.
   2. Quantity as required.
   3. Provide one spare bit located in a clear plastic bag attached to the inside of each equipment rack in plain view.
   4. Acceptable Product:
      a. Middle Atlantic HW.

2.26 PLATES AND PANELS

A. A. Provide plates and panels and as described in Drawings. Engrave as shown on Drawings. Other Plates and Panels may be required to satisfy the requirements of the Work.
B. B. Custom panels shall be 1/8-inch thick aluminum, standard EIA sizes, brushed black anodized finish unless otherwise noted. Brush in direction of aluminum grain only.
C. C. Plate finish shall be coordinated with the Architect. Plastic plates are not acceptable.
D. D. Panel, plate and label engraving shall be 1/8-inch block sans serif characters unless noted otherwise. On dark panels or pushbuttons, letters shall be white; on stainless steel or brushed natural aluminum pushbuttons, letters shall be black.
E. Custom and/or Engraved Panels:
   1. Custom panels constructed of 1/8 inch brushed aluminum
   2. Finish: black anodize
   3. Acceptable Product:
      a. RCI Custom
      b. ProCo
F. Patch Panels for Audio/Video plate tie lines:
   1. Flat all-metal Shielded modular patch panels
   2. Mounts to standard cabinets and EIA 19” Racks
   3. 16-ports per 1U panel
   4. Strain relief bar includes cable tie slots for managing and supporting cables
   5. Label area to correspond to unique ID number of AV, AVC, FB plates (Labels to be printed, not hand-written)
   6. Utilizes Mini-Com Shielded snap-in modules
   7. Acceptable Product to include:
      a. Panduit #CP16WSBLY
      b. Panduit TX6 10Gig Shielded Modules
      c. Mounting screws as needed

2.27 CABLES & WIRING

A. All electrical conductors installed under this contract, except where otherwise specified, shall be soft drawn annealed stranded copper having a conductivity of not less than 98% of pure copper, and meet appropriate ratings (e.g. CMR, CMP, etc.)
B. Cable shall carry appropriate fire rating (e.g. CMR, CMP, OFNR, OFNP, etc.) on jacket of cable.
C. Where cables are routed through cable tray, provide tray rated cable of equal specification.
D. Where speaker cables are run exposed through a return air plenum, provide plenum rated cable of equal specification.
E. Shielded cables located in raceways shall have aluminum foil shield with drain wire.
F. Microphone/Line Level Wire:
   1. Provide shielded 22 AWG cable.
   2. Cable to be PVC jacketed.
   3. Jacket color: black.
   4. Acceptable Product:
      a. Belden 9451.

b. Liberty 22-1P-EZ.
c. Belden 88761 (where required).
d. Liberty 22-2C-PSH-WHT (where required).

G. Analog Video Cable:
1. Provide RG-59/U type cable.
2. Center conductor 23 AWG solid.
3. Cable to be PVC or FEP jacketed.
4. Jacket color: black.
5. Acceptable Product:
a. Belden 8241B.
b. Belden 88241 (where required).

H. HDMI Cable:
1. Provide pre-molded cables in lengths as required.
2. Acceptable Product:
a. Extron.
b. Liberty.

I. Digital Media 8G Cable:
a. Acceptable Product:
1) Crestron DM-CBL-8G-NP (non-plenum)
2) Crestron DM-CBL-8G-P (plenum) where required.

J. Relay Control Wire:
1. Provide unshielded 22 AWG cable.
2. Cable to be CMR or CMP rated.
3. Provide number of conductors where required.
4. Acceptable Product:
a. West Penn 27x Series.
b. West Penn 2527x Series (where required).

K. Speaker Level Wire – 70 volt:
1. Provide 16 AWG cable.
2. Cable to be CL3R or CL2P rated.
3. Jacket color: gray.
4. Acceptable Product:
a. West Penn 225.
b. West Penn 25225B (where required).

L. Other Misc. Cables:
1. Acceptable Product:
a. As per manufacturer specifications

2.15 CONNECTORS

A. XLR Panel mount Connectors:
1. Provide panel mount XLR connectors with unified metal shell.
2. RF-Protector connectors.
3. Shell Color: Black.
4. Contacts: Silver.
5. Terminations: Solder.
6. Acceptable Product:
a. Male Connectors: Neutrik NC*MD-L-1-BAG Series.
b. Female Connectors: Neutrik NC*FD-L-1-BAG Series.

B. XLR Cable Connectors:

1. Provide XLR cable connectors with die cast shell.
2. No-screw type assembly.
3. Chuck-type strain relief.
4. Shell Color: Black.
5. Contacts: Silver.
6. Terminations: Solder.
7. Acceptable Product:
    a. Male Connectors: Neutrik NC*MX-BAG Series.
    b. Female Connectors: Neutrik NC*FX-BAG Series.

C. BNC Cable Connectors:
1. Provide cable mount BNC connectors.
2. Contacts: Brass or copper.
3. Terminations: Crimp.
4. Acceptable Product:
    a. Kings
    b. Amp
    c. Amphenol
    d. Canare
    e. Liberty

D. Other Connectors:
1. As per manufacturers specifications

PART 3 EXECUTION

3.1 GENERAL

A. Coordinate incorporation of the Work specified herein with other project work so as to facilitate a cohesive final Products.
B. The installation recommendations contained within ASDI and Telecommunications Distribution Methods Manual are mandatory minimum standards and requirements.
C. Mount equipment and enclosures plumb and level.
D. Permanently installed equipment to be firmly and safely held in place. Design equipment supports to support loads imposed with a safety factor of at least five. Seismic bracing shall be installed on appropriate equipment where local codes require such installation.
E. Verify all locations of equipment in all rooms with Owner's Representative, Owner, and Consultant.

3.2 INSTALLATION
A. Installation of cable and wiring
1. Cabling and Wiring:
    a. Install cable in a manner to adhere to manufacturer's specifications for maximum cable pulling tension, minimum bend radius, and restrictions.
    b. Provide appropriate support at all horizontal-to-vertical transitions in order to keep the weight of the cable from degrading at the point of transition.
    c. If a J-hook or trapeze system is used to support cable bundles, all horizontal cables shall be supported at a maximum of 48-inch (1.2 meter) intervals. At no point shall the cables rest on light fixtures, acoustic ceiling grids, panels, conduits, sprinkler pipe, water pipe and/or HVAC system ducting.
    d. Horizontal distribution cables shall be bundled in groups of no more than 50 cables when being supported by J-Hook or trapeze systems. Cable bundle quantities in excess of 50 cables may cause deformation of the bottom cables within the bundle and degrade cable performance. An exception to this rule is when cable is installed in cable tray systems.
    e. Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and

support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices

f. Cables shall not be attached to ceiling grid or lighting fixture wires. Where support for horizontal cable is required, install appropriate carriers to support the cabling.

g. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced prior to final acceptance at no cost to the Owner.

h. Cables shall be identified by a self-adhesive machine label in accordance with the System Documentation Section of this specification and ANSI/TIA/EIA-606-A. The cable label shall be applied to the cable behind the faceplate on a section of cable that can be accessed by removing the cover plate.

i. Unshielded twisted pair cable shall be installed so that there are no bends smaller than four times the cable outside diameter at any point in the run and at the termination field.

j. Provide splice free wiring and cabling from origination to destination. Cables shall be installed in continuous lengths from origin to destination (no splices). Properly designed transition points, or consolidation points are not considered 'splice' points.

k. Make joints and connections with rosin-core 60/40 solder or with mechanical connectors specifically intended for the type and class of cable being used. Where spade lugs are used, crimp properly with ratchet type tool.

l. Take precaution to prevent and guard against electromagnetic and electrostatic hum. For line-level audio signal, float cable shield at one end. Shield not connected to be folded back over cable jacket and covered with heat-shrink tubing. Do not cut off unused shield.

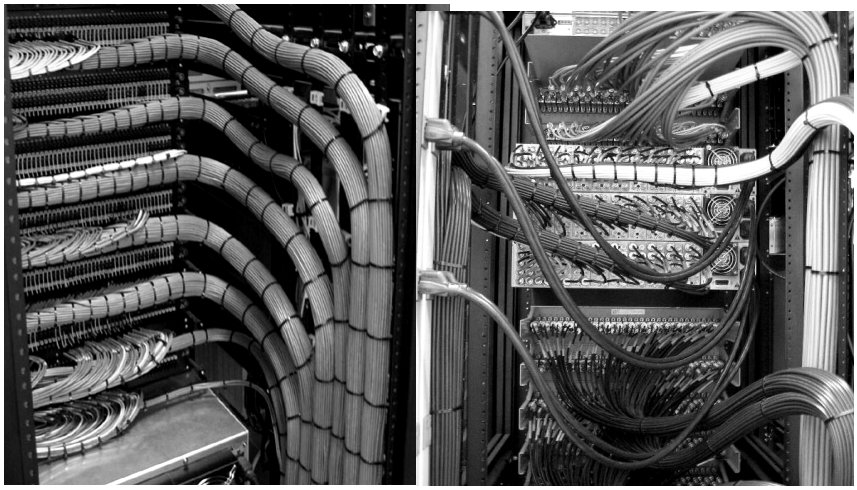
m. Isolate cables and wires of different signals or different levels; and separate, organize, and route to restrict channel crosstalk or feedback oscillation in any amplifier section. Keep wiring separated into groups for microphone level circuits, line level circuits, loudspeaker circuits, and power circuits.

n. Connect cable to active components through XLR connections whenever multiple formats are available. Make connections to speaker transformers with properly sized closed end connectors crimped with factory approved ratchet type tool. Wire nut or "Scotchlock" connectors are not acceptable. Do not wrap audio cable splices or connections with adhesive backed tape.

o. Cover edges of cable and wire pass-through holes in chassis, housings, boxes, etc., with rubber grommets or Brady GRNY nylon grommetting.

p. Execute wiring in strict adherence to:
   1) Phillip Giddings. Audio System Design and Installation. Indianapolis: Howard W. Sams & Co., 1990.
   2) Don Davis and Carolyn Davis. Appendix II, Recommended Wiring Practices. Sound System Engineering, 2nd Edition. Indianapolis: Howard W. Sams & Co., 1989.
   3) AV Installation Handbook Second Edition: The Best Practices for Quality Audiovisual Systems, Infocomm, 2009

2. Equipment Housing Cabling and Wiring:
   a. Lace, tie, or harness wire or cable as required herein, and in accordance with accepted professional practice. Dress, lace or harness all wire or cable to prevent mechanical stress on electrical connections; no wire or cable shall be supported by a connection point. Install cable and wire neatly tied in manageable bundles with cable lengths cut to minimize excess cable slack but still allow for service and testing. Provide horizontal support bars if cable bundles sag. Reference photos below for standard of quality.



b. Provide adequate service loops so that equipment mounted on rack slides may be pulled fully out, to their locked position without straining cable.
c. Neatly bundle excess AC power cable from housing mounted equipment with plastic cable ties.
d. Provide plastic cable ties or Velcro straps to bundle cabling and wiring. Electrical tape and adhesive backed cable tie anchors are not acceptable.
e. Install with connections completely visible and labeled.
f. Provide termination resistors, if required, of 5 per cent tolerance; fully visible and not concealed.

B. Installation of connectors, plates & panels:
1. Install panel mounted connectors rigidly attached to panels, plumb and level.
2. Custom rack panels shall be 1/8 inch thick aluminum, standard EIA sizes, brushed black anodized finish (brushed in direction of aluminum grain only), unless otherwise noted.
3. Custom connector plates (speaker, microphone, etc) are typically stainless steel, unless otherwise noted or specified. However, verify plate finish with the Architect.
4. Install XLR type connectors in accordance with IEC-268 standard, with a wiring scheme of pin 2 hot (high), pin 3 (low), and pin 1 screen (shield).
5. Other Plates and Panels may be required to satisfy the requirements of the Work.

C. Installation power and grounding:
1. Coordinate final connection of power and ground wiring to housings.
2. Hardwire power wiring directly to internal AC receptacles to ensure uninterrupted operation.
3. Provide 3-conductor, isolated ground, 120 VAC outlets as required within each housing. Provide a minimum of two spare outlets in each rack.
4. Provide a copper ground buss top to bottom in each housing, insulated from the housing. Ground equipment chassis not having a three wire power cord to these busses using 6/32 nuts, bolts and lock-washers with No. 12 wire. Connect green ground wire from each AC outlet in housing to this buss bar.
5. Replace manufacturers supplied 18 gauge IEC power cords with UL listed 18 gauge pre-molded 6”, 12”, 18”, or 24”. Use minimum length required. No looped or cable tied IEC power cords will be permitted within the equipment rack.
6. Replace manufacturers supplied 14 gauge IEC power cords with UL listed 14 gauge pre-molded 18” or 36” for all equipment IEC capable. Use minimum length required and minimize looped or cable tied IEC power cords present in the equipment rack.

D. Installation of electronic equipment:
1. Take appropriate precautions against electrostatic discharge (ESD). Establish a personal ground before handling electronic equipment through the use of a grounded wrist wrap and/or an anti-static floor pad.
2. Take appropriate precautions to protect the equipment from damage during installation. Equipment to be installed free of damages, scratches, dents, etc.

3. Mount trim potentiometers, custom circuit cards, relays, and transformers (except large 70V units) in shielded enclosures, and mark their function and connections with engraved lamicoid labels.
4. Mount equipment plumb and level, firmly and safely held in place.

E. Installation of equipment housing:
1. Mount equipment in racks and consoles and fully wire and test before delivery to job site. If field conditions prevent prior assembly of racks, notify Owner in writing that racks will be fabricated on site and the reasons for the change.
2. Provide rear support for housing mounted equipment greater than 15 inches deep.
3. Provide blank panels to fill unused panel space within the equipment housing.
4. If Key door locks are required, key each housing type alike.
5. Looking at the rack from the rear, locate AC power and speaker wiring on the left; line level audio, video, and RF wiring on the right.
6. Provide shaft locks or security covers on non-user operated equipment having front panel controls. These panels are to be installed at the conclusion of testing.
7. If forced air active thermal management is used, provide ventilation blocking material on the front, sides, and rear of the equipment rack as needed. Reference Middle Atlantic Products “Controlling the Temperature Inside Equipment Racks”.
8. Panels or equipment mounted on the rear rack rails shall not block access to any front mounted components.
9. If equipment rack is not equipped with casters, provide two inch high wood base to isolate equipment rack from floor. Wood base should be capable of supporting the load.

F. Installation of loudspeakers:
1. Loudspeakers shall be mounted at the operating position in a safe, secure and permanent manner.
2. Rigging, mounting and support systems for loudspeakers shall be reviewed and certified by a registered Professional Engineer (PE) licensed to practice in the State in which the project is located. Documentation shall be included as a submittal item. Once the systems are installed, the PE shall physically inspect the methods and means used to verify compliance with the original design.
3. Paint speakers, supports and related hardware color as directed by Architect.
4. The aiming direction of all loudspeakers shall be adjustable by ±5 degrees vertically.
5. Structural support members to have a safety factor of at least five. Mounting hardware and wire rope to have a safety factor of eight. All fasteners to be graded and certified for use in the intended applications. Overhead suspension hardware shall comply with ASME B30.20 standards and all applicable local building and safety codes. Overhead suspension hardware must be of a type that includes product traceability controls.
6. Provide safety cable on all bracket mounted loudspeakers.
7. All loudspeakers located in ceiling tiles shall be located in the center of the tile unless noted otherwise.

G. Installation of projectors:
1. Confirm distance of specified projection lens before mounting projector.
2. Projectors shall be mounted plumb and level at the operating position in a safe, secure and permanent manner.
3. All hardware required to locate the mount and projector at the required location shall be provided.
4. Projectors shall be mounted using tamper proof secure hardware.
5. Contractor may be required to adjust projection screen and lift upper and lower limit switches for projection screens and lifts specified elsewhere and not installed as part of this Contract.

H. Installation of flat panel monitors:
1. Confirm location before mounting.
2. Monitors shall be mounted plumb and level at the operating position in a safe, secure and permanent manner.
3. All hardware required to locate the mount and monitor at the required position shall be provided.
4. Locate monitor on the center line of the room unless noted otherwise.

3.3 FIRESTOP

A. A fire-stop system is comprised of the item or items penetrating the fire rated structure, the opening in the structure and the materials and assembly of the materials used to seal the penetrated structure. Fire-stop systems comprise an effective block for fire, smoke, heat, vapor and pressurized water stream.

B. All penetrations through fire-rated building structures (walls and floors) shall be sealed with an appropriate fire-stop system. This requirement applies to through penetrations (complete penetration) and membrane penetrations (through one side of a hollow fire rated structure). Any penetrating item i.e., riser slots and sleeves, cables, conduit, cable tray, and raceways, etc. shall be properly fire-stopped.

C. Fire-stop systems shall be UL Classified to ASTM E814 (UL 1479) and shall be approved by a qualified Professional Engineer (PE), licensed (actual or reciprocal) in the state where the work is to be performed.

D. A drawing showing the proposed fire-stop system, stamped/embossed by the PE shall be provided to the Owner's Technical Representative prior to installing the fire-stop system(s).

E. All fire-stop systems shall be installed in accordance with the manufacturer's recommendations and shall be completely installed and available for observation by the local authorities prior to cable system acceptance.

3.4 CONTROL SYSTEM PROGRAMMING

A. Transport Control

1. Provide standard Stop, Play, Pause, Fast Forward and Rewind for each playback device and menu control for DVD players. Buttons should be arranged in a conventional fashion that will be familiar to the normal user.
2. The selected control function should be displayed by showing the appropriate button "pressed". It should remain this way until another function is selected.
3. For devices that will go into a standby mode after a period of time, the control system shall sense this mode and restore normal operating mode once a transport function has been selected. This may require the use of current sensors to determine the state of the unit. No direct user action should be required at the playback device to restore the normal operating mode.

B. Screen/Shade Control

1. In addition to up-down functions, provide a Stop function to allow the movement to be halted. Once movement has been stopped, the up or down buttons should resume travel in the selected direction.
2. Control system shall not prevent screen/shade wall controls from being used as well.
3. Touch panel controls should be readily accessible to the user to permit direct control of shades or screen with having to navigate through multiple control pages.

C. Room Combining

1. Combining of adjacent areas shall be done through a graphical representation of the physical areas to be combined. Use of a floor plan metaphor is recommended with the graphic oriented correctly with respect to control panel location.
2. Use buttons or other appropriate objects placed along the common wall to enable the combining function.
3. When spaces are combined, the graphic appearance of those areas shall change to reflect this configuration. Once an area is separated from a combination, the color of its area should revert to the normal room color.
4. Common control functions between combined rooms shall be linked, allowing control of the combined area from any one of the touch panels. Examples of common functions include:
    a. Background music selection,
    b. Background music volume
    c. Background music muting
    d. Lighting preset recall
    e. Master volume (not individual channel volume)
5. When combining adjacent rooms, the control system shall force the common functions to a predetermined default configuration so all rooms have the same configuration.

6. To avoid unintentional changes, a control panel will not be able to operate a function in a remote location without also operating that same function in the room where the panel is located.

D. Level Control
   1. Objects requiring level adjustment such as volume or tone controls shall be through Up/Down buttons with a graphical representation of the actual level.
   2. Increment of level change to be adjusted for reasonable range without the need to push the Up or Down buttons needlessly.

E. Volume Mute
   1. Where the ability to mute the sound is needed, the button shall use the label “Vol On” and “VOL OFF” instead of Mute and Unmute. When in a “VOL OFF” mode, pushing the “VOL UP” button shall restore the sound and bring the system out of the muted mode.
   2. VOL ON/OFF buttons shall change color to indicate the status of the button.

F. Standard Colors
   1. Control functions shall be color coded to add clarity and show relationships between different groups of controls.
   2. The color Red shall be reserved to indicate a fault or abnormal condition.
   3. Green may be used to indicate normal operation, but may be used for standard control colors as well.
   4. Similar controls should maintain the same color scheme across all control pages.
   5. When a function is selected, the graphical depiction of that button should appear to be pressed and its color change to a darker shade of the regular button color.
   6. Color schemes used for background and foreground objects should be selected to be complimentary and provide a consistent theme throughout the control pages.

G. Minimum Button Size and Placement
   1. Minimum visual size of a button is 3/8” wide by 1/4” high.
   2. Spacing between buttons should be no less than 1/16”.
   3. Where buttons are immediately adjacent, the active selection area of the button should be reduced to 80% of the visual area of the button.

H. Button Actions
   1. When a function on a control page is selected, that button or visual object associated with that function should change to reflect what has been chosen.
   2. For functions that are momentary selections (i.e. VOL UP), the change of state is visible for as long as the button is being pressed.
   3. For function that are maintained selections (i.e. PLAY), the change of state remains visible until another function is selected and resets the previous function..
   4. The state change of a button or visible object should depict real-world objects as much as possible including the appearance of the button be pressed inward, change in shade of the original color, but not a change in hue.

I. Labels
   1. Use of simple words or titles are preferred to indicate functionality, navigation and system status.
   2. Use of stylish symbols should be avoided unless their identity is commonly recognized by the general public. Standard symbols for transport functions are acceptable.
   3. Labels should be presented in a clear, sans serif type face that will remain legible on lower resolution touch panels.
   4. Where physical buttons are present along the side of a touch panel, these buttons should be engraved and filled with a contrasting color.

J. Power On/Off
   1. For panels requiring an ON/OFF control, these functions should be linked through current sensors or other methods for the control system to detect the power on condition of the component being controlled.
   2. Powering off a system should not interfere with the ability of a projector to complete its cool down cycle.

K. Look & Feel
   1. Control pages should utilize a clean, elegant but stylish appearance.
   2. Use a common graphical template across all control pages for a consistent look.

3. The touch screen layout should utilize graphical elements such as drop shadows, gradient fills and transparency to provide a pleasing overall appearance.
4. Utilize graphical representations of floor plans to convey location information.
5. Include company logos, icons or watermarks to portray the corporate identity.
6. Provide clear navigation tools for moving between control pages.
7. Each sub-page should have a “BACK” button to return to the previous page. This button should appear in the same location on each page.
8. Provide a “HELP” button or icon on each user page to provide clear, non-technical instructions on how to use the functions available to regular users.

L. Security
1. Provide password access to control pages not intended to be accessed by the general public.
2. Unless otherwise noted, provide a minimum of three levels of access
   a. General User
   b. Non-Technical Employee
   c. AV Technician
3. Segregate the control functions to only allow authorized individuals access to more sophisticated control pages.
4. Provide a timeout feature to automatically return the control panel back to the default opening screen after 30 seconds of inactivity. After this reset, passwords must be reentered to return to a previous control page.

M. Presets
1. For systems that have different operating modes or configurations, provide the ability to store and recall preset combinations of system settings.
2. Provide a “Preset” page that permits a minimum of five presets to be recalled. Each button to include a label describing the function or configuration associated with that button.
3. Provide the ability for new presets to be stored over previous settings. New preset to be able to change the label to reflect the new or revised configuration.
4. When a preset has been recalled, the control page should indicate the active configuration.

3.5 LABELING OF EQUIPMENT

A. Provide each terminal strip with a unique descriptor and a numerical designator for each terminal. Show terminal strip descriptor and designator on system schematic drawing.

B. Provide logical and legible cable and wiring label permanently affixed for easy identification.
1. Labels on cables to be adhesive strip type covered with clear heat-shrink tubing. Factory stamped heat shrink tubing may be used in lieu of the adhesive strip style.
2. Wiring designator to be an alpha-numeric code unique for each cable. Actual cable designation assignments to be determined by Contractor. Add cable designation codes to system schematic drawings.
3. Locate the cable designator at the origination and destination of each circuit within 3 inches of the point of termination or connection. Provide cable designator on circuits with intermediate splice points with an additional suffix to indicate each segment.

3.6 ENGRAVING

A. Text font: 1/8 inch block sans serif characters unless noted otherwise.

B. On dark materials, provide white characters; on stainless steel or brushed natural aluminum plates, or light-colored materials, provide black characters.

C. Provide at least two lines of text with first line listing the general device name, e.g., amplifier. Second line to include schematic reference of the device, e.g., AMP-1.

D. Equipment label: black with white characters except where indicated.

3.7 COMMISSIONING

A. Prior to energizing or testing the system, ensure the following:
1. All products are installed in proper and safe manner according to manufacturer’s instructions.
2. Insulation and shrink tubing are present were required.
3. Dust, debris, solder splatter, etc. is removed.
4. Cable is dressed, routed, and labeled; connections are consistent with regard to polarity.

5. Labeling has been provided.
6. Temporary facilities and utilities have been properly disconnected, removed and disposed of off-site.
7. Products are neat, clean and unmarred and parts securely attached.
8. Broken work, including glass, raised flooring and supports, ceiling tiles and supports, walls, doors, etc. have been replaced or properly repaired, and debris cleaned up and discarded.

B. Prior to energizing the System verify and perform the following tests and adjustments in compliance with applicable EIA standards.
1. Electronic devices are properly grounded.
2. Test each AC power receptacle with a circuit checker for proper hot, neutral and ground connections.
3. Verify each individual component is operating properly.
4. Verify each individual component's performance meets the manufacturer's published performance for this unit.
5. Measure and record the DC resistance between the technical ground in any equipment rack or console and the main building ground. Resistance should be 0.15 ohms or less.

C. Speaker Circuit Verification Test
1. Measure the impedance of each speaker line leaving the equipment racks.
2. For constant voltage systems measure the impedance at 100 (or 250) Hz, 1 KHz and 8 (or 10) KHz of each line leaving the equipment rack with the line disconnected from the driving source. For band limited devices, use a frequency appropriate for the operating range of the transducer.
3. When documenting the results of these tests, include the calculated impedance based on number of units on a line and the size and distance of the run. Correct any field readings that differ more than 20% from the calculated impedance.
4. Include the results of the tests in the Project Record Manual.

D. Speaker Polarity Verification Test
1. Use an electronic polarity checker, TEF-20, SYSID, SIM II, Smaart, or other similar device to test each loudspeaker. All speakers should have the same relative polarity.
2. Follow manufacturer's recommendations in conducting the tests.
3. Include the results of the tests in the Project Record Manual.

E. Audio Signal Paths
1. Verify operation from each source device through all switching, amplification and distribution devices.

F. System Gain Adjustment
1. Adjust each active device to have proper gain structure from the mixer output to the input of the amplifier.
2. With all amplifiers turned off, connect a sine wave or pink noise generator to the input of the mixer. Using a RMS AC voltmeter with a dB scale, adjust the mixer to an output between -10 and 0 dBu. Once the level has been established, it should remain unchanged throughout the test. All equalizers should be set flat for this test.
3. Follow the signal flow from the mixer to each subsequent component. Measure the input level and output level of each device at the point of connection to the device. The input level reading should differ no more than 0.25 dB from the level recorded for the preceding device. Diagnose and correct the wiring or equipment when any readings exceed this range.
4. Adjust the output of each component to achieve the proper output level.
5. Record the output levels of each device in the Project Record Manual.

G. Signal Delay Adjustment
1. Adjust the delay to each subsystem to ensure proper synchronization between the main speakers and delayed speakers.
2. Using a TEF 20, SYSID, Smaart, SIM II, or other acceptable time based measurement system, measure the arrival time of the distant signal and then measure the arrival of the local signal.
3. Based on the arrival times measured, adjust the delay applied to the local speakers to synchronize them with the distant speakers. Repeat the test to verify the delay has been set to within 1 ms of the arrival of the distant signal. Once the precise delay time

has been determined, provide an additional 10 ms of Haas effect delay to maintain directional orientation toward the original sound source.
4. Continue to test and adjust each separate subsystem with a dedicated delay channel.
5. Provide hard-copy printout of each delay adjustment showing first the arrival times with no delay set and then the result after the delay has been adjusted. Record the settings of each delay in the Project Record Manual.

H. Remote Input Verification Test
1. Using a microphone or portable signal generator, connect to each microphone/line level receptacle throughout the facility.
2. Verify that the receptacle under test appears at the correct input and is operating properly.
3. In a similar manner, check all remote tielines and media related lines for correct wiring and labeling.

I. System Equalization
1. Using a RTA, TEF 20, SYSID, or SMAART, equalize all loudspeaker systems to provide a suitable frequency response as follows:
   a. Speech Reinforcement Systems: flat response from 125 Hz to 2.5 KHz, with 2 dB roll off above.
   b. Program Reproduction Systems: flat response from 65 Hz to 8 KHz, with 2 dB roll off above.
2. Verify system gain and amplifier levels.
3. Provide program levels of at least 85 dB and speech reinforcement levels of at least 70 dB in the seating area without objectionable distortion, buzzes, or rattles.
4. Provide hard copy printouts of the spectral response with the test data.

J. RFI and Parasitic Oscillation
1. With systems operating check to ensure that all systems are free from spurious oscillation and radio frequency interference in the absence of audio signal.

K. Buzzes, Rattles and other Distortions
1. Adjust the system for normal operating level in the space. Apply a slow sine wave sweep from 60 Hz to 3 KHz and listen carefully for buzzes, rattles and other objectionable distortions.
2. Correct the cause of the defect. If the cause is not from the system. Bring the cause to the attention of the GC, indicating cause and suggestive corrective actions.

L. Video Systems Test
1. Projected images and screen must be plumb with respect to ceiling line.

M. Video System Tests. Verify performance of all video equipment, components and systems, as specified herein.
1. Video (signal):
   a. S/N (peak to RMS), unweighted DC to 4.2 MHz: 55 dB minimum.
   b. Crosstalk, unweighted DC to 4.2 MHz: 45 dB minimum.
   c. Frequency Response: Within plus to minus 0.5 dB to 4.2 MHz.
   d. Line and Field Tilt: 2% maximum.
   e. Differential Gain: 2% maximum.
   f. Differential Phase: 2 degrees maximum.
   g. Frequency Response: DC to 4.2 MHz within plus or minus 0.5 dB.

N. Video Signal Paths
1. Verify operation from each source device through all switching, amplification and distribution devices.

O. Video Test Report shall include the following:
1. Test Failures and Notices
   a. Sink Device EDID Test – Open items or failures shall not be accepted.
   b. Cable Length Test – Open items or failures shall not be accepted.
   c. HDCP KSV Limitations – Limitations shall not be accepted.
   d. Cable Limitations - Limitations shall not be accepted.
   e. EDID Limitations - Limitations shall not be accepted.
   f. Cable Length Limits exceeded – Failing cables shall not be accepted.
2. Device Model Number, Serial Number, and Firmware Version for main chassis and each input and output card.

3. Device Model Number, Serial Number, and Firmware Version for connected transmitter and receiver devices.
4. EDID – Input Resolution and 3D support status for each input.
5. EDID – Supported Output Resolution and 3D support status for devices connected to each output.
6. EDID – Supported Audio formats for each input.
7. EDID – Supported Audio formats for devices connected to each output.

P. Control Systems
1. Verify operational functions of the control system and all interfaced devices.
2. Verify operational functionality of any wireless user devices.

3.8 CAT5E/CAT6 CABLE CERTIFICATION

A. General Field Test Requirements
1. All CAT5E/CAT6 cabling links installed as part of this scope shall be tested for the following, in accordance with the field test specifications defines in ANSI/TIA-568-C.2 “Commercial Balanced Twisted-Pair Telecommunications Cabling and Components Standard.” This document will be referred to as the “Category 5e Standard”:
a. Wire Map
b. Length
c. Insertion Loss
d. NEXT loss
e. PS NEXT Loss
f. ACR-F Loss
g. PS ACR-F Loss
h. Return Loss
i. Propagation Loss
j. Delay Skew
2. The installed twisted-pair horizontal links shall be tested from terminated end point to terminated end point for compliance with the “Permanent Link” performance specification as defined in the Category 5e Standard.
3. One hundred percent of the installed cabling links must pass the requirements of the Category 5e standard mentioned above and as further detailed in Section B below. Any failing link must be diagnosed and corrected. The corrective action shall be followed with a new test to prove that the corrected link meets the performance requirements. The final and passing result of the tests for all links shall be provided in the test results documentation in accordance with Section C below.
4. The test equipment (tester) shall comply with the accuracy requirements for level IIe field testers as defined in ANSI/TIA-1152. The tester including the appropriate interface adapter must meet the specified accuracy requirements. The accuracy requirements for the permanent link test configuration (baseline accuracy plus adapter contribution) are specified in Table 2 of ANSI/TIA-1152 (Table 2 in this TIA document also specifies the accuracy requirements for the channel configuration).
5. The RJ45 test plug shall fall within the values specified in ANSI/TIA-568-C Annex C for NEXT, FEXT and Return Loss.
6. The tester shall be within the calibration period recommended by the vendor in order to achieve the vendor-specified measurement accuracy.
7. The tester interface adapters must be of high quality and the cable shall not show any twisting or kinking resulting from coiling and storing of the tester interface adapters. In order to deliver optimum accuracy, preference is given to a permanent link interface adapter for the tester that can be calibrated to extend the reference plane of the Return Loss measurement to the permanent link interface. To ensure that normal handling on the job does not cause measurable Return Loss change, the adapter cord cable shall not be of twisted-pair construction.
8. The Pass or Fail condition of the link-under-test is determined by the results of the required individual tests (detailed in Section 4.2.2 of ANSI/TIA-1152). Any Fail result yields a Fail for the link-under-test. In order to achieve an overall Pass condition, the results for each individual test parameter must Pass.
9. A Pass or Fail result for each parameter is determined by comparing the measured values with the specifies test limits for that parameter.

B. Performance Test Parameters

1. The test parameters are defined by the Category 5e Standard. The test of each link shall contain all of the following parameters as detailed below. In order to pass the test, all measurements (at each frequency in the range from 1 MHz through 100 MHz) must meet or exceed the limit value determined in the above mentioned standard.
2. Wire Map - Shall report Pass if the wiring of each wire-pair from end to end is determined to be correct.
3. Length – The field tester shall be capable of measuring length of all pairs of a basic link or channel based on the propagation delay measurement and the average value for NVP. The physical length of the link shall be calculated using the pair with the shortest electrical delay. This length figure shall be reported and shall be used for making the Pass/Fail decision. The Pass/Fail criteria are based on the maximum length allowed for the Permanent Link configuration (90 meters – 295 feet) plus 10% to allow for the variation and uncertainty of NVP.
4. Insertion Loss (Attenuation) – Insertion Loss is a measure of signal loss in the permanent link or channel. The term “Attenuation” has been used to designate “Insertion Loss.” Insertion Loss shall be tested from 1 MHz through 100 MHz in maximum step size of 1 MHz. It is preferred to measure insertion loss at the same frequency intervals as NEXT loss in order to provide a more accurate calculation of the Attenuation-to-Crosstalk Ratio (ACR) parameter. Minimum test results documentation (summary results): Identify the worst wire pair (1 of 4 possible). The test results of the worst wire pair must show the highest attenuation value measured (worst case), the frequency at which the worst case value occurs, and the test limit value at this frequency.
5. NEXT Loss – Pair-to-pair near end crosstalk loss (abbreviated as NEXT loss) shall be tested for each wire pair combination from each end of the link (a total of 12 pair combinations).This parameter is to be measured from 1 through 100 MHz. NEXT Loss measures the crosstalk disturbance on a wire pair at the end from which the disturbance signal is transmitted (near-end) on the disturbing pair. The maximum step size for NEXT loss measurements shall not exceed the maximum step size defined in the Category 5e Standard as shown in Table 1. Minimum test results documentation (summary results): Identify the wire pair combination that exhibits the worst value of NEXT (worst case). NEXT is to be measured from each end of the link-under-test. These wire pair combinations must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.

Table 1 – Maximum frequency step size as defined in ANSI/TIA-1152

a.

Frequency Range (MHz)	Maximum Step size (MHz)
1 - 31.25	0.15
31.26 - 100	0.25

b.

6. PS NEXT Loss – Power Sum NEXT Loss shall be evaluated and reported for each wire pair from both ends of the link under-test (a total of eight results). PS NEXT Loss captures the combined near-end crosstalk effect (statistical) on a wire pair when all other pairs actively transmit signals. Like NEXT this test parameter must be evaluated from 1 through 100 MHz and the step size may not exceed the maximum step size defined in the Category 5e Standard as shown in Table 1. Maximum test results documentation (summary results): Identify the wire pair that exhibits the worst-case margin and the wire pair that exhibits the worst value for PS next. These wire pairs must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.
7. ACR-F Loss, pair to pair – Attenuation Crosstalk Ratio Far-end is calculated from the pair-to-pair FEXT Loss. It shall be measured for each wire-pair combination from both ends of the link under-test. FEXT Loss measures the crosstalk disturbance on a wire pair at the opposite end (far-end) from which the transmitter emits the disturbing signal on the disturbing pair. FEXT is measured to compute ACR-F Loss that must be evaluated and reported in the test results. ACR-F measures the relative strength of the

far-end crosstalk disturbance relative to the attenuated signal that arrives at the end of the link. This test yields 24 wire pair combinations. ACR-F is to be measured 1 through 100 MHz and the maximum step size for FEXT loss measurements shall not exceed the maximum step size defined as the standard as in Table 1. Minimum test results documentation (summary results): Identify the wire pair combination that exhibits the worst value for ACR-F. There wire pairs must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.

8. PS ACR-F Loss – Power Sum Attenuation Crosstalk Ratio Far-end is a calculated parameter that combines the effect of the FEXT disturbance from three wire pairs of the fourth one. This test yields eight wire-pair combinations. Each wire-pair is evaluated from 1 through 100 MHz in frequency increments that do not exceed the maximum step size defined in the standard as shown in Table 1. Minimum test results documentation (summary results): Identify the wire pair that exhibits the worst pair combinations must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.
9. Return Loss – Return Loss (RL) measures the total energy reflected on each wire pair. Return Loss is to be measured from both ends of the link-under-test for each wire pair. This parameter is also to be measured from 1 through 100 MHz in frequency increments that do not exceed the maximum step size defined in the Category 5e Standard as shown in Table 1. Minimum test results documentation (summary results): Identify the wire pair that exhibits the worst value of Return Loss. These wire pairs must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.
10. Propagation Delay – Propagation delay is the time required for the signal to travel from one of the links to the other. This measurement is to be performed for each of the four wire pairs. Minimum test results documentation (summary results): Identify the wire pair with the worst propagation delay. The report shall include the propagation delay value measured as well as the test limit value.
11. Delay Skew – [as defined in the Category 5e Standard; Section 6.2.19] This parameter shows the difference in propagation delay between the four wire pairs. The pair with the shortest propagation delay between the four wire pairs. The pair with the shortest propagation delay is the reference pair with a delay skew value of zero. Minimum test results documentation (summary results): Identify the wire pair with the worst-case propagation delay (the longest propagation delay). The report shall include the delay skew value measured as well as the test limit value.

C. Test Result Documentation
   1. The test results/measurements shall be transferred into a Windows based database utility that allows for the maintenance, inspection, and archiving of these test records. A guarantee must be made that the measurement results are transferred to the PC unaltered, i.e., “as saved in the tester” at the end of each test and that these results cannot be modified at a later time.
   2. The database for the completed job shall be stored and delivered on CD-ROM or DVD including the software tools required to view, inspect, and print any selection of test reports.
   3. A paper copy of the test results shall be provided that lists all the links that have been tested with the following summary information:
      a. The identification of the link in accordance with the naming convention defined in the overall system documentation.
      b. The overall Pass/Fail evaluation of the link-under-test including the NEXT Headroom (overall worst case) number.
      c. The date and time the test results were saved in the memory of the tester.
   4. General information to be provided in the electronic data base with the test results information for each link:
      a. The identification of the customer site as specified by the end-user.
      b. The identification of the link in accordance with the naming convention defined in the overall system documentation.
      c. The overall Pass/Fail evaluation of the link-under-test

d. The name of the test limit selected to execute the stored test results
e. The cable type and value of NVP used for length calculations
f. The date and time the test results were saved in the memory of the tester
g. The brand name, model, and serial number of the tester.
h. The identification of the tester interface
i. The revision of the tester software and the revision of the test limits database in the tester
j. The test results information must contain information on each of the required test parameters that are listed in Section B and as further detailed below under paragraph C5.

5. For each of the frequency-dependent test parameters, the value measured at every frequency during the test is stored. The PC-resident database program must be able to process the stored results to display and print a color graph of the measured parameters. The PC-resident software must also provide a summary numeric format in which some critical information is provided numerically as defined by the summary results (minimum numeric test results documentation) as outlined above for each of the test parameters.

6. The detailed test results data to be provided in the electronic database must contain the following information:
   a. Length: Identify the wire-pair with the shortest electrical length, the value of the length rounded to the nearest 0.1 m330 and test limit value.
   b. Propagation delay: Identify the pair with the shortest propagation delay, the value measured in nanoseconds (ns) and the test limit value.
   c. Delay Skew: Identify the pair with the largest value for delay skew, the value measured in nanoseconds (ns) and the test limit value.
   d. Insertion Loss (Attenuation): Minimum test results documentation as explained in Section B for the worst pair.
   e. Return Loss: Minimum test results documentation as explained in Section B for the worst pair as measured from each end of the link.
   f. NEXT, ACR-F: Minimum test results documentation as explained in Section B for the worst pair combination as measured from each end of the link.
   g. PS NEXT and PS ACR-F: Minimum test results documentation as explained in Section B for the worst pair combination as measured from each end of the link.

3.9 FINAL OBSERVATION & TESTING

A. Upon completion of installation, initial adjustments, tests and measurements specified in Part 3, and submission and review of the results, a final observation and test will be performed by the Owner or Owner’s representative no earlier than two weeks after receipt of the written results.
B. Provide a minimum of one (1) person for observation and testing familiar with aspects of the System to assist the Owner.
C. The process of testing the System may necessitate moving and adjusting certain components.
D. Testing includes operation of each major system and any other components deemed necessary. Perform tests and provide required test equipment, tools and material required to make any necessary repairs, corrections, or adjustments.
E. The following procedures will be performed on each System:
   1. Observation of the methods and means employed to incorporate the System within the facility.
   2. Verification of proper operation, from controlling devices to controlled devices.
   3. Verification of proper adjustment, balance, and alignment of equipment for optimum quality and to meet the manufacturer's published specifications. Establish and mark normal settings for each level control, and appropriately record these settings within the Record Documents.
   4. Other tests on equipment or systems deemed appropriate.
F. In the event the need for further adjustment or work becomes evident during testing, the Contractor is to continue his work until the System is acceptable at no addition to the contract

price. If approval is delayed because of defective equipment, or failure of equipment or installation to meet the requirements of these specifications and any extension of the observation and testing period is required, the Contractor shall pay for additional time and expenses of the Owner at the standard rate in effect at that time.

3.10 TEST EQUIPMENT

A. Thirty days prior to start of testing, provide a list to the Owner of test equipment make, model numbers and calibration dates that will be used.

B. The following equipment shall be available on site for the entire test period through final system testing.

1. Sound Level Meter : ANSI S1.4-1971 Type S1A with digital or analog display. Meter to provide ranges of 40 to 120 dBA.
2. Pink Noise Source - Equal energy per octave bandwidth 20 Hz to 20,000 Hz, ±1 dB (long-term average) at 0 dBm output. Stability: ±2 dB per day.
3. Dual-trace oscilloscope - 100 MHz bandwidth, 1 mV/cm sensitivity.
4. Impedance Meter - Capable of testing audio lines at three frequencies, minimum, between 250 Hz and 5k Hz. Measurement Range: 1 ohm to 100 kohms.
5. Audio Oscillator: bandwidth 20 Hz to 20k Hz ±.5 dB at 0 dBm output. Output to be balanced. Oscillator to include adjustable output level over the range from –30 dBu to +10 dBu.
6. Multimeter - Measurement range, DC to 20k Hz, 100 mV to 300 V, 10 ma to 10 A, dB.
7. NTSC Test generator
8. Real time analyzer with LED or CRT display. The unit shall meet the filter requirements of ANSI S1.11 Class III for one third octave filters.
9. Video (analog) test generator capable of generating signal up to 1920 x 1200 with audio.
10. Video (digital) test generator capable of generating signal up to 1920 x 1200 with audio.
11. Ladders and scaffolding necessary to inspect elevated equipment, junction boxes, etc.

C. Provide three portable VHF or UHF business band radios for use during acceptance testing with transmission range sufficient to cover entire project. Include rechargeable batteries and recharger along with holster for wearing on belt. Radios to be available for duration of testing process, including any follow-up visits required prior to final acceptance.

3.11 INSTRUCTION OF OWNER PERSONNEL

A. Provide 8 hours instruction to Owner designated personnel focusing on the use, operation and maintenance of the systems, scheduled as a minimum of two separate sessions, by an instructor fully knowledgeable and qualified in system operation. The System Reference Manuals should be complete and on site at the time of this instruction. Coordinate schedule of demonstration with Owner’s Representative.

B. Video record all training sessions and compile a training video to be provided to the Owner on DVD.

C. Provide sign in sheet to document the attendee’s presence.

D. If Contractor is not properly equipped to conduct Owner training on particular equipment, arrange for factory representatives of the equipment to be present to provide training at no additional cost to the Owner.

3.12 CLEANUP AND REPAIR

A. Upon completion of the work, remove refuse and rubbish from and about the premises. Leave areas and equipment clean and in an operational state. Repair any damage caused to the premises by the installation of systems at no cost to the Owner.

END OF SECTION 27 41 16

SECTION 28 00 00

SECURITY BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes general administrative and procedural requirements for Division 28 and is intended to supplement, not supersede, the requirements specified in Division 1.

B. The requirements described herein include the following:
   1. References
   2. Definitions
   3. System Description
   4. Submittals
   5. Quality Assurance
   6. Product Delivery, Storage, and Handling
   7. Project Management and Coordination Services
   8. Warranty
   9. Maintenance

C. Related Sections:
   1. Consult other Sections, determine the extent and character of related work, and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable installation.
   2. Earthwork: Include trenching, backfilling, boring and soil compaction as required for the installation of underground conduit, in-grade pull boxes, vaults, and bollard foundations. Refer to Division 2.
   3. Concrete Work: Include forming, steel bar reinforcing, cast-in- place concrete, finishing and grouting as required for underground conduit encasement, pedestal foundations, and curbs (also includes saw-cutting of existing slabs and grouting of conduits in saw-cut).
   4. Miscellaneous Metal Work: Include fittings, brackets, backing, supports, rods, welding and pipe as required for support and bracing of raceways, equipment enclosures, cameras, and similar devices. Refer to Division 5.
   5. Moisture Protection and Smoke Barrier Penetrations: Include membrane clamps, sheet metal flashing, counter flashing, caulking and sealant as required for waterproofing of conduit penetrations and sealing penetrations in or through fire walls, floors, ceiling slabs and foundation walls. Tape and make vapor tight penetrations through vapor barriers at slabs on grade. Refer to Division 7.
   6. Locking Hardware: Include interface to electronic hardware and door controllers on security related doors. Refer to Division 8.
   7. Access Panels and Doors: Required in walls, ceilings, and floors to provide access to security devices and equipment.
   8. Painting: Include surface preparation, priming and finish coating as required for security cabinets, exposed conduit, pull and junction boxes, and devices where indicated as field painted in this Division. Refer to Division 9.
   9. Elevators: Include interface to elevator floor and hall call on security related elevators. Refer to Division 14.

1.2 REFERENCES

A. General

1. Codes, standards, and industry manuals/guidelines listed by reference, including revisions by issuing authority, form a part of this specification section to extent indicated. Consider such codes and/or standards a part of this Specification as though fully repeated herein.
2. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.
3. Reference to codes, standards, specifications and recommendations of technical societies, trade organizations and governmental agencies shall mean that latest edition of such publications adopted and published prior to submittal of the bid unless otherwise specifically stated.

B. Codes: Perform Work executed under this Section in accordance with applicable requirements of the latest edition of governing codes, rules and regulations including but not limited to the following minimum standards, whether statutory or not:
1. United States Department of Labor (DOL) Regulations (Standards - 29 CFR)
   a. Part 1910 – Occupational Safety and Health Standards
2. National Fire Protection Agency (NFPA)
   a. NFPA 70 – National Electrical Code (NEC)
   b. NFPA 75 – Protection of Information Technology Equipment
3. Uniform Building Code (UBC)
4. Uniform Fire Code (UFC)
5. Uniform Mechanical Code (UMC)
6. National, State, Local and other binding building and fire codes
7. FCC Regulations:
   a. Part 15 – Radio Frequency Devices & Radiation Limits
   b. Part 68 – Connection of Terminal Equipment to the Telephone Network

C. Standards: Perform Work and furnish materials and equipment under Division 28 in accordance with the latest editions of the following standards as applicable:
1. Underwriter's Laboratories (UL): Applicable listing and ratings.
   a. UL 294 – Access Control System Units
   b. UL 1076 – Proprietary Burglar Alarm Units and Systems
   c. UL 2044 – Commercial Closed-Circuit Television Equipment

1.3 DEFINITIONS

A. In addition to those Definitions of Division 1, the following list of terms as used in this specification defined as follows:
1. “Owner”: Fannin County
2. “General Contractor”: Manhattan/Byrne/3i
3. “Engineer”: MEPCE
4. “Furnish”: To purchase, procure, acquire, and deliver complete with related accessories.
5. “Install”: To set in place, join, unite, fasten, link, attach, set up or otherwise connect together and test before turning over to the Owner, parts, items, or equipment supplied by contractor or others. Complete installation and make ready for regular operation.
6. “Provide”: To furnish, transport, install, erect, connect, test and turn over to the Owner, complete and ready for regular operation.
7. “Connect”: To install required patch cords, equipment cords, cross-connect wire, etc. to complete an electrical or optical circuit.
8. “As directed”: As directed or instructed by the Owner, or their authorized representative.
9. “Cabling”: A combination of cables, wire, cords, and connecting hardware (e.g., cables, conductor terminations, connectors, outlets, patch panels, blocks, and labeling).
10. “SEC”: Security Equipment Cabinet
11. “SJB”: Security Junction Box
12. “ACAMS”: Access Control & Alarm Monitoring System
13. “DCS”: Detention Control System
14. “IDS”: Intrusion Detection System

15. “NVR”: Network Video Recorder
16. “VSS”: Video Surveillance System

1.4 SYSTEM DESCRIPTION

A. In circumstances where the Specifications and Drawings conflict, the Drawings shall govern quantity and the Specifications shall govern quality.

1.5 SUBMITTALS

A. Submit required submittals to the General Contractor in the quantities and formats as required under the general contract. In the absence of requirements, provide as described in the following with reference to quantity and format.

B. Contractor Qualifications
   1. Resumes of the Project Manager, General Foreman, and Lead Technician(s) indicating role, years of experience, product certifications and training, listing of similar projects the individual performed the role proposed for this project along with client contact information for each.
   2. Certification letters stating the Contractor is an authorized reseller, installer, and extended warranty provider for the following systems:
      a. ACAMS manufacturer & certification level
      b. VSS manufacturer & certification level

C. Product Data
   1. Obtain written approval from the Engineer for the product data submittal prior to the release of materials and equipment purchase order and prior to installation.
   2. Quantity: Submit product data submittals as described in Division 1.
   3. Format:
      a. Minimum Format: Submit each product data submittal in an 8-1/2 x 11 inch folder. Product data submittal shall be in a 3-ring binder (or similar). If in a 3-ring binder, insert the submittal information the transparent front cover and spine pockets.
      b. Clearly label the cover and spine of each submittal with the following information:
         1) Client Name
         2) Project Name and Address
         3) Project Submittal Number
         4) Submittal Name (e.g., “Product Data Submittal for Video Surveillance System”)
         5) Specification Section Number (e.g., “Section 28 23 00”)
         6) Date of Submittal Format: <month> <day>, <year> (e.g., “January 1, 2020”)
         7) Contractor Name
      c. Include a Table of Contents at the beginning of the submittal that lists materials by article and paragraph number (e.g., “2.02-A Network Video Recorders”).
      d. Include tabbed separators for improved navigation through the submittal.
   4. Content:
      a. Cover Letter: Product data submittals shall include a cover letter stating that the submittal is in full compliance with the requirements of the Contract Documents. Sign (and stamped, if applicable) cover letter and list items and data submitted. Have the person who prepared the submittal sign the document as well. Failure to comply with this requirement shall constitute grounds for rejection of submittal.

b. Product Information: Product Data submittal shall consist of manufacturer's technical data, product literature, "catalog cuts", data sheets, specifications, and block wiring diagrams (if necessary). This data shall clearly describe the product's characteristics, physical and dimensional information, electrical performance data, materials used in fabrication, material color & finish, and other relevant information such as test data, typical usage examples, independent test agency information, and storage requirements. Clearly indicate by arrows or brackets precisely what is being submitted on and those optional accessories, which are included and those which are excluded. At a minimum, include products listed in the Division 28 specifications. Include relevant products that will be installed, which are not listed in the specifications.

c. Re-submittals: Provide a cover letter with the re-submittal that lists the action taken and revisions made to each product submittal in response to Submittal Review Comments. No review shall take place for any re-submittal packages that is not accompanied by this cover letter. Failure to include this cover letter will constitute rejection of the re-submittal package.

D. Shop Drawings

1. Obtain written approval from the Engineer for the shop-drawings submittal prior to the release of materials and equipment purchase order and prior to installation.
2. Quantity and Media: Submit shop-drawings as described in Division 1.
3. Format:
   a. Produce shop drawings using AutoCAD, or other computer design application that can save files to AutoCAD-compatible files.
   b. Use the same size drawing sheet as the drawings of the Contract Documents.
   c. Text: minimum of 3/32" high when plotted at full size.
   d. Screen background information.
   e. Plot system components (devices, cable routes, etc.) and text at a sufficient line weight to stand out against background information.
   f. Scaling:
      1) Scale floor plans at 1/8"=1'-0"
      2) Scale enlarged room plans at 1/4"=1'-0"
      3) Scale wall elevations at 1"=1'-0"
4. Content:
   a. Submit shop drawings that represent proposed installation of security system.
   b. Floor Plans: Scale floor plans at 1/8"=1'-0". Floor plans shall show:
      1) Locations and identifiers of security devices.
      2) Size, quantity, location and proposed routes of security cabling.
      3) Size, quantity, location, and routes of pathways (such as cable trays, cable basket, conduits, cable hangers, and other cable support devices).
   c. Point-to-Point Diagrams: Include wiring, points of connection and interconnecting devices.
   d. Schedules: Provide schedules for devices and control panels that show each point ID with a description of the connected devices.
   e. Block Diagram/Riser Diagram: Show the devices, conduit, wire types, and sizes between them, including cabling interties between termination hardware.
   f. Proposed mounting details

E. As-Built Drawings

1. Quantity and Media: Submit as-built drawings as described in Division 1.
2. Format:
   a. Produce as-built drawings using AutoCAD, or other computer design application that can save files to AutoCAD-compatible files.
   b. Use the sheet size as the drawings of the Contract Documents, and use the project title block.
   c. Text: minimum of 3/32" high when plotted at full size.
   d. Use symbols identical to the symbols shown on the Drawings.
   e. Screen background information.

f. Plot system components (devices, cable routes, etc.) and text at a sufficient line weight to stand out against background information.

3. Content:
   a. Submit as-built drawings that fully represent actual installed conditions and that incorporate modifications made during the course of construction.
   b. Floor Plans: Scale floor plans at 1/8"=1'-0". Floor plans shall show:
      1) Locations and identifiers of security devices.
      2) Size, quantity, location and proposed routes of security cabling.
      3) Size, quantity, location, and routes of pathways (such as cable trays, cable basket, conduits, cable hangers, and other cable support devices).
   c. Point-to-Point Diagrams: Include wiring, points of connection and interconnecting devices.
   d. Schedules: Provide schedules for devices and control panels that show each point ID with a description of the connected devices.
   e. Block Diagram/Riser Diagram: Show the devices, conduit, wire types, and sizes between them, including cabling interties between termination hardware.
   f. Custom mounting details

F. Operation and Maintenance (O&M) Manuals
1. Quantity: Submit quantity of O&M Manuals as described in Division 1.
2. Format:
   a. Submit each O & M Manual in a white, 3-ring binder with front cover and spine clear pockets for insertion of the project information.
   b. Clearly label the cover of each O&M Manual with the following information:
      1) Client Name
      2) Project Name and Address
      3) Manual Name (e.g., "Operation and Maintenance Manual for Video Surveillance System")
      4) Date of Submittal Format: <month> <day>, <year> (e.g., "January 1, 2020")
      5) Contractor Name
   c. Include a Table of Contents at the beginning that lists the contents.
   d. Include tabbed separators for improved navigation through the manual.
3. Content:
   a. 11"x17" prints of as-built drawings, as described above
   b. Manufacturer's original catalog information sheets for each component provided under applicable Section (typically, this is similar to the accepted product data submittal)
   c. Warranty certificate from the manufacturer and the Contractor
   d. Manufacturer's instructions for system or component use
   e. Instructions and requirements for maintenance and warranty issues
4. Contents shall include requirements and methods for maintaining installed products.

1.6 QUALITY ASSURANCE

A. Contractor Qualifications
1. A current, active, and valid and Texas State Contractors License
2. Minimum five years experience in installation and service of access control, video surveillance, and intrusion detection systems.
3. Minimum five completed projects similar to scope and cost.
4. Evidence of technicians qualified for the work in the form of current manufacturer's training certification

B. Materials
1. Materials, support hardware, equipment, parts comprising units, etc., shall be new, unused, without defects and of current manufacturer, materials
2. Use specified products and applications, unless otherwise submitted and approved in writing.

C. Regulatory Requirements

1. Work and materials shall conform to the latest rules of National Board of Fire Underwriters wherever such standards have been established and shall conform to the regulations of the State Fire Marshal, OSHA and the codes of the governing local municipalities. Work under Division 28 shall confirm to the most stringent of the applicable codes.
2. Provide the quality identified within these Specifications and Drawings when codes, standards, regulations, etc. allow Work of lesser quality or extent. The Contract Documents address the minimum requirements for construction.

D. Drawings
1. Follow the general layout shown on the Drawings except where other Work may conflict with the Drawings.
2. Drawings for the Work within this Division are essentially diagrammatic within the constraints of the symbology applied.
3. The Drawings do not fully represent the entire installation for the security system. Drawings indicate the general route for the cables and the location of outlets. The Drawings might not expressly show every conduit, sleeve, hanger, etc., but a complete system is required.

1.7 PROJECT MANAGEMENT AND COORDINATION SERVICES

A. Project Management and Coordination Services
1. Provide a project manager for the duration of the project to coordinate this Work with other trades. Coordination services, procedures and documentation responsibility include, but are not limited to, the items listed in this section.
2. Review of Shop Drawings Prepared by Other Subcontractors:
a. Obtain copies of shop drawings for equipment provided by others that require telecommunication service connections or interface with Work.
b. Perform a thorough review of the shop drawings to confirm compliance with the service requirements contained in the Division 28 contract documents. Document discrepancies or deviations as follows:
1) Prepare memo summarizing the discrepancy
2) Submit a copy of the specific shop drawing, indicating via cloud, the discrepancy
c. Prepare and maintain a shop drawing review log indicating the following information:
1) Shop drawing number and brief description of the system/material
2) Date of the review
3) Name of the individual performing the review
4) Indication if follow-up coordination is required

B. Role of the Engineer
1. During the construction phase of the project, the Engineer will work with the Contractor to provide interpretation and clarification of project contract documents, reply to (and 'process') relevant Requests for Information (RFIs), and act as an interface between the Contractor and the Owner.
2. The Owner has retained the Engineer's services to observe the Work for general compliance with the Contract Documents and to ensure that the installation meets the design intent of the system.
3. In general, the Engineer will participate during the construction phase as follows:
a. Review product data and shop drawings submittals for general compliance with the contract drawings and specifications.
b. Review changes as they arise, and confirm that the proposed solutions maintain the intended functionality of the system.
c. Interpret field problems for Owner, and translate between Owner and Construction Team.
d. Review the testing procedures to confirm compliance with industry-accepted practices.

C. Use of CAD Files
1. Should the Contractor need the Engineer's CAD files to produce shop drawings and/or as-built drawings, the Engineer requires the Contractor sign a CAD files release agreement.

1.8 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery
   1. Do not deliver security system components to the site until protected storage space is available. Storage outdoors covered by rainproof material is not acceptable.
   2. Replace equipment damaged during shipping and return to manufacturer at no cost to the Owner.

B. Storage
   1. Store materials in a clean, dry, ventilated space free from temperature extremes.
   2. Maintain factory wrapping or provide a heavy canvas/plastic cover to protect units from dirt, water, construction debris, and traffic.
   3. Provide heat where required to prevent condensation or temperature related damage.

C. Handling
   1. Handle in accordance with manufacturer's written instructions.
   2. Prevent internal component damage, breakage, denting and scoring. Do not install damaged equipment. Replace damaged equipment and return equipment to manufacturer.

1.9 WARRANTY

A. Provide the Security System as described in this specification with a one-year parts and service warranty at no additional cost to the Owner.

B. Include in the warranty package, at a minimum, the following:
   1. Software support agreement for the ACAMS and VSS
   2. Software upgrades and patches
   3. Labor to install software upgrades and patches necessary to maintain the latest version
   4. Emergency service on regular working hour basis
   5. Service by factory trained and employed service representatives of system manufacturer

C. Maintain regular service facilities and provide a qualified technician familiar with this work at the site within four (4) hours of receipt of a notice of malfunction including weekends and holidays. Provide material, devices equipment and personnel necessary for repairs. Install approved temporary, alternate equipment if required by the Owner, complete and operational within twenty four (24) hours after notification of a malfunction, at no additional cost.

D. Conduct warranty repairs and service at the job site unless in violation of manufacturer's warranty; in the latter event, provide substitute systems, equipment and/or devices, acceptable to the Owner, for the duration of such off-site repairs. Transport warranty substitute and/or test systems, equipment, devices, material, parts and personnel to and from the job site at no additional cost.

1.10 MAINTENANCE

A. Extra Materials
   1. Deliver extra materials to a secured location determined by the Owner.
   2. Provide a complete Bill of Materials listing quantities, part numbers, and descriptions for each device for the Owner to sign indicating receipt of equipment.
   3. Provide new and unused spare parts in their original packing materials upon delivery.

B. Maintenance Service
   1. For the first year of service, conduct quarterly system performance review meetings to review system operation problems and/or defects that occurred during the preceding 3 months. During these performance review meetings, perform the following:
      a. Visual checks and operational tests of the central processor, local processors, monitors, keyboards, system printers, peripheral equipment, ACAMS equipment, power supplies, and electrical and mechanical controls
      b. Clean system equipment, including interior and exterior surfaces
      c. Perform diagnostics on equipment
      d. Check and calibrate each device

e. Run system software and correct diagnosed problems
f. Resolve previous outstanding problems

2. Provide software and firmware updates issued free of charge by the manufacturer.

PART 2 - PRODUCTS

2.1 GENERAL

A. Material and equipment specified herein have been selected as the basis of acceptable quality and performance and have been coordinated to function as components of the included systems. Where a particular material, device, equipment or system is specified directly, the current manufacturer's specification for same is a part of these specifications, as if completely elaborated herein.

B. Use standard, regularly manufactured, materials and equipment for this and/or other similar systems, and not custom designed especially for this project. Provide systems and components thoroughly tested and proven in actual use. Provide subsystems of one manufacturer.

2.2 SUBSTITUTIONS

A. Conform to the general requirements and procedure outlined in Division 1 in the Request for Substitution.

B. Only one substitution allowed for each product specified.

C. Where products are noted as "or equal", a product of equivalent design, construction, and performance will be considered. Submit product data – catalog cuts, product information, and pertinent test data – required to substantiate that the product is in fact equivalent to that specified. The burden of proof rest with the Contractor that the substituted product is equivalent to the specified product.

D. Manufacturers' names and model numbers used in conjunction with materials, processes or equipment included in the Contract Documents are used to establish standards of quality, utility and appearance. Materials, processes or equipment that, in the opinion of the Engineer, are equivalent in quality, utility and appearance will be approved as substitutions to that specified when “or equal” follows the manufacturers' names or model number(s).

E. When the Engineer accepts a substitution in writing, it is with the understanding that the Contractor guarantees the substituted product, component, article, or material to be equivalent to the one specified and dimensioned to fit within the construction according to contract documents. Do not provide substituted material, processes, or equipment without written authorization from the Engineer. Assumptions on the acceptability of a proposed substitution, prior to acceptance by the Engineer, are at the sole risk of the Contractor.

F. Approved substitutions shall not relieve the Contractor of responsibilities for the proper execution of the Work, or from provisions of the Specifications.

G. Pay expenses, without additional charge to the Owner, in connection with substitution materials, processes and equipment, including the effect of substitution on self, subcontractor's or other Contractor's work.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Conditions: Verify existing conditions, which have been previously provided under other sections, are acceptable for product installation in accordance with manufacturer's instructions.

B. Pathways: Verify that pathways and supporting devices, which have been previously provided under other sections, are properly installed, and that temporary supports and devices have been removed.

C. Field Measurements: Verify dimensions of pathways, including length of pathways. For example, “True Tape” the conduits to verify cable distances.

3.2 FIELD QUALITY CONTROL

A. Staffing: Provide a qualified foreman who is in charge of the Work and who is present at the job site at times Work is being performed. Perform the Work using skilled technicians under the direction of the foreman. Supervise the work force executing the Work. Perform the installation within the restraints of the construction schedule. Do not change the supervisor during the project without prior written approval from the Owner.

B. Inspection: Perform inspection after installation. Keep areas of work accessible and notify code authorities, or designated inspectors, of work completion released for inspection. Document completion and inspection as required.

3.3 INSTALLATION

A. Perform this work in accordance with acknowledged industry and professional standards and practices and the procedures specified herein.

B. Provide a complete, operating system. Include devices specified including basic components and accessories, interconnecting wiring and other equipment and installation devices necessary for a complete system as specified.

C. Manufacturer's Instructions:
   1. Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions, and product carton instructions for installation.
   2. Maintain jobsite file of Material Safety Data Sheets (MSDS) for each product delivered to jobsite.

D. Boxes, Panels, and Enclosures
   1. Install boxes, panels, and enclosures square and plumb.
   2. Set "flush mounted" units with the face of the cover, bezel or escutcheon in the same plane as the surrounding finished surface.
   3. Mount boxes, panels and trim so that there are no gaps, cracks or obvious lines between the trim and the adjacent finished surface and ready them to receive final finish, as applicable.
   4. Install insulating terminations in signal circuit boxes, panels, wireways or enclosures.

E. Painting
   1. Custom paint devices as indicated on the drawings.

3.4 REPAIR/RESTORATION

A. Replace or repair work completed by others that you deface or destroy, at not cost to the Owner.

B. Punch List:
   1. Inspect installed work in conjunction with the General Contractor and develop a punch list for items needing correction.
   2. Provide punch list to Engineer for review prior to performing punch walk with the Engineer.

C. Re-Installation:
   1. Make changes to the system such that defects in workmanship are correct and cables and the associated termination hardware passes the minimum test requirements.
   2. Repair defects prior to system acceptance.

D. Painting: Repaint surfaces altered during installation of the security system to match previous conditions.

3.5 CLEANING

A. Remove temporary coverings and protection of adjacent work areas. Remove unused products, debris, spills, or other excess materials. Remove installation equipment.

B. Leave finished work and adjacent surfaces in neat, clean condition with no evidence of damage.

C. Repair or replace damaged installed products.

D. Legally dispose of debris.

E. Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance.

END OF SECTION

SECTION 28 05 13

SECURITY SYSTEM CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. General: Furnish engineering, labor, materials, apparatus, tools, equipment, transportation, temporary construction and special or occasional services as required to make a complete working security system installation, as described in these specifications.

B. Section Includes:
   1. Wire and cable
   2. Compression Seal BNC Connectors

C. Related Sections:
   1. Consult other Sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable system.
   2. Section 28 00 00 – Basic Security Requirements: includes general project requirements, submittal formats, installation, and warranty requirements.
   3. Section 28 05 53 – Security System Labeling: includes label types and formats.
   4. Section 26 05 33 – Conduit: includes pathway types in different areas of the project.

1.2 SUBMITTALS

A. Product Data: Submit product information, including:
   1. Cable Description and Use
   2. Jacket Rating
   3. Outside Diameter (of the overall wire or cable)
   4. Manufacturer and Part Number

PART 2 - PRODUCTS

2.1 WIRE AND CABLE

A. General
   1. Provide required wire and cable sized to allow for voltage drop on long runs and effectively shielded as required to allow the routing of 12 & 24V power and video signal cable in the same conduit without interference or signal noise.
   2. Cable installed outdoors or in underground conduit must contain a PVC or Polyethylene jacket to prevent water intrusion and compliant with the TIA-455-82B water infiltration test.
   3. Cables installed indoors to contain a GREEN plenum rated jacket (type CMP).

B. Manufacturers:
   1. West Penn
   2. Or Equal

C. Access Control & Alarm Monitoring System
   1. Plenum Jacketed Cable
      a. #18/2 AWG unshielded: West Penn #25224B, door contact cable
      b. #18/4 AWG unshielded: West Penn #25244B, REX and alarm device cable
      c. #18/6 AWG shielded (overall): West Penn #253186B, card reader cable
      d. #16/2 AWG unshielded: West Penn #25225B, lock power cable

e. #14/2 AWG unshielded: West Penn #25226B, lock power cable from local power booster to exit device

D. Video Surveillance System
1. Horizontal cabling for network cameras provided by Telecommunications contractor. Refer to Section 27 15 13 – Communications Horizontal Twisted Pair Cabling.
2. Provide RG-59/U CCTV video coaxial cable between each elevator camera and the network video encoder servers. Cabling to include the the following features:
a. 95% percent copper braid
b. Foam dielectric
c. Solid copper core
d. 75 ohm characteristic impedance
e. Plenum jacket
3. Plenum Jacketed Cable
a. #RG-59/U coaxial: West Penn #25815, analog camera video cable
b. #18/2 AWG unshielded: West Penn #25224B, power cable

E. Intercom System
1. Horizontal cabling for network intercom stations provided by Telecommunications contractor. Refer to Section 27 15 13 – Communications Horizontal Twisted Pair Cabling.

2.2 MISCELLANEOUS COMPONENTS

A. Cable Ties
1. General
a. Provide Velco-style cable ties on security cabling within telecommunications spaces and covered wireways.
b. Dress and bind cabling with cable ties every 24” minimum.
c. Width: 0.75 inches
d. Color: Black
2. Manufacturer:
a. Panduit #HLS-15-R-0 Black, 15 feet roll, cut to length
b. Or Equal

B. Compression Seal BNC (Bayonet Neill Concelman) Connectors
1. General
a. Suitable for use on RG-59/U coaxial cable for CCTV systems.
b. Compression seal connection
c. Capable of accepting cable with outside diameters between 0.195 - 0.245 inches. Twist-on or crimp-on style connectors are not permitted.
2. Manufacturer:
a. GEM Electronics #302-10CSTP compression seal BNC connector
b. Or Equal

PART 3 - EXECUTION

3.1 INSTALLATION

A. Label cables in accordance with Section 280553 – Security System Labeling.

B. Horizontal Cable Installation and Routing
1. Provide wire and cable with a continuous, splice-free sheath for the entire length of run between designated connections or terminations. Splices not permitted.

2. Place cables within designated pathways, such as cable tray, basketway, cable hangers, etc. Do no fasten (such as with cable ties) or attach cables to other building infrastructure (such as ducts, pipes, conduits, etc), other systems (such as ceiling support wires, wall studs, etc), or to the outside of conduits, cable trays, or other non-approved pathway systems.
3. Place and suspend cables and conductors during installation and termination in a manner to protect them from physical interference or damage. Place cables with no kinks, twists, or impact damage to the sheath. Replace cables damaged during installation or termination at no additional cost.
4. Route cables at 90-degree angles, allowing for bending radius, along corridors for ease of access.
5. Do not exceed manufacturer's limits for pulling tension.
6. Do not use cable-pulling compounds for indoor installations.
7. Route cables under building infrastructure (such as ducts, pipes, conduits, etc) so the installation results in easy accessibility to the cables in the future. Do not route cables over building infrastructure.
8. Dress and secure coaxial cables to preclude stress and/or deformation.
9. Install shielded wiring or route in separate raceways as recommended by the manufacturer's current requirements.
10. Place cables 6", minimum, away from power sources to reduce interference from EMI.
11. Do not run signal wire and cable in parallel to power (120VAC).
12. Make connections to screw-type barrier blocks with insulated crimp-type spade lugs. Size lugs properly to assure high electrical integrity, i.e., low resistance connections.
13. Follow manufacturers recommended guidelines for installation.
14. When exiting the primary pathway (such as cable tray) to the work area, exit via the top of the pathway. Secure the cables to the pathway using an approved cable tie.

C. Cable Routing and Dressing within Telecommunication Rooms
1. Place cables within the overhead cable support and, when routing vertically, fasten the cables onto wall-mounted vertical cable support every 24 inches on-center using cable ties.
2. Only use Velcro type cable ties within the TR.
3. Neatly bundle (dress cable longitudinally) and support security cables within overhead cable runways.
4. Dress and bind cabling with cable ties every 12” minimum.
5. Provide 4 feet, minimum, sheathed cable slack – length not to exceed permanent link maximum length requirement. Place the slack within the screw cover gutter wireways.

END OF SECTION

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SECTION 28 05 53

SECURITY SYSTEM LABELING

PART 1 - GENERAL

1.1 SUMMARY

A. General: Furnish engineering, labor, materials, apparatus, tools, equipment, transportation, temporary construction and special or occasional services as required to make a complete working security system installation, as described in these specifications.

B. Section Includes:
   1. Labeling of wire, cable, security devices, enclosures, and raceways.

C. Related Sections:
   1. Consult other Sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable system.
   2. Section 28 00 00 – Basic Security Requirements: includes general project requirements, submittal formats, warranty, and installation requirements.

1.2 SUBMITTALS

A. Product Data: Submit the following:
   1. Product information for components specified herein.
   2. List of equipment (wire, cable, devices, enclosures, and raceways) and the corresponding text for the label.

PART 2 - PRODUCTS

2.1 NAMEPLATES

A. Engraved, plastic laminated nameplates, signs, and instruction plates. Engrave stock melamine plastic laminate 1/16 inch minimum thickness for signs up to 20 square inches, or 8 inches in length; 1/8 inch thick for larger sizes. Use white letters for engraved nameplates and punch for mechanical fasteners.

2.2 LABELS

A. Wire and Cable Labels:
   1. General
      a. Self-laminating adhesive laser labels.
      b. Machine printable with a laser printer.
      c. Cable size: 0.16 – 0.32" OD
      d. Color: white with black lettering
   2. Manufacturer:
      a. Brady #WML–211-295 and #WML-311-292 wire marking labels
      b. Or Equal

B. Device Labels:
   1. Self-laminating, type on tape, adhesive labels. Use Helvetica 12 pt text

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Requirements
   1. Label the security system components. The components include, but are not limited to, the following:
      a. Equipment Enclosures
      b. Conduits
      c. Security Devices
      d. Batteries
      e. Wires and Cables
      f. Equipment Racks
      g. Terminal Blocks
      h. Relays
      i. Patch panels, and the termination positions within the patch panels.
   2. Labels to coincide with device IDs used on the record drawings.
   3. Degrease and clean surfaces to receive nameplates and labels
   4. Install nameplates parallel to equipment lines. Secure nameplates to equipment fronts using machine screws.

B. Equipment Cabinets
   1. Label SEC enclosures associated with the security system with a nameplate.
   2. Mount label on exterior of door, centered horizontally, and positioned one-third of the door height vertically from the top.
   3. Example: Line 1: "SEC-01" (1/2 inch high letters)
      Line 2: "Security Equipment Cabinet" (1/4 inch high letters)

C. Conduits
   1. Write the destination for every conduit entering a junction box, SEC, and CEC enclosure, or wireway using a black permanent ink marker next to the conduit inside the box.
   2. Example: "To SEC-01"

D. Security Devices
   1. Label devices associated with the security system with a permanent machine generated, laminated, label. Use 12 point Helvetica text with a clear background. Use white or black lettering depending upon the color of the device.
   2. Label each device in a concealed location with the system point number and address.

E. Batteries
   1. Label power supply batteries with the month and year they were installed.
   2. Example: "April 2020"

F. Wire and Cable
   1. Identify wire and cable clearly with permanent machine-generated labels wrapped about the full circumference within one (1) inch of each connection.
   2. Indicate the cable ID designated on the associated field or shop drawings or run sheet, as applies.
   3. Assign wire or cable designations consistently throughout a given system; i.e., each wire or cable to carry the same labeled designation over its entire run, regardless of intermediate terminations.
   4. Provide labels where wire and cable first enter and exit from conduit, junction or distribution boxes; locate labels within six (6) inches of the point of exit.
   5. Positional labels so they are clearly visible without the need to remove wire management or other obstructions.
   6. Label cables at both ends of a run and within pull and junction boxes using machine generated wrap-around labels.

3.2 CABLE LABEL FORMAT

A. From Panel to Field Device
   1. Line 1: Device Type and Device Number
   2. Line 2: Panel ID – Port Number
   3. Example: CR 033
      PANEL 2 – CR1
   4. Standard Device Types
      a. CR = Card Reader
      b. K = Camera
      c. ET = Entry Telephone
      d. R = Relay Output
      e. A = Alarm Point
   5. Standard Port #s
      a. CR = Reader
      b. M = Monitored Input
      c. R = Relay Output

B. From Door Junction Box to Card Reader
   1. Line 1: Device Type and Device Number
   2. Line 2: Panel ID – Port Number
   3. Example: CR 033
      PANEL 2 – CR1

C. Miscellaneous Examples:
   1. From Door Junction Box to Door Contact
      a. CR033
      b. DC
   2. From Door Junction Box to Rex Alarm
      a. CR033
      b. REX ALM
   3. From Panel to Rex
      a. CR033
      b. REX PWR
      c. 12 VDC
   4. From Panel to Lock
      a. CR033
      b. LCK PWR
      c. 24 VDC

D. Communications Cable
   1. Line 1: Communication Type and Direction
   2. Line 2: Panel ID
   3. Example: RS-485 TO
      PANEL 2
   4. Typical Communication Types
      a. RS-485
      b. RS-232
      c. RS-422

END OF SECTION

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SECTION 28 08 00

SECURITY SYSTEM ACCEPTANCE TESTING

PART 1 - GENERAL

1.1 GENERAL

A. Furnish engineering, labor, materials, apparatus, tools, equipment, and transportation required to thoroughly test the completed security system installation as described in these specifications.

B. Full testing of a completed security system which includes:
   1. Develop, submit, and obtain Engineer's approval of security system Pre-Functional and Functional testing forms.
   2. Complete 100% Pre-Functional test of the security system. Submit Pre-Functional testing documentation reflecting that all security devices, cabling, locking hardware, power, interfaces to other systems, network switches, servers, workstations, and other components required for a completely functional security system are provided per project documents.
   3. Complete 100% Functional test of the security system. Submit Functional testing documentation reflecting that all security equipment, components, interfaces, and programming are functioning correctly per project documents. Upon receiving approval of functional testing documentation, schedule final acceptance testing activities to be witnessed by Engineer and/or Owner.
   4. Demonstrate 100% security system functionality to the Engineer and Owner's IT and Security representatives. Document testing activities and submit with final As-Built drawing.

1.2 SUMMARY OF SYSTEM COMMISSIONING ACTIVITIES

A. Overview
   1. The purpose of system commissioning is to ensure the security system operates properly when it is needed most. Security systems are very complex from both an equipment and programming standpoint, and thorough testing is necessary to ensure correct operation.
   2. Perform testing activities after-hours or on weekends when the system is "quiet" and the building is generally unoccupied. This will minimize the amount of irrelevant activity in the system activity reports that will be used as a record of the pre and final test results.

B. Pre-Functional Test
   1. Perform a 100% pre-functional test of system aspects to verify correct operation prior to scheduling the final test. The pre-test will help to make the final test run smoothly when demonstrating the system's operation to the Engineer and Owner's IT and Security representatives.
   2. Document the results of the pre-test using the approved test forms and submit a copy to the Engineer along with the system activity reports

C. Functional Test
   1. Perform a 100% pre-functional test of system aspects to verify correct operation prior to scheduling the final test. The pre-test will help to make the final test run smoothly when demonstrating the system's operation to the Engineer and Owner's IT and Security representatives.
   2. Document the results of the pre-test using the approved test forms and submit a copy to the Engineer along with the system activity reports

D. Final Acceptance Test
   1. Perform a final test of the system in the presence of the Engineer and Owner's IT and Security representatives to demonstrate correct operation of the security system.

1.3 SUBMITTALS

A. Operation and Maintenance Manuals

1. Functional Design Manual: Includes a detailed explanation of the operation of the system.
2. Hardware Manual which includes:
    a. Pictorial parts list and part numbers
    b. Pictorial and schematic electrical drawings of wiring systems, including devices, control panels, instrumentation and annunciators
    c. Telephone numbers for the authorized parts and service distributors
    d. Include service bulletins
3. Software Manual which includes:
    a. Use of system and applications software
    b. Initialization, start-up, and shut down procedures
    c. Alarm Reports
4. Operator's Manual which fully explains procedures and instructions for the operation of the system and includes:
    a. Computers and peripherals
    b. System start up and shut down procedures
    c. Use of system, command, and applications software
    d. Recovery and restart procedures
    e. Graphic alarm presentation
    f. Use of report generator and generation of reports
    g. Data entry operator commands
    h. Alarm messages and reprinting formats
    i. System access requirements
5. Maintenance Manual which includes:
    a. Instructions for routine maintenance listed for each component, and a multi-page summary of component's routine maintenance requirements.
    b. Detailed instructions for repair of the security system.
    c. A summary of the software licenses, including license numbers, quantity of clients, summary of the software options provided and database capabilities.
    d. A summary of the TCP/IP address used and which system component they are associated with. Include the gateway address, subnet mask, DNS server, and host name information.
6. Test Results Manual, which includes the document results of tests, required under this Specification, organized by System, Floor, and Door.
7. Record Drawings Manual which includes 11"x17" prints of record drawings as described below.

B. Record Drawings
1. Drawings to fully represent installed conditions including actual locations of devices, actual cable and terminal block numbering, and correct wire sizing as well as routing. Record changes in the work during the course of construction on blue or black line prints.
2. Include drawings submitted as part of the Shop Drawing package, plus additional information required to accurately document installed conditions.
3. Include the following additional information:
    a. Device addresses & IP address information.
    b. Settings for each camera (lens specs, mm setting, auto shutter setting, and other available camera settings, etc.)
4. Final acceptance will not be made until the Engineer approves the record drawings.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 SCHEDULING

A. Coordinate security commissioning with the General Contractor and provide specific information on pre-test and final-testing activities to be entered into the overall project construction schedule.

3.2 TESTING REQUIREMENTS

A. Site Tests
   1. Perform a 100% pretest of the system prior to final testing by the Engineer. Provide the Engineer with a minimum of a 5 day notice prior to scheduling testing.
   2. At the conclusion of the work on a floor, test the system on that floor to verify proper operation and reporting of devices.
   3. Work with the door hardware supplier to resolve electric hardware failures and door alignment/closure problems.
   4. At the completion of the work, test the entire system to verify proper operation. At a minimum, include these tests:
      a. Door Hardware Test: Coordinate with door hardware contractor to test electrified locking hardware of associated card reader doors.
      b. Card Reader Test: Test functionality of card reader, alarm contact, and request-to-exit sensors to indicate the following: valid card read, invalid card read, door forced, and door propped alarms.
      c. Duress Button Test: Test functionality of duress buttons to alarm on ACAMS workstations. Verify dispatch requirements and integration with VSS to provide automatic camera call up upon alarm activation.
      d. ACAMS Software Test: Test software for correct programming and setup. Verify integration with the video surveillance, detention control system, intercom system, and other security subsystems. Verify graphical mapping screens and devices.
      e. Intercom System Test: Test functionality of intercom station to automatically direct dial associated VOIP phone and rollover/backup phones. Verify integration with ACAMS and detention control system to provide a virtual master station at desired locations.
      f. Camera Test: Review cameras for proper coverage, resolution, frame rate, and overall quality of image.
      g. Video Management Software Test: Test recording system for correct programming, alarms, and event retrieval. Verify integration with ACAMS and video analytics software. Verify functionality at each client workstation. Verify graphical mapping screens and devices.
      h. Video Virtual Matrix Test: Test functionality of virtual matrix switch for correct programming, operation, and alarm call up. Verify functionality to push video streams on-demand to any monitor and any client workstation.

i.	Video Analytics Software Test:	Test functionality of designated behavior alarms and associated zones. Coordinate with Owner's IT and Security representative to provision the sizing of zones and sensitivity to limit false alarms.
j.	Video Appliance Test:	Test functionality of servers and storage appliances for system parity and bandwidth load balancing. Verify RAID-6x functionality by demonstrating 5 simultaneous drive failures and 1 server failure.
k.	Battery and UPS Load Test:	Disconnect AC power to security system components to verify battery operation functions and system remains fully operational.

B. Test Preparation
   1. Provide device identification numbers that differ from or were not included on the original contract drawing set.
   2. Provide a complete systems point list.
   3. Provide paper and toner for the printer so that an event log can be printed out and attached to the test reports as verification of test sequence and systems response.
   4. During testing, provide a minimum of three technicians familiar with the installation to assist with the test. Stage the technicians as follows: one at the host, one at the device being tested, and one runner responsible to furnishing tools, step ladders, etc.
   5. Provide radios for use by the Engineer and Owner during testing.
   6. Provide pre-programmed access cards for use during testing. Provide one card for each access level.

3.3 TEST PROCEDURES

A. Refer to the test forms for testing procedures for each type of device/system.

3.4 DOCUMENTATION

A. Provide a full-sized drawing package containing a detailed wiring diagram (layout of equipment/elevation, complete parts list, and a complete wiring diagram for each access control panel) for each SEC location in the TR rooms. Fold the diagram and place it inside a clear plastic pocket affixed to the inside door of the SEC.

B. Provide a service log on the inside door of each SEC. Include columns for the following information: date of service, description of work performed, service technician(s), and service company in the service log. Place the service log inside a separate clear plastic pocket affixed to the inside door of the SEC.

3.5 DEMONSTRATION

A. On completion of the acceptance test, instruct the owner's representatives, at a time convenient to them, in the operation and testing of the system.

B. Utilize the database for the project during training to give the users a project specific example to learn from.

C. Provide a minimum of 80 hours of on-site training by a factory trained representative for each of the following systems:
   1. Access Control & Alarm Monitoring System
   2. Video Surveillance System
      a. Network Video Recording System
      b. Network Video Analytics System
      c. Network Video Servers and Storage Appliances
   3. Intercom System

D. Maintain a sign in sheet with names and dates of persons trained and forwarded to owner upon completion of training.

E. Provide for four (4) Owner's representatives to attend factory certification training (off-site) for both the following systems:
   1. Access Control & Alarm Monitoring System
   2. Video Surveillance System

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SECTION 28 13 00

ACCESS CONTROL & ALARM MONITORING SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. General: Furnish engineering, labor, materials, apparatus, tools, equipment, transportation, temporary construction and special or occasional services as required to make a complete working Access Control & Alarm Monitoring system installation, as described in these specifications. Contractor responsible for coordinating door hardware requirements and providing all necessary equipment and materials for proper installation of concealed access control system at each secured door with only user interaction required devices not required to be concealed.

B. Section Includes:
   1. ACAMS servers and client workstations
   2. ACAMS control panels, input/output modules, and card readers
   3. ACAMS power supplies
   4. Alarm initiating devices, including: magnetic switch contacts, request-to-exit sensors, duress buttons, and general alarm points
   5. Integration with the VSS and other security subsystems to allow bi-directional communication with one another
   6. Interface to electric door hardware and ADA door operators
   7. Interface to elevator controllers
   8. Interface to fire/life-safety system

C. Products Furnished and Installed Under another Section:
   1. 120V power
   2. Conduit and junction boxes
   3. ADA door operators and push buttons
   4. Fire/life-safety system interface relays
   5. Parking gate operators.
   6. Electromagnetic door holders
   7. Network connectivity for ACAMS devices via Owner's local/wide area network

D. Related Sections:
   1. Consult other Divisions, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable system.
   2. Section 11 14 13 – Security Turnstiles: for interface requirement with the ACAMS.
   3. Section 27 51 23 – Intercom System: for interface requirement with the ACAMS.
   4. Section 28 00 00 – Security Basic Requirements: for submittal formats, warranty, general product requirements, and installation requirements.
   5. Section 28 05 13 – Security System Cabling: for cable requirements related to the ACAMS.
   6. Section 28 05 53 – Security System Labeling: for device labeling requirements.
   7. Section 28 08 00 – Security System Acceptance Testing: for testing requirements.
   8. Section 28 16 00 – Intrusion Detection System: for interface requirement to the ACAMS.
   9. Section 28 13 53 – Access Detection Systems: for interface requirements to the ACAMS.
   10. Section 28 23 00 – Video Surveillance System: for interface requirement with the ACAMS.

1.2 SYSTEM DESCRIPTION

A. Overview
   1. The ACAMS is a distributed network of control panels connected to and programmed from a host server and client workstations.
   2. The ACAMS is utilized for electronically controlling access to off-stage and on-stage areas, lounges, and supply rooms, storage rooms, and other staff-only spaces.
   3. The ACAMS consists of redundant host servers located in the primary and secondary ER rooms, client workstations, control panels, card readers, and alarm initiating devices. The host server communicates with the field panels via the Owner's local/wide area network.

B. Access Control & Alarm Monitoring System
   1. Provide ACAMS software and associated licenses to support the devices shown on the project drawings. Provide rack-mount primary and redundant host servers in the ER room that allow for a certified "five-nine" (99.999% uptime) solution.
   2. Provide ACAMS client software licenses for monitoring and control of ACAMS. Provide web browser client license (thin client) to allow for remote viewing on other workstations.
   3. Provide ACAMS control panels located in the ER and TR rooms as indicated on project drawings. Panels support up to 64 card readers each with locking control outputs and multiple general purpose input/output modules for automation.
   4. Provide multi-technology card readers as indicated on project drawings.
   5. Provide multi-technology card readers at Trans-Vac automatic feeder locations (not shown on project drawings) to activate feeder functionality. Assume a minimum of 75 locations.
   6. Provide interface to latch position switch (LX) and request-to-exit (RX) switch within electrified door hardware for card reader controlled doors. Provide alarm contacts and request-to-exit motion detectors for card reader doors that do not contain LX and RX sensors within the electrified hardware set. Refer to Section 08 06 00 – Door Hardware for additional requirements.
   7. Provide alarm contacts for non-card reader controller perimeter doors as indicated on project drawings.
   8. Provide connection to local audible alarms at monitored at exit-only and emergency exit doors as indicated on project drawings. Local audible alarms to sound upon alarm activation (forced door, door held open, etc).
   9. Provide 12/24VDC ACAMS device and lock power supplies as indicated on project drawings.
   10. Provide battery backup of system components and power supplies.

C. Badging System
   1. Included in Fannin County IT department.

D. ACAMS Integration Requirements
   1. Provide ACAMS interface software to VSS network video recorders to enable alarm event recording and automatic call up of associated cameras upon alarm activation (forced door, door held open, etc).
   2. Provide ACAMS interface software for IDS control panels to enable bidirectional alarm communication and notification.
   3. Provide ACAMS interface software to Intercom system to enable virtual master station functionality through the ACAMS client software.
   4. Utilize hardwired input/output points to provide integration between detention control system and ACAMS to allow for redundant reporting of alarms within the Inmate ED Unit.
   5. Provide software integration between the ACAMS database and the following non-security systems:
      a. Owner's HR database to allow automatic provisioning and revocation of cardholder privileges
      b. MS Active Directory to enable single sign-on, logical access control, and debit card capabilities

c. Owner's Time & Attendance system to restrict access to time clocks without a valid card read on the turnstiles at the Employee Entrance. This functionality will provide the Owner with a single entrance for staff to access the building. Staff that bypass the turnstiles will not be permitted to access the Time & Attendance system.

E. Interface to Elevator Conveying System
   1. Non-Public passenger and freight elevator card readers to control access to floors based on cardholder access levels. Public elevator card readers to control access to floors only in times of heightened security.
   2. Furnish card readers to elevator contractor for installation inside elevator cars.
   3. Provide security demarcation enclosures located in the elevator machine rooms as indicated on project drawings. Route security cabling from the ACAMS control panels to the security demarcation enclosures to interface with elevator controller. Connections in the demarcation enclosure include landings, terminal blocks, and labels.
   4. Provide coordination during installation of card reader and cable terminations. Elevator contractor responsible for elevator traveler cable, connection from elevator controller to security demarcation enclosure, and installation of card readers within the elevator cabs.

F. Interface to Fire/Life-Safety System
   1. Coordinate with Fire/Life-Safety system contractor to automatically drop power from stairwell, elevator vestibule lobby, optical turnstiles, and other access controlled doors within the path of egress upon alarm activation of the Fire/Life-Safety system.

G. Interface to Parking Controls
   1. Provide multi-technology card readers on a goose neck or parking control device at entry gates as shown on the project drawings.
   2. At each Entry Gate provide a 24" x 24" NEMA rated cabinet for housing all equipment to support the gate access controllers and accessories. A 110vac outlet will be installed inside the 24" x 24" NEMA rated cabinet to support power requirements for the Access Control Devices.
   3. Coordinate with Parking Controls system contractor for Card readers to grant access to authorized inbound traffic to secured areas and parking lots, while disabling the lane ticket dispenser for that vehicle only.

1.3 SUBMITTALS

A. Contractor Qualifications: Submit certification letters for the manufacturer of the ACAMS.

B. Product Data: Submit product information for components specified herein.

C. Shop Drawings:
   1. Device placement on floor plans
   2. Point-to-Point Diagrams: Include wiring, points of connection and interconnecting devices between the following:
      a. ACAMS control panel
      b. ACAMS card reader and input/output modules
      c. ACAMS power supplies
      d. Card Readers
      e. Alarm contacts and request-to-exit sensors
      f. Local audible alarms
      g. Interface to electrified door hardware
      h. Interface to fire/life-safety system
      i. Interface to elevator controller
      j. Cable conductors (identify conductors on the point-to-point diagrams with the same tag as the installed conductor)
   3. Schedules: Provide schedules for ACAMS control panels that show each point ID with a description of the connected devices.

4. Block Diagram/Riser Diagram: Show the ACAMS components, conduit, wire types, and sizes between them, including cabling interties between termination hardware.
5. Custom mounting details

PART 2 - PRODUCTS

2.1 ACAMS SOFTWARE & SERVER

A. General
1. Designed for unlimited scalability with a multi-tier enterprise architecture to allow for centralized monitoring and control of buildings within the Owner's campus and future remote sites.

B. Features
1. Capable of using a single user interface for the following applications:
   a. Access control
   b. Alarm monitoring
   c. Intrusion detection
   d. Graphical mapping
   e. Badging and credential management
   f. Visitor management
   g. Video management
2. Capable of configuring software to provide five-nines (99.999%) reliability with applicable fault tolerant servers, to provide the Owner with less than 5 minutes of downtime per year.
3. Supports automated communication in user configurable timed intervals for business automation processes and SQL databases using XML communications.
4. Supports real-time bidirectional communication between cardholder data with HR databases, emergency response systems, and third party systems using custom software scripts.

C. Manufacturer
1. Cisco
   a.

2.2 ACAMS WORKSTATIONS

A. ACAMS Workstation
1. Provided by Owner.

B. ACAMS Software
1. Manufacturer
   a. S2 access control system or equal.
2. Include software licenses:
   a. Integrated video management software for specified network video recording system, refer to Section 28 23 00 – Video Surveillance System

2.3 ACAMS CONTROLLERS

A. General
1. An intelligent controller with integrated battery backup, database, and communication ports that supports 16 card readers.
2. Supports multiple communication channels to which a variety of devices can connect.
3. Supports hardware modules used for additional memory and/or for future feature enhancements.
4. Functions provided include:
   a. Central control for attached devices and addressable modules
   b. Makes decisions for access
   c. Responds to monitor activity
   d. Receives input to control its decision making

e. Reports activity to other devices

B. Features
1. Supports HID proximity, MIFARE, and DESFire card reader formats
2. Supports flash upgrades for firmware updates
3. Utilizes an onboard Ethernet NIC
4. Global input/output and anti-passback functionality
5. Capable of utilizing keypad commands to activate/deactivate events

C. Supports RS-485 connectivity to addressable modules:
1. Input Module: Supports 8 Class A supervised input points
2. Output Module: Supports 8 Form C dry contact relays
3. Reader Interface Module: Supports 2 card readers with associated alarm contacts, request-to-exit devices, and lock outputs configured in Fail Secure mode.

D. Manufacturer
1. S2 system compatible with the existing Fannin county access controllers.

2.4 EQUIPMENT ENCLOSURES

A. General
1. Provide enclosures with butt hinged and lockable door containing a lock kit (keyed alike with other security enclosures on the project).
2. Provide perforated back panel for mounting control boards, relays, and terminal strips with enclosure.
3. Provide slotted wiring duct for routing security cabling within enclosure.
4. One tamper switch for each enclosure

B. Security Equipment Cabinets
1. Type: NEMA type 1 enclosure
2. Size: 36” x 24” x 6” minimum
3. Finish: ANSI 61 gray polyester powder paint finish inside and out
4. Manufacturer
a. Hoffman
1) #A36N24M enclosure with #A36N24MPP back panel and #A612AR lock kit
b. Or equal

C. Slotted Wiring Duct
1. Type: Lead-free PVC with narrow finger design
2. Size: 1” x 1” minimum
3. Color: Light gray
4. Manufacturer
a. Panduit
1) #Type-F narrow slot wiring duct
b. Or equal

2.5 WIREWAYS

A. General
1. Provide screw cover wireway sections with open top assembly as shown on Security drawings.
2. Provide closure plates to secure end of wireway sections.

B. Screw Cover Gutter Wireways
1. Type: NEMA type 1 enclosure
2. Size: 4” x 4” x 48” minimum
3. Finish: ANSI 61 gray polyester powder paint finish inside and out

C. Manufacturer
1. Hoffman

a. # F44T148GVP lay-in painted wireway without knockouts
b. #A44GCPNK closure plate without knockouts

2. Or equal

2.6 CARD READERS

A. General
1. Presenting an access card to the reader initiates a single transmission to the ACAMS controller.
2. Rugged, weatherized polycarbonate enclosure, designed to withstand an operating temperatures of -22 to 120 degrees Fahrenheit (-30 to 65 degrees Celsius) and operating humidity of 5-95% non-condensing.
3. Utilizes a Wiegand protocol for communication for compatibility with standard access control systems.
4. Utilizes a multi-color LED and an audible sounder to indicate the status of the door.
5. Utilizes an internal tamper switch that will indicate an alarm condition if an unauthorized attempt is made to disassemble the unit.
6. Capable of reading the following frequencies and card formats:
a. 125kHz – Indala Prox (coordinate with Owner's existing security vendor for facility code and other propriety format information)
b. 13.56MHz – HID iClass

B. Manufacturer
1. Cisco

2.7 MAGNETIC CONTACT SWITCHES

A. Wood, Steel, and Hallow Metal Doors
1. General
a. Mounting: Recessed
b. Contacts: Single Pole, Single Throw
c. Gap Distance: 0.5" maximum
2. Manufacturer
a. GE Security
1) #1078C 3/4" alarm contact switch
b. Or equal

2.8 DURESS BUTTONS

A. Under-Counter
1. General
a. Actuating lever, housing, and cover plate made of ABS fire-retardant plastic
b. Latching circuit with integrated LED
c. Contact: Normally Open or Normally Closed electrical loop, SPDT
d. Operating Voltage: 12VDC
2. Manufacturer
a. GE Security
1) #3040 panic switch
b. Or equal

2.9 REQUEST-TO-EXIT MOTION SENSORS

A. General
1. Power: 12 or 24VDC, 35mA
2. Relay Output: 2 form "C" contacts
3. Adjustable relay latch time
4. Programmable retrigger or non-retrigger mode
5. Programmable Fail Safe or Fail Secure Modes

6. Radio Frequency Interference (RFI) Immunity range from 26 to 1,000 MHz at 50 v/m

B. Manufacturer
   1. Bosch
      1) #DS160 request-to-exit sensor
      2) #TP160 electrical back box adapter plate
   2. Or equal

2.10 MOTION SENSORS

A. General
   1. Type: Passive infrared (PIR) detector with Fresnel type lens
   2. Operating Voltage: 10-14VDC
   3. Range: 35' x 35' minimum
   4. Integrated tamper switch

B. Manufacturer
   1. Bosch
      1) #ISM-BLP1 blue line PIR detector
   2. Or equal

2.11 ACAMS POWER SUPPLIES

A. General
   1. Provides a 120VAC to 12 and 24VDC output, fully supervised power supply to power ACAMS field devices. Contractor responsible for providing power as necessary even if not shown on plans.
   2. Utilizes 16 PTC Class 2 rated power limited outputs.
   3. Short circuit and thermal overload protection.
   4. Integrated charger for sealed lead acid or gel type batteries.
   5. Capable of providing a 10 amp supply current.
   6. Supports a fire alarm disconnect to relay that individually selects any or all of the 16 outputs.

B. Manufacturer
   1. Altronix
      1) #MAXIM75 power supply
   2. Or equal

2.12 BATTERIES

A. General:
   1. Voltage: 12.00
   2. Amps: 12.00
   3. Chemistry: SLA or VRLA valve regulated
   4. Termination: Spade protected terminals

B. Manufacturer:
   1. Yuasa
      1) #RE12-12 sealed lead acid 12V 12Ah battery
   2. Or equal

PART 3 - EXECUTION

3.1 INSTALLATION

A. ACAMS Software & Server
   1. Rack mount server in the security equipment rack in ER room as indicated on project drawings.

2. Install MS Windows Server 2008 and necessary client access licenses. Coordinate with Owner's IT and Security representatives to program OS and other critical applications to Owner's existing standards.
3. Install ACAMS software and configure server to provide five-nines (99.999%) reliability on fault tolerant servers, to provide the Owner with less than 5 minutes of downtime per year.

B. KVM Console
1. Rack mount KVM console with integrated LCD monitor, keyboard, and mouse in the security equipment rack in ER room as indicated on the project drawings.
2. Connect ACAMS servers to the KVM console. Provide adapters and cable extensions as required.

C. ACAMS Control Panels
1. Place power supply and associated hardware in same location.
2. Provide designated resistors at device end of line per manufacturer's EOL recommendation to provide four-state supervision of security device and cabling.
3. Provide EOL supervision for alarm contacts, local alarm sounders, motion detectors, glass break detectors, help/duress buttons, and other designated security devices connected to the ACAMS and IDS.
4. Provide the following states of supervision:
   a. Contact closed = Secure
   b. Contact open = Alarm
   c. Short circuit = Line fault
   d. Open circuit = Line fault

D. Card Readers
1. Wire the card reader's multi-color LED to indicate the following status of the door.
   a. Red status indicates the door is secure (locked).
   b. Green status indicates the door is unsecured (unlocked).
   c. Yellow status indicates the card reader is not functioning (off-line/trouble), is processing a read request, or has denied access.
2. Utilize configuration card to enable optical tamper.
3. Wire the card reader's optical tamper to spare input on the ACAMS reader module and jumper ground wire from door contact to provide a Normally Closed circuit.
4. The card reader to produce an audible beep tone to indicate to the user:
   a. The card was read and/or access was denied.
   b. Door is being held open and needs to be closed.

E. Elevator Readers
1. Furnish card reader to elevator contractor for installation,
2. Coordinate the installation and termination of the card reader inside the cab and in the elevator machine room.
3. Coordinate with elevator contractor to connect ACAMS output relays to elevator controller. Install terminal blocks in security demarcation enclosure as indicated on project drawings to separate security from elevator cabling.

F. Door Hardware
1. Route power to electrically controlled locks on life-safety doors through fire alarm output to automatically unlock the door upon activation of Fire/Life-Safety system. Connect fire alarm output to the disconnect relay on the associated 24VDC lock power supply.
2. Setup and conduct a door hardware coordination meeting.
3. Coordinate the installation and termination of the security cable with the installation of the electric door hardware and transfer hinge.
4. Provide cable and terminate wires to delayed egress devices for monitoring activation of delayed egress by the ACAMS system.

G. Door Contacts

1. Install on protected (secured) side of door.
2. Install 6” from leading edge at top of door.

H. Duress Buttons
1. Mount duress buttons under work desks as indicated on the project drawings.
2. Coordinate with architect and casework contractor to field determine exact placement prior to installation.

I. Request-To Exit Motion Detectors
1. Mount motion detector on the secured (protected) side of door.
2. Install motion detector so that detection pattern is not obstructed by Exit Signs, light fixtures and other objects that would interfere with proper operation.
3. Adjust relay hold time and pattern to properly detect valid exit and allow shunting of door contact.
4. Adjust detection sensitivity to pulse.
5. Mask detector lens to provide a confined detection area limited to the door handle or push bar area.
6. Run wire inside structural tube steel frame into back of condulet for cage locations.

J. Local Alarm Sounders
1. Mount local alarm sounder as necessary for proper coverage.
2. Install local, square, and plumb. Set flush-mounted units so that the face of the cover, bezel, or escutcheon matches the surrounding finished surface.
3. Mount so that there are no gaps, cracks, or obvious lines between the trim and the adjacent finished surface.

3.2 PROGRAMMING

A. Prior to the completion of construction, schedule a meeting with the Owner’s IT and Security representatives to determine the programming criteria. Discuss the following:
1. Access card levels and door groupings
2. Alarm priority levels
3. Schedules and time codes
4. Holidays and holiday types (priorities)
5. Action/responses from individual input points
6. Standard and custom (expanded) reports
7. Defining alarm messages and standard response messages applicable to site
8. Routing of alarm points to selected mobile phones
9. Routing of alarm points to operator’s workstations, printers, and history files
10. Coordinate implementation of graphics with Owner. Develop sample graphic complete with icons and text. Alarms to appear on building floor plans depicting the nature and location of alarms. Review and revise graphic layout as required by Owner.

B. Document the results of the meeting and perform necessary programming to achieve the Owner’s requests.

C. System Operation, Alarm and Reporting Function: Program door control panel tamper switches to immediately report as a separate “tamper” point to the system resulting in an alarm condition displayed in both text and graphic form on the applicable workstation(s) and an alarm message transmitted to the appropriate pager(s).

D. Receive CAD drawing files of floor plans and perform the following relative to system graphics:
1. Delete non-applicable drawing layers and details to arrive at simple floor plans of the building as built.
2. Convert drawings to a graphic file format compatible with the Owner’s access control and alarm monitoring system.
3. Load drawing files into the system.
4. Apply new and predefined icons and other points on each graphic to indicate point and control status.

5. Link graphic images to reader, monitor and control points.

3.3 TESTING

A. Commission ACAMS in accordance with Section 28 08 00.

END OF SECTION

SECTION 28 16 00

INTRUSION DETECTION SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. General: Furnish engineering, labor, materials, apparatus, tools, equipment, transportation, temporary construction, and special or occasional services required to make a complete working intrusion detection system installation as described in these specifications.

B. Section includes:
   1. Intrusion Detection System, including digital communicator, keypad, and alarm devices.
   2. Door contacts, glass break detectors, motion sensors
   3. Duress alarm stations
   4. Interfaces and connections between intrusion detection subsystems to allow communication with one another

C. Products furnished and installed under another section:
   1. 120V power
   2. Phone line

D. Related sections:
   1. Section 28 00 00 – Basic Security Requirements: for submittal format, warranty, general product requirements, and installation requirements
   2. Section 28 13 00 – ACAMS: for interface requirement to the intrusion detection system
   3. Section 28 05 13 – Security System Cabling: for cable requirements related to the IDS
   4. Section 28 05 53 – Security System Labeling: for device labeling requirements
   5. Section 28 08 00 – Security System Acceptance Testing: for testing requirements

1.2 SYSTEM DESCRIPTION

A. Overview
   1. The IDS is utilized for after hours monitoring of facility.
   2. Activation of the IDS direct dials emergency services with a prerecorded message requesting law enforcement.
   3. The IDS integrates with the ACAMS through software to provide bidirectional communication and notification of alarm events.

B. Intrusion Detection System
   1. Provide an IDS control panel with integrated UL listed digital communicator located in the telecommunication room as indicated on project drawings. Panels support up to 8 areas and 128 zones by use of addressable input/output point modules.
   2. Provide LCD command keypads in the security desk. Keypads allow for system arming and disarming by authorized users.
   3. Provide battery backup of IDS components and power supplies for a minimum of 24 hours in the event of a power failure or emergency.

C. Interface with ACAMS
   1. Provide Ethernet network interface module to allow for software integration with ACAMS.
   2. Configure IDS and ACAMS to allow for bidirectional communication of alarm contacts and motion detectors in the OR Satellite Pharmacy as shown on the project drawings.

1.3 SUBMITTALS

A. Product Data: Submit product information for the intrusion detection systems, including:
   1. IDS control panel
   2. Keypads
   3. Calculations for backup batteries

B. Shop Drawings: Submit shop drawings containing the following:
   1. Device placement on floor plans
   2. Point-to-Point Wiring Diagrams: Include wiring, points of connect, and interconnecting devices between the following:
      a. IDS control panel
      b. IDS expansion modules and relays
      c. Keypads
      d. Motion sensors
      e. Alarm contacts
      f. Power supplies
      g. Cable conductors (identify conductors on the point-to-point diagrams with the same tag as the installed conductor)
   3. Schedules: Provide schedules for the IDS control panel that show each alarm zone, applicable area or partition, and a description of the connected device.
   4. Custom mounting details

PART 2 - PRODUCTS

2.1 IDS CONTROL PANELS

A. General
   1. Integrated UL listed digital communicator with phone line monitor (loop or ground start).
   2. Supports up to75 alarm zones and 8 programmable areas or partitions.
   3. Capable of utilizing multiple telephone numbers, primary and duplicate paths with main and alternate destinations.
   4. Capable of utilizing a dual phone line switcher to monitor 2 phone lines.
   5. Capable of sending daily automatic test and status reports.
   6. Supports supervised expansion and relay output modules.
   7. Supports RS-232 connectivity to third party devices for automation.
   8. Capable of utilizing an TCP/IP converter for Ethernet connectivity.

B. Manufacturer
   1. Bosch G series control panels
      a. Bosch #D7412GV2 control panel
      b. Bosch #D8128D OctpPOPIT 8-point input module
      c. Bosch #D8129 Octo-relay 8-point output module
      d. Bosch #DX4020 Connettix Ethernet network interface module
   2. Or Equal

2.2 IDS KEYPADS

A. General
   1. 32-character display
   2. Keys light on entry or key press
   3. Back lighted multi-key touch pad
   4. User controlled brightness and loudness

B. Provide the ability to display for each detection point:
   1. Alarm
   2. Trouble
   3. Supervisory
   4. Faulted
   5. Custom text

C. System wide displays include:
   1. Local system test
   2. Sensor reset
   3. Event log

D. Manufacturer
   1. Bosch #D1260 alphanumeric LCD display keypad
   2. Or Equal

PART 3 - EXECUTION

3.1 INSTALLATION

A. General
   1. Follow manufacturers recommended guidelines for installation.
   2. Install glass break detection for all first floor and ground level windows.
   3. Install motion detectors in all public areas in basement, ground floor and first floor.

B. Components
   1. IDS Control Panel
      a. Place control panel and associated expansion boards in SEC (NEMA Type-1 enclosure) with ACAMS equipment in nearest TR room.
      b. Utilize ACAMS power supplies to power control panel and associated expansion boards. Do not use plug-in transformers.
      c. Provide standoff brackets to mount control boards to perforated panel within enclosure.
      d. Place power supply and associated hardware in same location.
      e. Install supervisory and end of line resistors as required.
      f. Coordinate installation of phone jack in IDS control panel enclosure with telecommunications contractor for communications to the alarm receiver.
   2. Keypads
      a. Mount keypads as indicated on project drawings.

3.2 PROGRAMMING

A. Prior to the completion of construction, schedule a meeting with the Owner's IT and Security representatives to determine the following programming criteria:
   1. Zone or alarm point descriptions
   2. User authority levels to arm/disarm areas or alarm partitions
   3. Auto arm/disarm schedules
   4. Interface requirement with ACAMS
   5. Dispatch response from individual alarm points
   6. Password and call list information

B. Document the results of the meeting and perform necessary programming to achieve the Owner's requests. Program and setup the system such that no additional programming other than entering new access codes is required.

3.3 TESTING

A. Commission the Intrusion Detection System in accordance with Section 28 08 00.

END OF SECTION

SECTION 28 23 00

VIDEO SURVEILLANCE SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. General
   1. Provide engineering, labor, materials, apparatus, tools, equipment, transportation, temporary construction, and special or occasional services as required to make a complete working video surveillance system installation, as described in this specification.
   2. Section Includes:
      a. Network video recording system
      b. Network video management software
      c. Network video analytics software
      d. Network video cameras
      e. Network video encoder servers
      f. Analog cameras
      g. Power supplies
      h. Integration with the ACAMS and other security subsystems to allow for bidirectional communication
      i. Interface to elevator conveying system
      j. Interface to Point-of-Sale (POS) system
   3. Products Furnished and Installed Under another Section:
      a. 120V power
      b. Horizontal fiber optic and UTP cabling for IP cameras

B. Related Sections
   1. Consult other Divisions, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable system.
   2. Section 28 00 00 – Security Basic Requirements: for submittal formats, warranty, general product requirements, and installation requirements.
   3. Section 28 05 13 – Security System Cabling: for cable requirements related to the VSS.
   4. Section 28 05 53 – Security System Labeling: for device labeling requirements.
   5. Section 28 08 00 – Security System Acceptance Testing: for testing requirements.
   6. Section 28 13 00 – Access Control & Alarm Monitoring System: for interface requirements related to the VSS.
   7. Section 28 48 00 – Detention Control System: for interface requirements related to the VSS.

1.2 SYSTEM DESCRIPTION

A. Overview
   1. The Owner desires a comprehensive and feature rich IP video surveillance system to monitor the flow of visitors, and staff throughout the building.
   2. The VSS consists of host servers, RAID storage devices, video management software, a combination of fixed network and analog cameras, video encoder servers, and integration with other security subsystems.
   3. The VSS software will reside on fully scalable iSCSI SAN array storage devices with integrated MS Windows based servers to provide a non-proprietary software-based video solution.

4. The VSS will utilize PoE network cameras within interior and exterior spaces of the building and traditional analog cameras within the elevator cars.

B. Video Surveillance System
   1. Provide video management software and camera licenses to support the devices shown on the project drawings. Provide rack-mount NVR servers and RAID storage devices in the ER security cabinet to allow for 30 days of storage with continuous recording with 24fps at 1280x720.
   2. Provide client video management software licenses for live viewing and monitoring of the cameras on ACAMS workstations. Provide web browser client software license (thin client) to allow for remote viewing on other workstations.
   3. Provide network fixed and PTZ/360/180 cameras as shown on the project drawings. Typical cameras locations include:
      a. Corridors
      b. Perimeter entrances and emergency exits
      c. Stairwells
      d. Elevator vestibules
      e. Exterior mounted cameras

C. Video Analytics System
   1. Provide network video analytics software and software licenses to support the interior cameras for the employee entrance turnstiles and for exterior cameras shown on the project drawings.
   2. Provide an Advanced Analytics Package and Counting Package in addition to Flow Violation & Crowd Monitoring Packages.
   3. Include the following additional behaviors:
      a. Crowding – alarm generated upon crowd size reaching a user-defined threshold for a configurable amount of time.
      b. Tailgating – detection of person crossing entry/access-point line within a user-defined time interval after another person.
      c. Loitering – detection of person sojourning within a user-defined zone for a configurable amount of time.
      d. Stopped Vehicle – detection of vehicles stopped in one or more user-defined areas beyond a configurable amount of time (exterior cameras only)
      e. Gunshot Detection – Detect muzzle flash and sound against ambient background noise with a 99% or greater success rate.
      f. Multiline tripwire: Enables the association between two virtual tripwires with respect to crossing one before the other and relative time between crossing both.
      g. Leave-behind events: Detects when an object has been left behind or inserted in the full view of a camera.
      h. Object classification: Differentiates between a person, vehicle, or other objects.
      i. Camera tampering detection: Identifies any event that significantly changes the field of view of the camera.
      j. Glass Break: Detect the sound of breaking glass.
      k. Counting package:
         1) Enters/exits events: Detects when an object enters or exits a specified area of interest from any direction within the camera's field of view.
         2) Occupancy: Provides information about the number of people in a user-defined area of interest.
         3) Dwell time: Provides data about the length of time each person spends in a user-defined area of interest.

D. VSS Integration Requirements
   1. Provide software integration between the ACAMS and video management software for automatic camera call-up upon access control event (i.e. door prop/held alarm, infant tagging system alarm, intercom station, etc.) and recording/logging of behavior alarms through the video analytics software.

2. Provide integration between detention control system and video management software for automatic camera call-up upon activation of intercom station or alarm at all duress button locations and fire alarm manual pull stations. Utilize digital I/O to capture hardwired input/outputs from detention control system and convert them to digital alarms on the video management system.
3. Provide integration between POS system and video management software to enable recording of POS transactions on associated cameras in the Dining & Serving areas.

E. Interface to Elevator Conveying System
1. Each elevator to contain an analog fixed camera within the ceiling of the elevator car.
2. Provide stainless steel finish trim rings for mini-dome camera housings for cameras within the elevator cars. Coordinate with manufacturer to furnish custom painted housings.
3. Furnish analog cameras with custom stainless steel finish to elevator contractor for installation within the elevator car.
4. Provide analog signal cabling between the elevator machine room and the nearest TR room. Coordinate with elevator contractor for termination requirements.
5. Provide analog camera power supplies to support the cameras in the elevator cars. Coordinate with elevator contractor for exact location.
6. Provide rack-mount video encoder servers in the TR room to convert elevator analog video signals into a digital IP format for communication to the video management software.

1.3 SUBMITTALS

A. Product Data: Submit product information for components specified herein.

B. Shop Drawings:
1. Floor Plans: 1/8 inch scale floor and site plans showing the locations of devices and cable routing paths with cable types and quantity called out.
2. Point-to-Point Diagrams: Include wiring, points of connection and interconnecting devices between the following:
3. Video surveillance system, monitors, and recording equipment
4. Devices connected to the system
5. Conductors (identify conductors on the point-to-point diagrams with the same tag as the installed conductor)
6. Block Diagram/Riser Diagram: Show the video surveillance system components, conduit, wire types, and cabling interties between termination hardware.
7. Custom mounting details

1.4 EXTRA MATERIALS

A. Furnish extra materials to the Owner in the original manufacturer's packaging.

B. Provide spare parts of the following installed devices:
1. 4 x interior fixed network cameras
2. 2 x exterior network cameras
3. 4 x 8TB hard drives

PART 2 - PRODUCTS

2.1 NETWORK VIDEO RECORDING SOFTWARE

A. General
1. Complete software-based platform that encompasses recording video, viewing video, reviewing recorded video, and storing video for indefinite periods of time.
2. Designed for a multi-site, multi-server environment for a fully scalable network video recording solution.

3. The system simultaneously records, displays live video, and plays back video. None of the video operations interfere with each other. Live view and video playback does not interrupt the recording process.

B. Features
   1. Simultaneous support for MJPEG, MPEG-4, and H.264 video compression formats.
   2. Standards-based, open architecture software that is capable of running on non-proprietary hardware.
   3. Supports desktop, web browser, and mobile web clients. Capable of pushing live video on-demand to and from any client.
   4. Integrated virtual matrix switch for distributed video wall management.
   5. Search Capabilities
      a. Motion detection time line
      b. Auto-generated time intervals with thumbnail image previews
      c. Object or zone based search
      d. Alarm or event via ACAMS or video analytics behaviors
      e. Supports an unlimited amount of configurable camera group views
   6. Recording Configuration
      a. Advanced motion detection with configurable motion sensitivity, size, and speed
      b. User configurable archiving schedules and sequences that do not impact uptime
      c. Hardware and bandwidth utilization for monitoring and recording video and different frame rates and resolutions
      d. Multiple channel audio recording
   7. Virtual Matrix Switch Configuration
      a. Supports graphical keypads, touch screen monitors, dynamic mapping, and PTZ joystick controls
      b. Supports an unlimited amount of cameras, monitors, and operators
      c. Capable of pushing camera streams to any video wall monitor or remote display within the video management system
      d. Capable of creating custom groups on-demand
      e. Utilizes a one-touch or one-click selection from active maps to specific floor plans with detailed camera locations and viewing angles
      f. Integrates with video analytics, ACAMS, and POS systems
      g. Enables real-time notification, reviewing, and acknowledgement of events and alarms
   8. Video Analytics
   9. Network Configuration
      a. Capable of utilizing multiple networks and subnets
      b. Capable of utilizing user authentication via MS Windows User Account and Groups
      c. Capable of running as a MS Windows service
      d. Support for MS Active Directory
      e. Support for VMware and MS Virtual PC

C. Manufacturer
   1. S2 NetVR 100 Series System

2.2 NETWORK VIDEO ANALYTICS SOFTWARE

A. General
   1. Provides the core functionality of a video analytics system that will process the digital video and generate alarms and/or event messages when specific events are detected.
   2. Software based solution installed on non-proprietary hardware with NVR integration
   3. The software will operate in various environmental conditions including the following:
      a. Natural or artificial lighting in indoor/outdoor environments
      b. Infrared illumination for use with compatible cameras
      c. Immune to false alarms in various weather conditions including sun, clouds, rain, snow, sleet, wind or fog

d. Image stabilization to counter camera shake from wind or vibration due to camera mounting location

B. Performance Requirements
1. Capable of providing a variety of detection zones
a. A detection zone is defined as a region with a camera field of view used to detect behaviors specific to that zone.
2. Capable of defining multiple detection zones with a single camera view.
3. Capable of reporting alarms with the following:
a. On screen display with alarm text
b. Audio alarm alerts
c. Email notification containing the key video frame and relevant data

C. Manufacturer
a. S2 Security

2.3 NETWORK VIDEO SERVER & STORAGE APPLIANCES

A. Document the cost of this hardware at time of bid due to price reductions and advancements in technology. Prior to placement of order, provide upgrades to the most current model as requested by the Owner up to the cost of the specified system.

B. General
1. Controller: S2 Security Controller
2. Processor: Intel Corei3 product family
3. Memory: 8 GB RAM
4. Hard Drive Configuration: RAID 5
5. Hard Drive per Server: 2 x 8 TB SAS 7.2K RPM 3.5 inch HDD
6. Chassis Configuration: Rack chassis with sliding rails

C. Features
1. Fully scalable iSCSI SAN array with integrated virtual servers to provide a cloud-based video storage solution.
2. Capable of creating a SAN array of up to 288 TB of raw storage with no single point of failure. Data access is protected during switch, port, NIC, power supply, fan, and disk failures.
3. Capable of supporting RAID-6x so up to 5 simultaneous disk failures and a single server appliance failure will not affect data. Server applications restart automatically on an appliance failure.
4. Integrated management software to provide alarms and alerts for disk failure, automation of iSCSI connections, and data protection.

D. Manufacturer
1. S2 Security

2.4 NETWORK HD FIXED CAMERAS

A. Complete prepackaged unit containing:
1. Sensor: 1/3" progressive scan CMOS Sensor
2. Resolution: 30 frames at 1920 x 1080 (1080p HDTV)
3. Video compression format: H.264 and MJPEG
4. Camera Power over Ethernet (IEEE 802.3af) excluding heater/blower load

B. Manufacturer
a. Axis P3225-LV Mk II

2.5 NETWORK HD CORNER MOUNTED CAMERAS

A. Complete prepackaged unit containing:
1. Sensor: 1/3" progressive scan CMOS Sensor

2. Resolution: 30 frames at 1920 x 1080 (1080p HDTV)
3. Video compression format: H.264 and MJPEG

B. Manufacturer
   a. AXIS Q8414-LVS in White

2.6 NETWORK HD EXTERIOR CAMERAS

A. Complete prepackaged unit containing:
   1. Sensor: 1/3" progressive scan CMOS Sensor
   2. Resolution: 30 frames at 1920 x 1080 (1080p HDTV)
   3. Video compression format: H.264 and MJPEG

B. Manufacturer
   a. AXIS P3227-LVE

2.7 NETWORK VIDEO ENCODERS

A. General
   1. Video Compression: Dual H.264 video streams per input
   2. Resolution: 30 frames at 720x480 (NTSC)
   3. Alarm and event management
   4. Inputs: 4 or 8 BNC, looping

B. Manufacturer
   a. Axis

2.8 ANALOG FIXED CAMERAS

A. Complete prepackaged unit containing:
   1. 1/3” high resolution color CCD camera
   2. Resolution: 704x480 (4CIF)
   3. Auto iris, varifocal lens of 3.0-9.5mm
   4. Connectors:
      a. Analog video, composite video output
      b. Power, 12VDC or 24VAC
      c. Vandal-resistant, IP66 rated dome housing
      d. Stainless steel finish

B. Features
   1. Digital signal processing
   2. Digital slow shutter to enhance image quality in low light applications

C. Manufacturer
   a. Axis

2.9 POWER SUPPLIES

A. General
   1. Provide a 120 to 24VAC output, continuous current, fully supervised power supply for each for each exterior camera with internal defroster/heater and each elevator camera.
   2. Provide separate transformers and cables for the defroster/heater in each exterior camera housing (i.e. do not connect these loads to the camera power supply).

B. Manufacturer
   a. Axis

2.10 FIBER OPTIC MEDIA CONVERTERS

A. General
   1. Provide fiber optic media converts to support the stand-alone cameras shown on the site drawings.
   2. Refer to Section 27 51 23 – Intercom & Emergency Phone System for devices to support cameras integrated onto emergency phone stanchions and other requirements.

B. Manufacturer
   1. TC Communications (no substitutions)
      a. Devices within each standalone camera:
         1) #TC3212-03-SC1-24 multi-mode fiber converter, stand alone, 24VDC

PART 3 - EXECUTION

3.1 INSTALLATION

A. Network Video Recording Software
   1. Program record rate for network cameras at 30 frames per second at full resolution (1920x1080) using H.264 compression format.
   2. Coordinate with Owner's IT and Security representatives to set the following criteria:
      a. Administrator and operator passwords
      b. Camera and video device naming conventions
      c. Maximum bit rate
      d. Bandwidth throttle
      e. Camera groups and operator views
      f. Mapping features and criteria for a fully interactive graphical display of each floor plan
      g. Alarm events and integration into ACAMS
      h. Interface with POS system in Dining/Serving area

B. Network Video Analytics Software
   1. Interface with video management software to transmit metadata from behavior alarms on recorded video.
   2. Coordinate with Owner's IT and Security representatives to set the following criteria:
      a. Define zones for advanced motion detection to enable "tailgating" behavior alarm for turnstiles at the Employee Entrance.
      b. Define crowd size and time threshold to enable "crowding", "loitering", and "stopped vehicle" behavior alarms for exterior cameras.

C. Network Video Server & Storage Appliance
   1. Rack mount servers in the ER room as indicated on project drawings. Coordinate with Owner's IT representative and telecommunications contractor to provide network connectivity.
   2. Install MS Windows Server 2008 and necessary client access licenses.
   3. Install video management and video analytics software packages.
   4. Configure each array to support the maximum volume of disks in a RAID-6x configuration.
   5. Setup management software to transmit alerts and alarms for disk failure to the ACAMS. This will enable a single point of monitoring all security related alarms.
   6. Connect six (6) patch cords from network switch to each appliance to provide fault tolerance and sufficient switch ports for video throughput.

D. Interior Network HD Cameras
   1. Provide flush ceiling mount for fixed network cameras within ceiling space. Install camera body above ceiling line when camera located in ceiling so only dome exposed.
   2. Provide surface mount ring and electrical back box adapter plate for fixed network cameras in stairwells or other wall mounted locations.
   3. Field determine exact placement of cameras to ensure complete coverage.

4. Adjust the wide dynamic range, gain control, and noise reduction settings on each camera as required to provide clear and crisp video images.

E. Exterior Network HD Cameras
   1. Provide outdoor housing and mounts for exterior cameras.
   2. Field determine exact placement of cameras to ensure complete coverage.
   3. Coordinate a meeting with Owner's IT and Security representatives and Division 26 contractor to walk site and confirm actual mounting locations for each CCTV camera prior to installation.
   4. Field determine fixed camera lens size and settings to ensure complete coverage.

F. Network Video Encoder Servers
   1. Rack mount video encoders in the TR rooms as shown on the project drawings.
   2. Connect analog video signal cabling from elevator cameras to BNC inputs.
   3. Program record rate at 12 frames per second at full resolution (704x480) using H.264 compression format.

G. Analog Cameras in Elevator Cars
   1. Furnish housing, camera, and lens and deliver to elevator contractor.
   2. Installation of cameras within elevator cars by elevator contractor.
   3. Coordinate a meeting with elevator contractor to determine termination point of traveler cable coax for analog camera video signal.
   4. Camera powered by low voltage power supply within elevator car.
   5. Terminate analog cameras to network video encoder servers in nearest TR room.

3.2 TESTING

A. Commission the video surveillance system in accordance with Section 28 08 00 – Security System Acceptance Testing.

END OF SECTION

SECTION 283100

VOICE EVACUATION FIRE ALARM SYSTEM

PART 1 -GENERAL

1.1. Related documents

A. Drawings and general provisions of the contract apply to this section.

1.2. Summary

A. Fire Alarm / Voice Evacuation System

Provide all permits, labor, equipment, materials and services to furnish and install a fully tested functional, UL Listed, code compliant, intelligent addressable networked voice evacuation fire alarm system including but not limited to all initiation and notification appliances, all raceways and wiring, and all control, annunciation, and head-end components and panels.

The *fire alarm system* supplied under this specification shall utilize modular low voltage design with direct wired, node to node, peer-to-peer network communications. The system shall utilize independently addressed, fire detection devices, input/output control modules, audio amplifiers, telephone communications and notification appliances as described in this specification. Network panels shall contain the required user interfaces for all functions.

The system shall be designed for interior building audibility of 15 dBA-fast over ambient condition and intelligibility. Intelligibility shall be designed to ensure Common Intelligibility Standard (CIS) rating of 0.7 or Sound Transmission Index of 0.5 in all areas.

All equipment shall be new and the current products of a single manufacturer, actively engaged in the manufacturing and sale of digital fire detection devices for over ten years.

Also included are system wiring, raceways, pull boxes, terminal cabinets, mounting boxes, and any accessories and miscellaneous items required for a code compliant system.

The system drawings show the intended coverage and suggested device locations. Final device quantity, location, and AHJ approval are the responsibility of the contractor.

The final system shall be complete, tested, and ready for operation as described elsewhere in this specification, before owner acceptance.

Strict conformance to this specification is required to ensure that the installed and programmed system will function as designed, and will accommodate the future requirements and operations of the building owner. All specified operational features must be met without exception.

The system shall be required to communicate via ASHRAE BACnet protocol with the existing Building Automation System at the site.

The system shall be open source/non-proprietary, or if a proprietary system is used, there shall be a minimum of five (5) independent fire alarm companies in the immediate Dallas-Fort Worth metroplex capable of providing components for and making modifications to the system.

1.3. References

A. Codes-General

All work and materials shall conform to all applicable federal, state and local codes and regulations governing the installation. If there is a conflict between the referenced standards, federal, state or local codes, and this specification, it is the bidder's responsibility to immediately bring the conflict to the attention of the engineer for resolution. National standards shall prevail unless local codes are more stringent.

The bidder shall not attempt to resolve conflicts directly with the local authorities unless specifically authorized by the engineer.

B. Fire Alarm System Codes

The equipment and installation shall comply with the provisions of the following codes and standards unless the authority having jurisdiction has adopted an earlier version:

National Fire Protection Association (NFPA)
NFPA 70 - 2011 *National Electric Code*®
NFPA 72 - 2010 *National Fire Alarm Code*®

Underwriter's Laboratories, Inc
UL 864 - Control Units for Fire Protective Signaling Systems.
UL 268 - Smoke Detectors for Fire Protective Signaling Systems.
UL 268A - Smoke Detectors for Duct Applications.
UL 217 - Single and Multiple Station Smoke Alarms
UL 521 - Heat Detectors for Fire Protective Signaling Systems.
UL 228 - Door Closers-Holders, With or Without Integral Smoke Detectors.
UL 464 - Audible Signaling Appliances.
UL 38 - Manually Actuated Signaling Boxes for Use with Fire-Protective Signaling Systems
UL 346 - Waterflow Indicators for Fire Protective Signaling Systems.
UL 1971 - Signaling Devices for the Hearing-Impaired.
UL-1480 - Speakers for Fire Alarm, Emergency, and Commercial and Professional Use
UL 1481 - Power Supplies for Fire Protective Signaling Systems.
UL 1711 - Amplifiers for Fire Protective Signaling Systems.
UL 1635 - Digital Alarm Communicator System Units
UL-1638 - Signaling Appliances - Private Mode Emergency and General Utility Signaling

Note: Control equipment shall listed to both UL 864 and UL2572 standards.

Factory Mutual (FM) approval

International Code Council
International Building Code (2015 edition with City of Dallas amendments)

International Fire Code (2015 edition with City of Dallas amendments)
International Mechanical Code (2015 edition with City of Dallas amendments)

Federal Codes and Regulations
Americans with Disabilities Act (ADA)

Electrical Industries Association
EIA-232-D: Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange
EIA-485: Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems

C. Definitions and Abbreviations

ACU: Autonomous Control Unit.
ADA: Americans with Disabilities Act.
AFF: Above Finished Floor.
AHJ: Authority Having Jurisdiction.
Approved: Unless otherwise stated, materials, equipment or submittals approved by the Authority or AHJ.
Circuit: Wire path from a group of devices or appliances to a control panel or transponder.
CCS: Central Control Station.
CPU: The central computer of a multiplex fire alarm or voice command control system.
FACP: Fire Alarm Control Panel.
FCC: Fire Command Center.
FM: FM Global (Factory Mutual)
HVAC: Heating Ventilating and Air Conditioning.
IDC: Initiating Device Circuit.
LCD: Liquid Crystal Display.
LED: Light Emitting Diode.
NAC: Notification Appliance Circuit.
NFPA: National Fire Protection Association.
NICET: National Institute for Certification in Engineering Technologies
NRTL: Nationally Recognized Testing Laboratory
PTR: Printer.
RCP: Remote Control Panel
SLC: Signaling Line Circuit.
Style 1: As defined by NFPA 72, Class B.
Style 4: As defined by NFPA 72, Class B.
Style 6: As defined by NFPA 72, Class A.
Style 7: As defined by NFPA 72, Class A.
Style B: As defined in NFPA 72, Class B.
Style D: As defined in NFPA 72, Class A.
Style Y: As defined in NFPA 72, Class B.
UL or ULI: Underwriters Laboratories, Inc.
UL Listed: Materials or equipment listed and included in the most recent edition of the UL Fire Protection Equipment Directory.
Zone: Combination of one or more circuits or devices in a defined building area, i.e. 3 speaker circuits on a floor combined to form a single zone.

1.4. System Description

A. General Fire Alarm

The system supplied under this specification shall be a new UL Listed modular fire alarm voice evacuation system that uses independently addressed fire detection devices, input/output control modules, amplifiers and speakers.

The fire network shall utilize token ring, peer-to-peer communications. The network shall consist of one main and multiple remote Autonomous Control Unit/Fire Alarm Control Panels (ACU/FACP).

The system shall be fully field programmable such that virtually any combination of system output functions may be correlated to any type of input event(s). Inputs may be combined using Boolean logic, be time dependent or under manual control, as defined by required system operation. All software operations are to be stored in a non-volatile programmable memory within the fire alarm control panels. There shall be no limit, other than maximum system capacity, as to the number of addressable devices which may be in alarm simultaneously.

Addressable smoke detector sensitivity settings for both pre-alarm and alarm activation shall be automatically individually configurable for both daytime and nighttime operation. Addressable smoke detectors shall be UL listed for automatic sensitivity testing.

The system shall provide a one-way multi-channel emergency communication sub-system for the distribution of emergency messages to facility occupants.

The network shall connect the main ACU/FACP or Central Command Station (CCS) to all remote ACU/FACPs. The CCS shall be capable of initiating live and prerecorded audio messages to any combinations of ACU/FACPs connected to the network, as detailed under the Performance Requirements section of this specification.

System ACU/FACPs shall utilize configurable message routing and selective event messaging to direct event information only to the required system displays and printers as determined by the event type and location.

The existing fire alarm shall be removed and discarded and new control panels, power supplies, audio/visual indicating appliances (wiring may be reused within building if warranted as new and will work with new system if electrically sound) and related equipment shall be installed as specified.

B. Fire Alarm – General Requirements

Comply with the provisions of NFPA 72 and the operational requirements of this specification.

The system shall identify all off normal conditions and log each condition into the system as an event.

- The system shall automatically display on the control panel Liquid Crystal Display (LCD) the first (oldest) event of the highest priority by type. The event priority shall be alarm, supervisory, trouble, and monitor.

- The system shall utilize four event queues, and shall not require event acknowledgment by the system operator. Labeled, color coded indicators shall be provided for each type of event queue: alarm - red, supervisory - yellow, trouble - yellow, monitor - yellow. When an unseen event exists for a given type, the indicator shall be lit.

- For each event, the display shall include the current time, the total number of events, the type of event, the time the event occurred and up to a 42 character custom user description.

- The user shall be able to review each event queue by simply selecting scrolling keys (up-down) for the event

type.

- New alarm, supervisory, or trouble events shall sound a distinct, silenceable audible signal at the control panel.
- The LCD shall show the number of active alarm, supervisory, trouble and monitor events
- The LCD shall show the system time and the number of active and disabled points in the system.
- Specific input/output devices shall operate in accordance with the alarm, supervisory, trouble, monitor sections that follow and the input/output matrix.

All critical systems, sub-systems and circuits shall be monitored for integrity. System faults shall be annunciated.

Strobes shall be synchronized within the entire building.

Batteries shall be sized to support the system for 24 Hrs. of standby operation followed by 15 minutes of alarm operation at the end of the 24 Hour period.

Off premises reporting of the loss of AC mains power to any system component shall be automatically delayed for a period of time acceptable to the AHJ to reduce traffic at the central monitoring station due to wide-area power failures.

The system shall provide configurable service groups to facilitate “one man” testing of the system based on the physical layout of the building. Each service group shall be capable of supporting any combination of system devices, independent of the circuit on which they are installed. Systems that disable entire circuits, circuits serving multiple floors or fire zones for testing shall not be considered as equal. Activated devices on a service group shall be capable of initiating alternative system test responses to facilitate system maintenance and minimizing occupant disturbances while in test mode.

Event processing and display shall be prioritized as follows:

a. Fire alarms
b. Supervisory events
c. Trouble events
d. Monitor events

C. Alarm Operation

Upon the alarm activation of any area smoke detector, heat detector, manual pull station, sprinkler waterflow, the following functions shall automatically occur:

- The system shall remain in the alarm mode until all initiating devices are reset and the fire alarm panel is manually reset and restored to normal.
- The internal audible device shall sound at the control panel or command center.
- Display the alarm event on the graphical workstation.
- The LCD Display shall indicate all applicable information associated with the alarm condition including: zone, device type, device location and time/date.
- All system activity/events shall be documented on the system printer and logged into system history.
- Any remote or local annunciator LCD/LED's associated with the alarm zone shall be illuminated.

The following audio messages and actions shall occur simultaneously:

- An evacuation message shall be sounded general alarm evacuation. It is the intent of this message to advise occupants hearing this message that they are near danger and should leave the building via the stairs (nearest exit) immediately.

- Activate visual strobes general alarm evacuation. The visual strobe shall continue to flash until the system has been reset. The visual strobe shall not stop operating when the "Alarm Silence" is pressed.

- An alert message shall be sounded on the remainder of building. It is the intent of this message to advise occupants to prepare for evacuation if necessary.

- An instructional message shall be sounded in the stairwells instructing occupants to move carefully and quickly down the stairs to exit the building and to exit to a safe floor if you encounter smoke in the stairwell.

- An instructional message shall be sounded in the elevator cabs. It is the intent of this message to advise elevator occupants that an emergency exists, the elevator has been directed to the ground floor, and that occupants should quickly exit the building.

- An instructional message shall be sounded in the lobby. It is the intent of this message to advise lobby occupants to leave the lobby and clear the area for arriving firefighters.

- An instructional message shall be sounded in the concourses connected to the building's lobby. It is the intent of this message to prevent new entries into the lobby by advising occupants not to attempt to enter the lobby of the affected building.

- Provide selective paging to each individual floor (zone). In addition to the message/channels detailed above, a dedicated page channel shall be capable of simultaneously providing live voice instructions without interrupting any of the messages listed above shall be provided.

- The notification appliance dedicated to sprinkler system water flow alarm shall not be silenced while the sprinkler system is flowing at a rate of flow equal to a single head.

- Transmit signal to the building automation system.

- Transmit signal to the central monitoring station with point identification.

- All automatic events programmed to the alarm point shall be executed and the associated outputs activated.

- Activation of elevator lobby or elevator equipment room smoke detectors shall initiate recall of the bank of elevators to the 1st floor and lockout the elevator controls. Activation of the first floor elevator lobby smoke detector shall recall shall be to an alternate floor, and lockout the elevator controls.

- Activation of heat detectors in elevator shafts and machine rooms shall activate the elevator power shunt trip circuit breaker.

- All stairwell/exit doors shall unlock throughout the building.

- All self-closing fire/smoke doors held open shall be released.

- Transmit alarm text messages to "alpha-numerical" display pagers.

D. Fire Alarm - Supervisory Operation

Upon supervisory activation of any sprinkler valve supervisory switch, duct smoke detector, elevator shunt trip supervision, the following functions shall automatically occur:

- The internal supervisory event audible device shall sound at the control panel.
- Display the event on the graphical workstation and display a pictorial image.
- The LCD display shall indicate all applicable information associated with the supervisory condition including; zone, device type, device location and time/date.
- All system activity/events shall be documented on the system printer and logged to system history.
- Any remote or local annunciator LCD/LED's associated with the supervisory zone shall be illuminated.
- Transmit signal to the central monitoring station with point identification.

E. Fire Alarm - Trouble Operation

Upon activation of a trouble condition or signal from any device or internal system integrity monitoring function on the system, the following functions shall automatically occur:

- The internal panel audible device shall sound at the control panel.
- Display the event on the graphical workstation and display a pictorial image.
- The LCD keypad display shall indicate all applicable information associated with the trouble condition including; zone, device type, device location and time/date.
- Trouble conditions that have been restored to normal shall be automatically removed from the trouble display queue and not require operator intervention. This feature shall be software selectable and shall not prevent the logging of trouble events to the historical file.
- All system activity/events shall be documented on the system printer and logged to system history.
- Any remote or local annunciator LCD/LED's associated with the trouble zone shall be illuminated.
- Transmit a trouble signal to the central monitoring station with point identification.

F. Fire Alarm - Monitor Operation

Upon activation of any device connected to a monitor circuit, the following functions shall automatically occur:

- The internal panel audible device shall sound at the control panel.
- Display the event on the graphical workstation and display a pictorial image.
- The LCD display shall indicate all applicable information associated with the status condition including; zone, device type, device location and time/date.

- All system activity/events shall be documented on the system printer and logged to system history.
- Any remote or local annunciator LCD/LED's associated with the monitor circuit shall be illuminated.

1.5. Submittals

A. Submittal General

The contractor shall not purchase any equipment for the specified system until the owner has approved the project submittals in their entirety and has returned them to the contractor.

Approved submittals allow the contractor to proceed with the installation and shall not be construed to mean that the contractor has satisfied the requirements of these specifications.

Each submittal shall include a detailed list of variations that the submittal may have from the requirements of the contract documents.

The contractor shall provide specific notation on each shop drawing, sample, data sheet, installation manual, etc. submitted for review and approval, of each variation.

Any conflicts in the contract documents and/or with Authority Having Jurisdiction (AHJ) requirements shall be submitted to the owner in writing 7 days prior to bid.

Submittals shall be approved by authorities having jurisdiction prior to submitting them to the Engineer and Owner.

B. Submital Books

Submit for approval no less than three (3) copies of a submittal book to the consulting engineer for review and comment.

Submittal books shall meet the following requirements:

- Shall be a 3-ring binder with a cover that shows the project address, system type, and contractor.
- Shall use labeled dividers for major sections.
- Shall include:
  - Cover sheet
  - Table of contents
- Provide a list of all types of equipment and components provided. This shall be incorporated as part of a table of contents, which will also indicate the manufacturer's part number, the description of the part, and the part number of the manufacturer's product datasheet on which the information can be found.
- Product data sheets, as detailed elsewhere in this specification

- Provide description of operation of the system (sequence of operation), similar to that provided in Part 2 of this section of the specifications. The description shall be specific to this project, and shall provide individual sequences for every type of alarm, supervisory, or trouble condition, which may occur as part of normal or off-normal system use.

- B-size (black line) reduced shop drawings, as detailed elsewhere in this specification.

- System calculations, as detailed elsewhere in this specification.

- Installation instructions.

Provide samples of various items when requested.

Copies of all licenses, documents and certifications, as detailed elsewhere in this specification.

Additional copies may be required at no additional cost to the project.

C. Product Data

System components proposed in this specification shall be UL listed to operate together as a system. The supplier shall provide evidence, with his submittal, of listings of all proposed equipment and combinations of equipment.

For each product submitted provide the following information:

- Manufacturer's catalog data, to include material description, agency approvals, operating characteristics, electrical characteristics, dimensions, mounting requirements and accessories.

- Product data sheets for system components shall be highlighted to indicate the specific products, features, or functions required to meet this specification.

- Manufacturer's product installation sheets: A copy of the documentation that is required to be shipped with all listed products by UL.

D. Design Calculations

1. Battery Capacity

   Provide battery capacity calculations for each power supply that uses batteries for secondary power. Identify all loads. Identify any loads shed during alarm operation. Use the manufacturer's recommended methods and/or forms.

2. 24 VDC Notification Appliance Circuits

   For each 24VDC NAC, provide worst case voltage drop calculations. The load shall be treated as a lump sum at the end of the circuit. *Worst case power supply terminal voltage shall include all applicable internal power supply losses.* Using 85% of nominal circuit voltage (20.4VDC) shall not be accepted as lowest terminal voltage without manufacturer's published documentation stating there are no internal losses in the power supply.

3. Audio (Speaker) Notification Appliance Circuits - Interior

   The system shall be designed for interior building audibility level of 15 dBA-fast over ambient condition and intelligibility. Intelligibility shall be designed to maintain Common Intelligibility Standard (CIS) rating of 0.7 or

Sound Transmission Index of 0.5 in all areas designated on the drawings to have intelligible audio.

Provide dB loss calculations for all audio (speaker) notification appliance circuits. Circuits shall be designed for no more than 0.5 db loss based on lump-sum load method.

E. Shop Drawings

Submit for approval three (3) sets of shop drawings to the consulting engineer for review and comment. Drawings shall be either D-size or E-size blue line drawings and of a sufficient resolution to be completely read. Drawing sets shall be bound. Additional copies may be required at no additional cost to the project.

Drawings shall contain symbol legends with device counts, wire tag legends, circuit schedules for all addressable and notification appliance circuits, the project name/address, and a drawing description which corresponds to that indicated in the drawing index on the coversheet drawing. A section of each drawing title block shall be reserved for revision numbers and notes.

Shop drawings shall meet the following requirements:

1. Shop drawings shall be prepared by persons with the following qualifications:
   - Trained and certified by the manufacturer of the submitted equipment in fire-alarm system design.
   - NICET-certified fire-alarm technician, Level III or IV minimum.
2. Coversheet with project name, address and drawing index.
3. General notes drawing with peripheral device backbox size information, part numbers, device mounting height information, and the names, addresses, point of contact, and telephone numbers of all contract project team members.
4. Provide device floor plans for all areas served by the fire alarm system. Floor plans shall indicate accurate locations for all control and peripheral devices. Drawings shall be NO LESS THAN 1/8-INCH SCALE. If individual floors need to be segmented to accommodate the 1/8" scale requirements, KEY PLANS and BREAK-LINES shall be provided on the plans in an orderly and professional manner.
   - All addressable devices shall be shown. Coordinate the device address with the same device shown on the riser diagram.
   - Identify all notification appliances with a circuit and item number. Coordinate the circuit and item number with the same device shown on the riser diagram.
   - Show all raceways, marked for size, conductor count with type and size, showing the percentage of allowable National Electric Code fill used.
5. Device riser diagram, which individually depict all control panels, annunciators, addressable devices, and notification appliances. Shall include a specific, proposed device description above each addressable device. Shall include a specific, discrete device address that corresponds to addresses shown on the floor plans. Drawings shall provide wire specifications, and wire identification for all conductors depicted on the riser diagram. All circuits shall have identifiers that shall correspond with those required on the control panel and floor plan drawings. End-of-line resistors (and values) shall be depicted.
6. Control panel drawing(s) shall show internal component placement and all internal and field

terminations. Provide details indicating where conduit connections shall be made to avoid conflicts with internally mounted batteries. For each additional fire alarm panel, a separate drawing which clearly indicated the panel designation, service and location of the control enclosure.

7. Provide typical device wiring diagrams that show all system components, and the respective field wiring. Wire type, gauge, and jacket shall be indicated. When an addressable module is used in multiple configurations for monitoring or controlling equipment, provide a drawing for each application. End-of-line resistors (and values) shall be shown.

8. Provide a fire alarm system function matrix that illustrates alarm input/out events in association with initiation devices. Matrix summary shall include system supervisory and trouble output functions.

9. System Calculations as detailed elsewhere in this specification.

Upon receipt of approved drawings from the Authority Having Jurisdiction, the supplier shall immediately forward two sets of drawings to the owner. These drawings shall either be stamped approved or a copy of the letter stating approval shall be included.

F. Closeout

Two (2) copies of the following documents shall be delivered to the building owner's representative at the time of system acceptance.

- Project specific operating and maintenance manuals covering the system as installed. The manuals shall contain a description of the system architecture, inputs, notification signaling, auxiliary functions, annunciation, sequence of operations, expansion capability, application considerations and limitations. A generic instruction and operation manual shall not be acceptable.

- Technical literature (manufacturer's data sheets and installation manuals/instructions) for all parts of the system, including control panels, smoke detectors, batteries, manual stations, alarm notification appliances, power supplies, and remote alarm transmission means.

- Software and Firmware Operational Documentation

    - THE END-USER SHALL RETAIN COMPLETE RIGHTS AND OWNERSHIP TO ALL SITE-SPECIFIC SOFTWARE RUNNING IN THE SYSTEM. The fire alarm equipment supplier shall provide hard and soft copies of the software database to the end-user at the end of the warranty period. The database provided shall be useable by any authorized and certified distributor of the product line, and shall include all applicable passwords necessary for total and unrestricted use and modification of the database.

- Drawings
    - Provide “As Built” drawings of record of all the shop drawings used in the installation of the system.

    - Refer to the Submittals - Shop Drawings section of this specification for drawing requirements.

- Record of Completion
    - System supplier and contractor shall provide a certified test report to verify that the system and all components functioned properly and as intended.

    - A filled out Record of Completion similar to NFPA 72, 2007 edition figure 4.5.2.1 shall be provided.

- Warranty
    - Provide copies of the warranty documentation as detailed in the Warranty section of this specification.

- Service Organization
    - Provide the name, address and telephone of the authorized factory representative.

- Training
    - Conduct the required training as detailed in the Startup and Commissioning - Training section of this specification.

1.6. Quality Assurance

A. Qualifications of Supplier

The system supplier shall have a minimum of 5 years of experience in distribution and service of the proposed equipment brand.

The supplier shall have successfully designed and installed similar system fire detection, evacuation voice and visual signaling control components on a previous project of comparable scope, size and complexity.

The supplier shall have in-house engineering and project management capability consistent with the requirements of this project. The project shall be supervised by personnel certified by NICET as fire alarm Level IV technicians.

The supplier shall employ qualified and manufacturer certified system designers to perform the detailed engineering design, system calculations, for all the system equipment and programming.

The supplier shall produce all panel and equipment drawings, submittals, and operating manuals, as detailed elsewhere in this specification.

The supplier shall be responsible for providing qualified on site representative(s) for coordination of system installation, and final system testing and commissioning in accordance with these specifications.

B. Qualifications of Installer

Before commencing work, submit evidence showing that the equipment installer has successfully installed systems of the similar scope, type and design as specified.

The contractor/installer shall submit copies of all required Licenses and Bonds as required in the State having jurisdiction.

The contractor/installer shall be responsible for retaining qualified and authorized representative(s) of the system manufacturer (The Supplier) specified for detailed system design and documentation, coordination of system installation requirements, and final system testing and commissioning in accordance with these specifications.

The contractor/installer shall employ on staff a minimum of one NICET level II technician or a professional engineer, registered in the State of the installation.

Contractors unable to comply with the provisions of Qualification of Installers shall present proof of engaging the services of a subcontractor qualified to furnish the required services.

C. Delivery and Storage

The Contractor shall be responsible for all receiving, handling, and storage of his materials at the job site.

Overnight storage of materials is limited to the assigned storage area. Materials brought to the work area shall be installed the same day, or returned to the assigned storage area unless previously approved by the Owner.

The Contractor shall remove rubbish and debris resulting from his work on a daily basis. Rubbish not removed by the Contractor will be removed by the Owner and back-charged to the Contractor.

1.7. Project Conditions

A. Responsibility

It shall be the contractor's responsibility to inspect the job site and become familiar with the conditions under which the work will be performed.

A pre-bid meeting will be held to familiarize the contractors with the project. Failure to attend the pre-bid meeting may be considered cause for rejection of the contractor's bid. The minutes of this meeting will be distributed to all attendees and shall constitute an addendum to these specifications.

All work, may be conducted during normal working hours, 8:00 a.m. to 5:00 p.m., Monday through Friday, unless otherwise permitted by Dallas County.

1.8. Warranty

A. Installation Workmanship and Parts

The contractor shall warranty the installation and workmanship for one (1) year and all parts for thirty-six (36) months from date of final acceptance. A copy of the manufacturer’s warranty shall be provided with closeout documentation and included with the operation and installation manuals. The full cost of maintenance, labor and materials required to correct any defect during the warranty period shall be included in the submittal bid.

The contractor shall provide a five (5) year service agreement with the customer. Each year the contractor shall perform routine system inspection (all components of the system), as well as detector sensitivity testing and provide a report to the owner.

The system supplier shall maintain a service organization with adequate spare parts stock within 75 miles of the installation. Provide a telephone response to owner’s questions within 4 hours and on-site assistance within 24 hours.

Permit the owner’s fire alarm technicians to perform temporary bypasses and emergency repairs on the system without voiding the warranty.

1.9. Startup and Commissioning

A. Testing - General

In addition to tests required in this Section, the Contractor shall perform all electrical and mechanical tests required by the equipment manufacturer, the Engineer and the Authority having jurisdiction.

The contractor shall perform all testing in occupied facilities at times of day that present the lowest impact and disruption to business and activities. Coordinate all testing in occupied buildings with the building owner's representative to assure that fire alarm system testing does not interrupt operations. This may require extensive after hours work to perform such testing.

All equipment, instruments, tools and labor required to conduct the system tests shall be provided by the installing contractor. At a minimum, the following equipment shall be made available testing:

- Ladders and scaffolds as required to reach all installed equipment.
- Meters for reading voltage, current and resistance.
- Two-way communication devices
- Simulated smoke, heat-producing devices for heat detectors, extension poles for introducing smoke into detectors, as needed.
- Manufacturer's instruments to measure air flow through duct smoke detectors.
- Decibel meter and intelligibility testing equipment.
- Status and diagnostic software and PC.

All testing shall utilize a written acceptance test plan for testing the system components and operation in accordance with NFPA 72 and this specification. The contractor shall be responsible for the performance of the acceptance test plan, demonstrating the function of the system and verifying the correct operation of all system components, circuits, and system programming.

The systems operation matrix created by the equipment supplier shall be used to identify each alarm input and verify all associated output functions.

The system test plan shall include but not be limited to the following:

- Visually inspect all wiring.
- Verify the absence of unwanted voltages between circuit conductors and ground. The tests shall be accomplished at the preliminary test with results available at the final acceptance test.
- System wiring shall be tested to demonstrate correct system response for the following conditions:
  - Open, shorted and grounded signal line circuits.
  - Open, shorted and grounded notification appliance circuits.
- System indications shall be demonstrated as follows:
  - Correct message content for each alarm input at all system displays.
  - Correct annunciator light for each alarm input at each graphic display.
  - Correct history logging for all system activity.

- Correct sensitivity for all smoke detection devices. The use of system generated sensitivity reports is acceptable in meeting this requirement.

- Correct signals sent to the Central Monitoring Station.

- Notification appliances shall be demonstrated as follows:

  - All alarm notification appliances actuate as programmed

  - The system shall be tested for interior building audibility of 15 dBA-fast over ambient condition and intelligibility. Intelligibility shall be tested to ensure Common Intelligibility Standard (CIS) rating of 0.7 or Sound Transmission Index of 0.5 in all areas designated on the drawings to have intelligible audio. The mean value of at least 3 readings shall be required to compute the intelligibility score at each test location.

  - For 24VDC NACS, measure and record the voltage at the most remote appliance on each notification appliance circuit, while operating.

- System control functions shall be demonstrated as follows:

  - In accordance with the system operation matrix.

- System off premises reporting functions shall be demonstrated as follows:

  - Correct information received for each alarm and trouble event

- Secondary power supply (battery) capacity capabilities shall be demonstrated as follows:

  - System battery voltages and charging currents shall be measured and recorded at the fire alarm control panels.

  - System primary power shall be disconnected for 24 hours. At the end of that period, an alarm condition shall be created and the system shall perform as specified for a period of 15 minutes.

  - System primary power shall be restored for forty-eight (48) hours.

  - System battery voltages and charging currents shall again be measured and recorded at the fire alarm control panels.

- Verify the “As Built” record drawings are accurate.

B. Preliminary Testing

Conduct preliminary tests to ensure that all devices and circuits are functioning properly. Tests shall meet the requirements of the written test plan. Correct any deficiencies, omissions or anomalies and retest the affected devices to assure proper function per the specification.

C. Acceptance Testing

1. A final acceptance test shall not be scheduled until the system manuals are provided to and approved by the owner and the following are provided at the job site:
   (1) “As Built” Record drawings of the system as actually installed
   (2) A copy of the system operation matrix.

2. The acceptance inspector shall use the system “As Built” record drawings in combination with the system operation matrix and the written acceptance test plan during the testing to verify system operation.

3. Should the system not perform to the above criteria it shall not be accepted and the Contractor shall correct all deficiencies and shall re-test the system at Contractor's expense in the presence of the Architect using the same test criteria.

4. The building owner’s representative shall witness the final tests.

5. The central monitoring station and/or fire department shall be notified before final test in accordance with local requirements.

6. Operate every installed device to verify proper operation and correct annunciation at control panel.

7. Open signaling line circuits and notification appliance circuits in at least 2 locations to verify presence of supervision.

D. Test Reports

A "Fire Alarm System Record of Completion" per the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in shall be prepared by the Contractor. Submit three (3) copies to the Owner and Engineer. The report shall include, but not be limited to:

- A list of all equipment installed and wired.
- Certification that all equipment is properly installed and functions and conforms to these specifications.
- Sensitivity settings for each ionization and photoelectric detector as measured in place with the HVAC system operating.
- Technician's name, certificate number and date.

E. Training

The system supplier shall schedule and present a minimum of eight (8) hours of formal site specific instruction for the building owner, detailing the proper operation and maintenance of the installed system.

The instruction shall be presented in an organized and professional manner by a person factory trained in the operation and maintenance of the equipment and who is also thoroughly familiar with the installation.

The instruction shall cover the schedule of maintenance required by NFPA 72 and any additional maintenance recommended by the system manufacturer.

Copies of all training aids, presentations, etc. shall be left with the owner.

1.10. Maintenance

A. Spare Parts

The contractor shall furnish the following extra material that matches the products installed. Spares shall be packaged with protective covering for storage and identified with labels describing contents.

- Automatic detection devices - Two (2) percent of the installed quantity of each type, no less than one piece.

- Manual fire alarm stations - Two (2) percent of the installed quantity of each type, no less than one piece.
- Audible and visible devices - One (1) percent of the installed quantity of each type, but no less than two (2) devices.
- Keys - A minimum of three (3) sets of keys shall be provided and appropriately identified.

PART 2 - PRODUCTS

2.1. Fire Alarm Panel

A. General – Fire Alarm

1. Overview

All materials, equipment, accessories, devices and other facilities and appurtenances covered by these specifications or noted on the drawings shall be new, best suited for the intended use and shall conform to applicable and recognized standards for their use, and supplied by a single manufacturer. Should any equipment provided under this specification be supplied by a different manufacturer, that equipment shall be recognized compatible by BOTH manufacturers and listed as such as required by Underwriters' Laboratories.

The fire alarm control panel(s) shall be a multi-processor based networked system designed specifically for fire alarm. The control panel shall be listed and approved for the application standard(s) as listed in the References section of this specification.

The control panel shall include all required hardware, software and site specific system programming to provide a complete and operational system. The control panel(s) shall be designed such that interactions between any applications can be configured, and modified using software provided by the manufacturer. The control panel(s) operational priority shall assure that life safety takes precedence among the activities coordinated by the control panel.

The operating controls shall be located in a dead-front steel enclosure behind a locked door with viewing window. All control modules shall be labeled, and all zone locations shall be identified. All panel modules shall be placement supervised for and signal a trouble if damaged or removed.

2. System Features

Each control panel shall include the following capabilities:

- Supervision of the system electronics, wiring, detection devices and software
- Up to 2500 analog/addressable input/output points
- Network connections with up to 63 other control panels and annunciators.
- Support multiple dialers (DACTs) and modems
- Two communication ports
- An internal audible signal with different patterns to distinguish between alarm, supervisory, trouble and monitor events
- Support multiple 24 VDC and Audio NACs
- User configurable switches and LED indicators to support auxiliary functions
- Log up to 1740 chronological events
- The ability to download all applications and firmware from the configuration computer at a single location on

the fire network
- A real-time clock for time stamps and timed event control
- Electronic addressing of intelligent addressable devices
- Provide an independent hardware watchdog to supervise software and CPU operation
- “Dry” alarm, trouble and supervisory relay contacts
- Control panel modules shall plug in to a chassis assembly for ease of maintenance
- Field wiring shall connect to the panel using removable connectors

3. User Oriented Features

Each control panel shall include the following user oriented features:

- An LCD user interface control/display that shall annunciate and control system functions.
- Provide discreet system control switches for reset, alarm silence, panel silence, drill switch, previous message switch, next message switch and details.
- A “lamp test” feature shall verify operation of all visual indicators on the panel.
- An authorized user shall have the ability to operate or modify system functions including system time, date, passwords, holiday dates, restart the system and clear control panel event history file.
- An authorized user shall have the ability to disable/enable devices, zones, actions, timers and sequences.
- An authorized user shall have the ability to activate/restore outputs, actions, sequences, and simulate detector smoke levels.
- An authorized user shall have the ability to enter time and date, reconfigure an external port for download programming, initiate programming and change passwords.
- An authorized user shall have the ability to test the functions of the installed system.
- Service groups shall facilitate one-man walk testing. Service/test groups shall be capable of being configured with any combination of addressable devices, independent of SLC wiring. It shall be possible to program alternate device responses when the device’s service group is active. Devices not in an active service group shall process all events normally.
- Provide internal system diagnostics and maintenance user interface controls to display/report the power, communication, and general status of specific panel components, detectors, and modules.
- SLC loop controller diagnostics shall identify common alarm, trouble, ground fault, Class A fault, and map faults. Map faults include wire changes, device type changes by location, device additions/deletions and conventional open, short, and ground conditions. Ground faults on the supervised circuit wiring of remote addressable modules shall be identified by device address.
- An authorized user shall have the ability to generate a report history for alarm, supervisory, monitor, trouble, smoke verification, watchdog, and restore activity.
- System reports shall provide detailed description of the status of system parameters for corrective action or for preventative maintenance programs. Reports shall be displayed by the operator interface or capable of being printed on a printer.
- An authorized user shall have the ability to display/report the condition of addressable analog detectors. Reports shall include device address, device type, percent obscuration, and maintenance indication. The

maintenance indication shall provide the user with a measure of contamination of a device upon which cleaning decisions can be made.

4. Programmability

A Windows-based Configuration Utility (CU) shall be used to create the site-specific system programming. The utility shall facilitate programming of any input point to any output point. The utility shall allow customization of fundamental system operations using initiating events to start actions, timers, sequences and logical algorithms.

- Zoning of initiation devices.
- Initiation of events by time of day, day of week, day of year.
- Initiation of events by matrix groups (X-Y coordinate relationships) for releasing systems.
- Initiation of events using OR, AND, NOT and counting functions.
- Prioritizing system events.
- Programmable activation of detector sounder bases by detector, groups of bases, or all bases.
- Directing selected device messages to specific panel annunciators
- Detector sensitivity selection by time of day
- Support of 256 Central Monitoring Station accounts and directing selected device messages to any one of ten Central Monitoring Stations.

The configuration utility shall time and date stamp all changes to the site-specific program, and shall facilitate program versioning and shall store all previous program version data. The utility shall provide a compare feature to identify the differences between different versions of the site-specific program.

The configuration utility shall be capable of generating reports which detail the configurations of all fire alarm panels, addressable devices and their configuration settings including generating electrical maps of the addressable device SLCs.

The configuration utility shall support the use of bar code readers to expedite electronic addressing and custom programming functions.

B. Power Supply

System power supply(s) shall be a high efficiency switched mode design providing multiple supervised power limited 24 VDC output circuits as required by the panel and external loads fed by the panel. Initial power supply loading shall not exceed 80% of power supply capacity in order to allow for future system expansion.

Each system power supply shall be individually supervised. Power supply trouble signals shall identify the specific supply and the nature of the trouble condition.

It shall be possible to parallel system power supplies to increase capacity or to provide redundant operation.

Upon failure of normal (AC) power, the affected portion(s) of the system shall automatically switch over to secondary power without losing any system functionality.

All system power supplies shall be capable of recharging their associated batteries, from a fully discharged condition to a capacity sufficient to allow the system to perform consistent with the requirements of this section, in 48 hours maximum.

All standby batteries shall be continuously monitored by the power supply. The power supply shall be able to perform an automatic load test of batteries and indicate a trouble condition if the batteries fall outside a predetermined range. Power supplies shall incorporate the ability to adjust the charge rate of batteries based on

ambient temperatures. The power supply shall automatically disconnect the battery before low voltage damages the battery. Low battery and disconnection of battery power supply conditions shall immediately annunciated as battery trouble and identify the specific power supply(s) affected.

Batteries shall utilize sealed lead acid chemistry. Initial battery capacity shall provide 125% of calculated capacity requirements in order to allow for future system expansion.

All AC power connections shall be to the building's designated emergency electrical power circuit and shall meet the requirements of NFPA 70 and NFPA 72. The power circuit disconnect means shall be clearly labeled FIRE ALARM CIRCUIT CONTROL and shall have a red marking. The location of the circuit disconnect shall be labeled permanently inside the each control panel the disconnect serves.

C. User Interface

1. Panel LCD and Common Controls

The system shall be designed and equipped to receive, monitor, and annunciate signals from devices and circuits installed throughout the facility.

Each fire alarm control panel (system node) shall be capable of supporting a backlit LCD display. The display on each system node shall be configurable to display the status of any and/or all combinations of all alarm, supervisory, trouble, monitor, or service group event messages on the network. Each LCD display on the system shall be capable of being programmed to allow control functions of any combination of nodes on the entire network.

The LCD display shall provide separate alarm, trouble, supervisory, and monitor event queues of to minimize operator confusion. Receipt of alarm, trouble, and supervisory signals shall activate integral audible devices at the control panel(s) and at each remote annunciation device. The integral audible devices shall produce a sound output upon activation of not less than 85 dBA at 10 feet.

The LCD display shall contain the following system status indicators:

- System Power Indicator
- System Test Indicator
- System CPU Fail Indicator
- Ground Fault Indicator
- Disabled Points Indicator
- System Normal Indicator
- System Common Alarm Indicator
- System Common Trouble Indicator
- System Common Supervisory Indicator
- System Common Monitor Event Indicator

The LCD display shall contain the following system switch/indicators:

- System Reset Switch with Indicator
- System Alarm Silence Switch with Indicator
- System Panel Silence Switch with Indicator
- Drill Switch with Indicator
- Alarm Acknowledge Switch with Indicator
- Trouble Acknowledge Switch with Indicator

- Supervisory Acknowledge Switch with Indicator
- Monitor Acknowledge Switch with Indicator

The LCD display shall contain the following system function switches:

- System Event Message Queue Scroll Switch.
- Event Details Switch
- Command Menu Switch
- 10-Digit Keypad with Enter and Backspace switches

168 Character Backlit Liquid Crystal Text Display:

The user interface shall provide a backlit LCD that will allow custom event messages of up to 42 characters. The interface shall provide a minimum of eight lines by 21 characters and provide the emergency user hands free viewing of the first and last highest priority events. The last highest priority event shall always display and update automatically. Events shall be automatically placed in one of four easy to access queues. It shall be possible to scroll through and view specific alarm, trouble, supervisory and monitor events separately. Having to scroll through a mixed list of event types shall not be considered as equal. The total number of active and disabled events by type shall be displayed. Visual indication shall be provided of any event type that has not been acknowledged or viewed. It shall be possible to customize the designation of all user interface LEDs and Switches for local language requirements.

2. LEDs and Switches

A modular series of switches and LED indicators shall be available to customize the fire alarm control panel operation in accordance with this specification. All LED and switch functions shall be software programmable. Switches shall be configurable for momentary, maintained, toggle, or “exclusive or” operation as required by the application. LEDs shall be configurable for slow flash, fast flash or steady operation. LED/Switch modules shall be capable of mounting in any available fire panel module position. All LED/Switch modules shall be supervised. LEDs shall be available in a variety of colors to facilitate identification from a distance. The LED/Switch modules shall provide ample room for custom function text labels under a protective membrane.

3. Audio Annunciation and Control

Provide a master one-way emergency audio control unit as part of the main fire alarm control panel. The emergency audio control shall contain a paging microphone and shall be capable of generating and delivering multi-channel audio messages simultaneously over copper and/or fiber media to remote parts of the facility.

The one-way audio control unit shall store up to 32 minutes of pre-recorded audio messages digitally as WAV files. These messages shall be automatically directed to various areas in a facility under program control. The unit shall have the capacity to store up to 200 individual audio messages and to simultaneously play back seven (7) different messages in addition to live page message.

During non-alarm conditions, the control unit shall continuously distribute a default audio message to all amplifiers, providing total audio path supervision. To enhance system survivability, each remote FACP cabinet containing an amplifier shall play the default audio message in the event of a fire AND a control network system failure.

The one-way emergency audio control shall provide control switches to direct live paging messages as follows:

- "All Call" to direct the page messages to all areas in the facility, overriding all other messages and tones.
- "Page to Evacuation Area" to direct the message to the evacuation area(s), overriding all other messages

and tones.

- "Page to Alert Area" to direct page messages to the area(s) receiving the alert message and tones, overriding all other messages and tones.

The one-way audio control unit shall be capable of supporting up to 64 remote microphone inputs and a line level audio input.

The fire alarm control panels shall support remote cabinets with zoned amplifiers to receive, amplify and distribute messages through speakers over supervised circuits.

4. System Printer

The event and status printer shall be an ink jet or laser printer.

The printer output shall include the type of event, the circuit or device reporting including address, date, and event time. Event restoral conditions shall also be printed, including address, date, and event time.

In the event that the printer is off-line when an event is received, a panel buffer shall retain the data and it shall be printed when the printer is restored to service.

5. Reports

The system shall provide the operator with system reports that give detailed description of the status of system parameters for corrective action, or for preventative maintenance programs. The system shall provide these reports via the main LCD, and shall be capable of being printed on any system printer.

The system shall provide a report that gives a sensitivity listing of all detectors that have less than 80% environmental compensation remaining. The system shall provide a report that provides a sensitivity (% Obscuration per foot) listing of any particular detector.

When addressable CO detectors are installed, performing a “sensitivity” check from the panel shall report the approximate number months of sensor life remaining.
The system shall provide a report that gives a listing of the sensitivity of all of the detectors on any given panel in the system, or any given analog/addressable device loop within any given panel.

The system shall provide a report that gives a chronological listing of at least the last 1000 system events.

The system shall provide a listing of all of the firmware revision listings for all of the installed components in the system.

D. Signaling Line Circuits

1. SLC Systems

The signaling line circuit connecting panels/nodes to intelligent addressable devices including, detectors, monitor modules, and control modules shall be Class A (style 6 or 7). All signaling line circuits shall be supervised and power limited.

When the addressable devices on a signaling line circuit cover more than one designated fire/smoke compartment, a wire-to-wire short on the circuit shall not affect the operation of the addressable devices in other fire/smoke compartments.

Each SLC shall support no less than 125 addressable detector addresses and no less than 125 module addresses. The SLC shall support 100% of all addressable devices in alarm and provide support for a 100% compliment of detector isolator bases. Initial circuit loading shall not exceed 80% in order to allow for future system expansion.

The addressable device SLC module shall be UL Listed for use with code compliant, electrically sound existing wiring.

Each intelligent addressable device shall transmit information about its location with respect to other devices on the circuit. This information shall be used to create an “As-Built” wiring diagram as well as provide enhanced supervision of a device’s physical location. The device message and programmed system output function shall be associated with the device’s location on the SLC circuit location and not a device address.

The SLC module shall allow replacement of “same type” devices without the need to address and reload the “location” parameters on replacement device.

The SLC/Panels shall notify the user when programmed devices are detected on the SLC circuit. The SLC/Panels shall notify the user when the wrong device type is installed at a location configured for a different device type on the SLC circuit.

Should an SLC Controller CPU fail to communicate, the SLC circuit shall go into the stand-alone mode. The circuit shall be capable of producing a loop alarm if an alarm type device becomes active during stand-alone mode to enhance system integrity.

2.2. Notification Appliance Circuits

All notification circuits shall be supervised and power limited. Non-power limited circuits are not acceptable. All notification appliance circuits shall be Class B (Style "Y").
Initial circuit loading shall not exceed 80% in order to allow for future system expansion.

Notification appliance circuits shall have a minimum circuit output rating of 2 amps @ 24 VDC

24VDC NACs shall be polarized and provide strobe synchronization signals on a single pair of wires.

Audio notification appliance circuits shall be polarized and have a minimum circuit output rating of 50 watts @ 25V audio, and 35 watts @ 70V audio.

2.3. Audio Amplifiers

Each audio power amplifier shall have integral audio signal de-multiplexers, allowing the amplifier to select any one of eight digitized audio channels as directed by system programming.

Audio amplifiers shall be power limited and protected from short circuits conditions on the audio circuit wiring. Each amplifier output shall provide a selectable 25/70 Vrms output, suitable for connection to emergency speakers.

To enhance system survivability in the event of a total loss of audio data communications, all amplifiers shall default to the local “EVAC” tone generator channel. If the local panel has an alarm condition, then all amplifiers will sound the EVAC message on their speaker circuits. In the event of a loss of the fully digitized, multiplexed audio riser data, the audio amplifiers shall automatically default to an internally generated alarm tone which shall sound a 3-3-3 temporal pattern.

Amplifiers shall also include a 24 VDC notification appliance circuit rated at 24Vdc @ 3.5A for connection of visible (strobe) appliances. This circuit shall be fully programmable.

Provide as minimum, one twenty (20) watt audio amplifier per paging zone. Initial amplifier loading shall not exceed 80% in order to allow for future system expansion. Calculations shall assume each speaker is connected at one (1) watt.

2.4. Initiating Device Circuits

Conventional (2-wire) initiating device circuits monitoring manual fire alarm stations, smoke and heat detectors, waterflow switches, valve supervisory switches, fire pump functions, and air pressure supervisory switches shall be Class A (Style "D" or "E").

Initiating device circuits shall be configurable for latched or non-latched operation and configurable to initiate alarm, supervisory or monitor events.

End-of-line resistors for conventional initiating device circuits shall be covered with insulated tubing, terminated with ring lugs and display a UL label.

2.5. Off Premises Communications

The system shall provide off premises communications capability using a Digital Alarm Communications Transmitter (DACT) for sending system events to multiple Central Monitoring Station (CMS) receivers over conventional telephone lines.

The system shall provide the CMS(s) with point identification of system events using 4/2, Contact ID ID (SIA DC-05) or SIA DCS protocols.

The dialer shall support up to 255 individual accounts and to send account information to eight (8) different receivers, each having a primary and secondary telephone access number. System events shall be capable of being directed to one or more receivers depending on event type or location as specified by the system design.

In the event of a fire alarm panel CPU failure during a fire alarm condition, the DACT degrade mode shall transmit a general fire alarm signal to the CMS.

The owner shall arrange for two (2) dedicated loop-start phone lines to be terminated using two RJ31X jacks within 5 ft of the main fire alarm control panel.

2.6. TCP-IP Network

A. Ethernet Network IO Module

Where the graphic command workstation must interface with third party equipment over the TCP/IP network, the TCP/IP network IO module shall be used. The module shall provide four (4) unsupervised inputs and four (4) NO relay contacts.

IO Module inputs shall be configurable as incoming events on the workstation and IO relays shall be operated by commands from the workstation.

Network communications shall be supervised by the graphic command workstation

The network IO module shall operate on a nominal 24 VDC supplied from a battery backed up fire alarm control panel or booster power supply to insure power to the switch is supervised and reliable.

B. VoIP Encoder-Decoder

The CCS and each ACU/FACP control panel audio system shall be connected to the TCP/IP network.

Network audio connectivity shall consist of a supervised encoder/decoder capable of encoding/decoding MP3, WMA, G.711 and PCM data streams in HTTP, UDP or RTP format, depending on its application.

The encoder input audio shall be generated from dedicated FACP amplifier and attenuated to the correct level using an audio bridge.

Analog audio from the decoder shall connect to the ACU/FACP audio source unit input. Signal monitoring shall be provided by supervisory modules.

The audio encoder/decoder shall operate on filtered-regulated 24 VDC power derived from the FACP power supply, ensuring a reliable and monitored power source.

The audio encoder/decoder shall be equipped with:

1. Line-level audio output.
2. 10/100 Base-T Mbit Automatic Ethernet port.
3. RS232, 115,200 baud communication port.
4. Normally open relay rated at 500 mA @ 24 VDC.
5. Reset button.

C. IP Network Switch

IP Network Cabling

Provide a dedicated Emergency Communications Ethernet TCP/IP Network.

IP Network Switch

The TCP/IP network switches shall be industrial grade auto-negotiating switching hubs. Switch shall be UL864 listed, shall provide four (4)10/100 Mbps shielded RJ-45 connectors for twisted pair (Ethernet) connections and two 100 Mbps multi-mode fiber ports.

The switches shall operate on a nominal 24 VDC supplied from a battery backed up fire alarm control panel or booster power supply to insure power to the switch is supervised and reliable.

Switches shall provide LED indicators for data rate, activity/link integrity, power and loop detection.

D. Network to RS232

The fire alarm control panel to LAN/WAN network interface shall be a UL 864 Listed industrial grade 10/100 Base-T Ethernet device server.

The interface shall operate on a nominal 24 VDC supplied from a battery backed up fire alarm control panel or booster power supply to insure power to the interface is supervised and reliable.

The interface shall have diagnostic LEDs on the front of the unit make it easy to determine its status, and incorporate flash ROM memory facilitating upgrading the operating firmware.

2.7. Remote Booster Power Supply

Install Remote NAC Power Supplies (boosters), as required, to minimize NAC voltage drops. Remote NAC power supplies shall be treated as peripheral NAC devices and shall not be considered fire alarm control units.

The NAC power supplies shall be fully enclosed in a surface mounted steel enclosure with hinged door and cylinder lock, and finished in red enamel. Door keys shall be the identical to FACP enclosure keys. The enclosure shall have factory installed mounting brackets for additional UL listed fire alarm equipment within its cabinet. Enclosures shall be sized to allow ample space for interconnection of all components and field wiring, and up to 10AH batteries. The enclosure shall have provisions for an optional tamper switch. All FACP addressable control modules required to initiate the required NAC power supply output functions shall be installed within the NAC power supply enclosure

Remote NAC power supply *input* circuits shall be configurable as Class B supervised inputs or for connection to any 6 to 45 VDC initiation source.

Remote booster power supplies shall provide four (4) synchronized Class B supervised or two (2) Class A, power limited, 24VDC filtered and regulated Notification Appliance Circuits (NACs). Each NAC output shall be configurable as a continuous 24Vdc auxiliary power output circuit. The booster power supply shall be capable of a total output of <6> 10 amps.

The power supply NACs shall be configurable to operate independently at any one of the following rates: continuous synchronized, or 3-3-3 temporal. It shall be possible to configure the NACs to follow the main FACP NAC or activate from intelligent addressable synchronized modules. All visible NACs within the facility shall be synchronized.

Upon failure of primary AC power, the remote power supply shall automatically switch over to secondary battery power without losing any system functions. It shall be possible to delay reporting of an AC power failure for up to 6 hours. All standby batteries shall be continuously monitored by the power supply. Low battery and disconnection of battery power supply conditions shall immediately annunciated as locally as battery trouble. All power supply trouble conditions (DC power failure, ground faults, low batteries, and IDC/NAC circuit faults) shall identify the specific remote power supply affected at the main FACP. All power supply trouble conditions except loss of AC power shall report immediately. Interconnecting NAC Booster power supplies in a manner which prevents identification of an individual power supply trouble shall not be considered as an equal.

The remote booster power supply shall be capable of recharging up to 24AH batteries to 70% capacity in 24 hours maximum. Batteries provided shall be sized to meet the same power supply performance requirements as the main FACP, as detailed elsewhere in this specification.

All AC power connections shall be to the building's designated dedicated emergency electrical power circuit. The power circuit disconnect means shall be clearly labeled FIRE ALARM CIRCUIT CONTROL and shall have a red marking. The location of the circuit disconnect shall be labeled permanently inside the each remote NAC power supply the disconnect serves. It is the contractor’s responsibility to provide 120V power connection from existing facility electrical infrastructure to all required booster power supply locations.

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2.9. Graphic Command Workstation

A. Overview

A graphical workstation shall be provided at the Central Command Station (CCS) that enables primary control of the fire alarm system provided under this specification.

The Graphic Command Workstation shall provide multiple points of view of a system event to deliver the user the maximum amount of information with minimum intervention. Complete control of connected fire alarm panels shall be provided. The workstation shall have a paging microphone capable of live paging to any combination of destination buildings. The workstation shall be capable of transmitting pre-recorded messages to any combination of destination buildings.

B. Scope

The Graphic Command Workstation shall support a minimum of eighty (80) networked fire systems via Ethernet using IP protocol communications. The Graphic Command Workstation shall support a Digital Alarm Communications Receiver (DACR) unit to monitor third-party fire systems using Contact ID format via phone lines or Ethernet. The workstation shall be UL listed to command and control all fire alarm networks and equipment supplied under this contract.

C. Hardware

The workstation shall be an industrial grade computer listed for UL Standards 864 (Control Units for Fire-Protective Signaling Systems) under categories UOJZ, APOU, and UUKL; UL 1076, under category APOU as applicable. The workstation(s) shall be capable of annunciation and control of all fire detection, smoke control, intrusion detection and access control points.

The computer shall be a minimum of an Industrial Grade Dual Core 3.0 GHZ, 2 GB RAM, 800 MHZ front side bus. 500 GB hard drive.

The computer operating system shall be Windows® XP Pro, SP3.

The monitor shall be a 22" LCD desktop mount touch screen monitor. Installation of the computer shall be desk top mounting.

The Graphic Command Workstation shall be provided with an uninterruptable power source system sized for 4 hours of operation.

The workstation shall be capable of receiving signals from and transmitting commands to any of the panel manufacturer's listed fire alarm systems using a direct hardwired or a TCP/IP connection. The workstation shall support up to eighty (80) fire alarm system connections.

D. Operations

The workstation display shall be event driven, and shall simultaneously present from two to six of the following operator configurable viewports.

When any event occurs, the *"Event List Viewport"* shall display the alarm or off normal point with type and description and time of the event in a prioritized color-coded event list. New events shall be displayed by priority and remain on the list until they are acknowledged. Once an event is acknowledged, it shall move to the acknowledged events List. The All Events tab shall list all the events that have taken place in the system, up to a maximum of 10,000 events.

The *"Event List Viewport"* shall use the following color codes:

Red - Fire Alarms.
Gold - Supervisory Events.
Yellow - Trouble, Monitor, Non-Security, or Security Bypass.
Orange - Security Events.
Grey - Disabled or Security Partition Armed.
Green - Restored to normal.

The *"Map Viewport"* shall display a graphical representation (map) of the area/location in which the alarm or off-normal device is located.

It shall be possible to import graphics in any of the following formats: DXF, DWG, JPEG, RLE, TIF, BMP, and WMF. The main screen shall be an aerial photo of the building or campus, followed by photo of the building profile, floor plan architectural drawing, and multiple zoom fields on the floor plan.

Drawing design shall allow for zoom out to full floor view or zoom in to individual device location.

Provide a floor plan legend to identify location on floor plan key view. Graphics shall include:

a. Door swings.
b. Window locations.
c. Room number and designation of occupancy.
d. All initiating and notification device locations.
e. Locations of video camera/view.

Active device icons located on the graphics shall be surrounded by a color coded border (see above) that indicates the status of each device. The border shall flash when the device is active. Touching or clicking on an active device icon shall zoom the view to the next level of detail. Up to 32 levels of zoom shall be available. Alternately, it shall be possible for the user to manually zoom down to any portion of a vector-based graphic without aliasing, artifacting, or pixilation of the image. Users with sufficient permission can again touch the icon to access control privileges for the device and shall be able to enable or disable devices, retrieve device sensitivity, or modify specific extended message text.

Active icons shall also be used to create zone selection, control panels for the control of FACP functions.

The *"Event Action Viewport"* shall display a customized set of written operator instructions (up to 2,500 characters) for each state (alarm, trouble, restore, etc.) that each device may take. An event log shall record all events and operator actions to history for future review. An operator's log shall record operator's comments (up to 65,000 characters) for each event in system history with time and date.

The *"Event Action Viewport"* shall provide common control capability for Alarm Silence, Panel Silence, Drill and Reset as well as the Event Acknowledge button, the Computer Silence button, and the Event Log tab. Once an event is acknowledged, it shall move from the Event List to Acknowledged Events list.

The *"Image Viewport"* shall display a stored image (JPG, BMP, WMF, RLE) or video (AVI) of items relevant to the event highlighted in the event list viewport. Examples include hardware identification, equipment diagrams, etc.

The *"Browser Viewport"* shall have the capability to automatically access HTML web based emergency information sites (ChemTrec, Weather Channel, etc.), building automation systems or other 3rd party system (elevator control, IP camera, access control, etc.) based on the initiating event.

The workstation shall support a connection to a Simple Mail Transfer Protocol (SMTP) email server. It shall be possible to automatically send event based emails to user defined mailing lists. The system must support a minimum of 100 email recipients.

E. Web Clients

It shall be possible to remotely obtain status, diagnostic, and report information from the Graphic Command Workstations using PCs running client software and a compatible VPN, LAN, or WAN connection. The workstation shall act as a server to simultaneously communicate the status of all systems connected to the graphics workstation to up to fifteen (15) remote client PCs. All workstation to client communications shall be encrypted for privacy.

Client software shall actively poll the workstation server to determine event status. All event changes shall be automatically announced on the client PC. No operator interaction shall be required to retrieve or display incoming events. It shall be possible to capture workstation events and to run workstation and panel reports.
Coordinate with Dallas County for determination of a sufficient quantity of client software copies for installation on end user PCs, not to exceed 10 copies.

F. Graphic Command Workstation Color Laser Printer

Provide a color laser printer connected to the workstation that shall print the graphical floor plan views and system reports. The printer shall support PCL (Printer Control Language) and support dual 8-1/2 x 11 & 11 x17 paper sizes.

2.10. Peripheral Components

A. Addressable

1. Detectors – General Requirements

General Requirements for Intelligent Addressable Heat, Smoke and CO Detectors

Each detector shall contain an integral microprocessor which shall determine if the device is normal, in alarm, or has an internal trouble. The microprocessor's non-volatile memory shall permanently store the detector's serial number, device type and system address. It shall be possible to address each intelligent device without the use of switches. Devices requiring switches for addressing shall not be considered as equal. Memory shall automatically be updated with the hours of operation, last maintenance date, number of alarms and troubles, time of last alarm, and analog signal patterns for each sensing element just before the last alarm.

Each detector shall be capable of identifying up to 32 diagnostic codes. This information shall be available for system maintenance. The diagnostic code shall be stored at the detector.

Each addressable detector on the Signaling Line Circuit (SLC) shall transmit information regarding its location with respect to other intelligent devices on the signaling line circuit to the control panel, creating an "As-Built" circuit map. The circuit mapping function shall provide location supervision of all intelligent devices on the signaling line circuit. An intelligent detector's programmed system response functions shall be associated with the detector's actual *location* on the signaling line circuit and *not with the detector's address*. After system commissioning, detectors improperly installed in the wrong location shall function according to the mapped programmed response for its *location* on the circuit, not its detector's address.

Two status LEDs shall be provided on each detector. A flashing green LED shall indicate normal operation; flashing RED shall indicate the alarm state. A steady RED and steady GREEN shall indicate alarm state when in the stand-alone mode. LEDs shall be visible from any direction.

The system shall allow for changing of detector types for service replacement purposes without the need to reprogram the system. The replacement detector type shall automatically continue to operate with the same programmed sensitivity levels and functions as the detector it replaced, without the need for reprogramming. System shall display an off-normal condition until the proper detector type is installed or a change in the device type profile has been made.

Detectors shall be rated for operation in the following environment unless specifically noted:

- Temperature: 32°F to 120°F (0°C to 49°C)
- Humidity: 0-93% RH, non-condensing

2. Photoelectric Smoke Detectors

Provide analog/addressable photoelectric smoke detectors at the locations shown on the drawings.

The photoelectric smoke detector shall be suitable for direct insertion into air ducts up to 3 ft (0.91m) high and 3 ft (0.91m) wide with air velocities up to 5,000 ft/min. (0-25.39 m/sec) without requiring specific duct detector housings or supply tubes.

Each smoke detector shall be individually programmable to operate at any one of five (5) sensitivity settings. The detector shall also store pre-alarm and alternate pre-alarm sensitivity settings. Pre alarm sensitivity values shall be configurable in 5% increments of the alarm and alternate alarm sensitivity settings respectively. The detector shall be able to differentiate between a long term drift above the pre alarm threshold and fast rise above the threshold. The detector shall monitor the sensitivity of the smoke sensor. If the sensitivity shifts outside the UL limits, a trouble signal shall be sent to the panel. It shall be possible to automatically change the sensitivity of individual intelligent addressable smoke detectors for day and night (alternate) periods.

Each detector shall utilize an environmental compensation algorithm that shall automatically adjust for background environmental conditions such as dust, temperature, and pressure. The detector shall provide a maintenance alert signal when 80% of the available compensation range has been used. The detector shall provide a dirty fault signal when 100% or greater compensation has been used.

3. Duct Smoke Detectors

Provide intelligent low profile photoelectric duct smoke detectors / remote test switches at the locations shown on the drawings, and at each additional air handling unit at the site.

The intelligent duct smoke detector shall operate in ducts having from 100ft/min to 4,000ft/min air velocity. The detector shall be suitable for operation over a temperature range of -20 to 158F° and offer a harsh environment gasket option. The detector shall utilize an air exhaust tube and an air sampling inlet tube that extends into the duct air stream up to ten (10) feet. Design of the detector shall permit sampling tube installation from either side of the detector and permit sampling tube installation in 45- degree increments to ensure proper alignment with duct airflow. Drilling templates and gaskets to facilitate locating and mounting the housing shall be provided.

The intelligent duct smoke detector shall obtain information from a photoelectric sensing element. The detector shall be able to differentiate between a long term drift above the pre alarm threshold and fast rise above the threshold. The detector shall monitor the sensitivity of the smoke sensor. If the sensitivity shifts outside the UL limits, a trouble signal shall be sent to the panel.

Each detector shall utilize an environmental compensation algorithm that shall automatically adjust for background environmental conditions such as dust, temperature, and pressure. The detector shall provide a maintenance alert signal when 80% of the available compensation range has been used. The detector shall provide a dirty fault signal when 100% or greater compensation has been used.

The intelligent duct smoke detector shall provide a form "C" auxiliary alarm relay rated at 2amps @ 30Vdc. The position of the relay contact shall be supervised by the control panel software. Operation of the relay shall be controlled either by its respective detector processor or under program control from the control panel as required by the application. The detector shall be equipped with a local magnet-activated test switch.

Each duct detector shall be installed and testing in accordance with manufacturer's instructions, including pressure differential and, velocity testing. Test results shall be submitted to the owner.

Remote test switches/LED indicators shall be provided below the detector on the ceiling to indicate location of the detector in non-mechanical areas.

Where addressable smoke detectors are directly mounted on a low velocity ducts up to 3 ft (0.91m) high x 3 ft (0.91m) wide, provide factory mounting plate assemblies to facilitate mounting the detectors. The mounting plate shall be code gauge steel with corrosion resistant red enamel finish. The detector mounting plate shall support an addressable detector along with a standard, relay or isolator detector mounting base.

4. Fixed Heat Detectors

Provide intelligent fixed temperature heat detectors at the locations shown on the drawings.

The detector shall continually monitor the temperature of the air in its surroundings to minimize thermal lag to the time required to process an alarm. The detector shall utilize a low mass thermistor heat sensor and operate at a nominal fixed temperature alarm point rating of 135°F (57°C). The integral microprocessor shall determine if an alarm condition exists and initiate an alarm based on the analysis of thermistor data.

The heat detector shall be rated for ceiling installation at a minimum of 70 ft (21.3m) centers and also be suitable for wall mount applications.

5. Standard Detector Bases

Provide standard detector bases suitable for mounting on either North American 1-gang, 3½ or 4 inch octagon box and 4 inch square box, European BESA or 1-gang box.

The bases shall utilize a twist-lock design and provide screw terminals for all field wiring connections.

The base shall contain no active electronics and support all Signature series detector types.

The base shall be capable of supporting a Remote Alarm LED Indicator.

Removal of the respective detector shall not affect communications with other detectors.

6. Relay Detector Bases

Provide relay detector bases suitable for mounting on either North American 1-gang, 3½ or 4 inch octagon box and 4 inch square box, European BESA or 1-gang box; as required.

The bases shall utilize a twist-lock design and provide screw terminals for all field wiring connections.

The base shall contain no electronics and support all Signature series detector types.
Removal of the respective detector shall not affect communications with other detectors.

The relay base shall meet the following requirements:

The relay shall be a bi-stable type and selectable for normally open or normally closed operation.
The position of the relay contact shall be supervised.
The operation of the base relay shall be configurable for control by its respective detector or for independent programmable control from the fire alarm panel. Relay bases not configurable for detector or panel operation shall not be considered equal.
The base relay shall provide form "C" contacts with a minimum rating of 1 amp @ 30 Vdc and be listed for pilot duty.

7. Isolator Detector Bases

Provide isolator detector bases suitable for mounting on either North American 1-gang, 3½ or 4 inch octagon box and 4 inch square box, European BESA or 1-gang box.

The bases shall utilize a twist-lock design and provide screw terminals for all field wiring connections.

Isolator bases shall limit number of modules or detectors that may be rendered inoperative by short-circuit fault on SLC loop segment or branch. In the event the Class A signaling line circuit on which the isolator bases are installed is shorted, each base shall open the SLC. Isolator bases shall then sequentially reconnect the isolated circuit segments until only the segment with the short is left out of the circuit, leaving the balance of the circuit operational.

8. Beam Smoke Detectors

Provide beam type smoke detectors when indicated on the drawings. Mounting shall be on 4 inch square box.

Provide reflector in accordance with the manufacturer’s recommendation. Locate reflectors as necessary to achieve proper smoke detection coverage. Coverage shall be minimum 330’ x 60’ (19,800 square feet).

Beam style smoke detectors shall addressable type, and be as permitted by NFPA 72 and UL 268 listed for use.

9. Manual Stations

Provide addressable double action, single stage fire alarm stations at the locations shown on the drawings.

The manual station shall be suitable for mounting on North American 2 ½ (64mm) deep 1-gang boxes and 1 ½ (38mm) deep 4 square boxes with 1-gang covers. If indicated as surface mounted, provide manufacturer's surface back box.

The fire alarm station shall utilize red polycarbonate construction with molded, raised-letter operating instructions

in a contrasting color; shall show visible indication of operation and incorporate an internal toggle switch.

The manual pull station will have an addressable module integral to the unit.

10. Modules - General

Intelligent addressable multifunction modules shall be provided at the locations shown on the drawings to provide the specific system input and output functions described by the operation section and functional matrix found elsewhere in this specification.

The operation of multifunction modules shall be software configurable at the site to meet operational conditions, and may be changed at any time by download changes from the control panel.

Each intelligent multifunction module on the Signaling Line Circuit (SLC) shall transmit information regarding its location with respect to other intelligent devices on the signaling line circuit to the control panel, creating an "As-Built" circuit map. The circuit mapping function shall provide location supervision of all intelligent devices on the signaling line circuit. An intelligent device's programmed system response functions shall be associated with the device's actual *location* on the signaling line circuit and *not with the device's address*. After system commissioning, devices improperly installed in the wrong location shall function according to the mapped programmed response for its *location* on the circuit, not its device address.

All input /output status decisions shall be made by the microprocessor within the module. Communications with a control panel shall not be required in order for the module to identify off-normal input/output conditions. Modules with supervised input or output circuits shall be capable of identifying ground fault conditions down to the module address level.

Each module shall be equipped with two (2) diagnostic indicators; a green LED to confirm communications and a red LED to display active status. LEDs shall be visible through the finished cover plate. The module shall be capable of storing a unique serial number and up to 24 diagnostic codes, hours of operation, number of alarms and troubles, and time of last alarm in its memory which can be retrieved for troubleshooting.

Modules shall be rated for operation in the following environment:

- Temperature: 32°F to 120°F (0°C to 49°C)
- Humidity: 0-93% RH, non-condensing

Where multiple modules are mounted in close proximity to each other, plug-in modular versions of the modules and motherboards shall be available to minimize field wiring and facilitate troubleshooting.

11. One Input Monitor

Provide addressable single input multifunction modules as required.

The module shall be suitable for mounting on North American 2½" (64mm) deep 1-gang boxes and 1½" (38mm) deep 4" square boxes with 1-gang covers.

Each module shall provide one (1) supervised Class B input circuit configurable as one of the following "personalities."

1. Normally-Open Alarm Latching (for alarm initiation applications)
2. Normally-Open Alarm Delayed Latching (for waterflow switch applications)
3. Normally-Open Active Non-Latching (for limit switch and monitor applications)
4. Normally-Open Active Latching (for tamper switch and supervisory applications)

Each module shall identify and report by device address, ground faults and opens associated with its initiating device circuit, to the control panel.

12. Two Input Monitor

Provide addressable dual input multifunction modules as required.

The module shall be suitable for mounting on North American 2½" (64mm) deep 1-gang boxes and 1½" (38mm) deep 4" square boxes with 1-gang covers.

Each module shall provide two (2) supervised Class B input circuit configurable as one of the following "personalities."

1. Normally-Open Alarm Latching (for alarm initiation applications)
2. Normally-Open Alarm Delayed Latching (for waterflow switch applications)
3. Normally-Open Active Non-Latching (for limit switch and monitor applications)
4. Normally-Open Active Latching (for tamper switch and supervisory applications)

Each module shall identify and report by device address, ground faults and opens associated with its initiating device circuits, to the control panel

13. Universal Modules

Provide intelligent universal Class A/B multifunction modules as required.

The module shall be suitable for mounting on North American 2½" (64mm) deep 2-gang boxes and 1½" (38mm) deep 4" square boxes with 2-gang covers.

Each universal module shall be configurable as one of the following "personalities."

a. Two (2) supervised Class B Normally-Open Alarm Latching. (for alarm initiation applications)
b. Two (2) supervised Class B Normally-Open Alarm Delayed Latching. (for waterflow switch applications)
c. Two (2) supervised Class B Normally-Open Active Non-Latching. (for limit switch and monitor applications)
d. Two (2) supervised Class B Normally-Open Active Latching. (for tamper switch and supervisory applications)
e. One (1) form "C" dry relay contact rated at 2 amps @ 24 Vdc. (for circuit control applications)
f. One (1) supervised Class A Normally-Open Alarm Latching. . (for alarm initiation applications)
g. One (1) supervised Class A Normally-Open Alarm Delayed Latching. . (for waterflow switch applications)
h. One (1) supervised Class A Normally-Open Active Non-Latching. (for limit switch and monitor applications)
i. One (1) supervised Class A Normally-Open Active Latching. . (for tamper switch and supervisory applications)
j. One (1) supervised Class A 2-wire Smoke Alarm Non-Verified. (for alarm initiation applications)
k. One (1) supervised Class B 2-wire Smoke Alarm Non-Verified. (for alarm initiation applications)
l. One (1) supervised Class A 2-wire Smoke Alarm Verified (for alarm initiation applications)
m. One (1) supervised Class B 2-wire Smoke Alarm Verified(for alarm initiation applications)
n. One (1) supervised Class A Signal Circuit, 24Vdc @ 2A.(for occupant notification applications)
o. One (1) supervised Class B Signal Circuit, 24Vdc @ 2A. .(for occupant notification applications)

Each module shall identify and report ground faults, opens and shorts associated with its supervised input / output circuits, by device address, to the control panel.

14. Beam Smoke Detectors

Beam type smoke detectors shall be supplied at the locations shown on the drawings.

The beam smoke detector shall consist of a separate transmitter and receiver capable of being powered separately or together. The detector shall operate in either a short range of 30 to 100 ft. (9.14 to 30.4 m) or a long range of 100 to 300 ft. (30.4 to 91.4 m). The detector shall feature a bank of alignment LEDs on both the receiver and transmitter to ensure proper alignment without the use of special tools. The detector shall utilize an automatic gain control to compensate for gradual signal deterioration from dirt accumulation on lenses. The beam smoke detectors shall be powered from the system control panel. Testing shall be carried out using calibrated test filters.

B. Conventional

1. General

All appliances supplied for the requirements of this specification shall be UL Listed for Fire Protective Service, and shall be capable of providing the “equivalent facilitation” which is allowed under the Americans with Disabilities Act Accessibilities Guidelines (ADA(AG)), and shall be UL 1971 Listed.

All appliances shall be of the same manufacturer as the fire alarm control panel specified to insure absolute compatibility between the appliances and the control panels, and to insure that the application of the appliances are done in accordance with the single manufacturer’s instructions.

Any appliances that do not meet the above requirements, and are submitted for use must show written proof of their compatibility for the purpose intended. Such proof shall be in the form of documentation from all manufacturers that clearly states that their equipment (as submitted) is 100% compatible with each other for the purpose intended.

All strobes shall be provided with lens markings oriented for wall mounting. Exterior mounted devices shall be provided with a weatherproof backbox.

All visual appliances shall be synchronized. Light and audible output levels shall be designed to meet ADA and NFPA requirements

All notification appliances shall be red unless noted otherwise on the drawings.

2. Strobes

Provide low profile wall mounted strobes at the locations shown on the drawings.

Low profile strobes shall mount in a North American 1-gang box, and protrude less than 1” from the finished wall. The word FIRE shall be prominently displayed on the housing.

The strobe output shall be switch selectable as required by its application from the following available settings: 15cd, 30cd, 75cd & 110cd. Selected strobe rating shall be visible when the strobe is in its installed position. Light shall be evenly distributed throughout the required.

When multiple strobes are installed within view of each other, their outputs shall be synchronized within ten (10) milliseconds of each other for an indefinite period without the need for separate synchronization modules.

Strobe power and synchronization shall be accomplished over a single pair of wires. In and out screw

terminals shall accommodate 18AWG to 12 AWG wiring and have captive hardware.

3. Strobes-Weatherproof

Provide low profile weatherproof strobes at the locations shown on the drawings.

The weatherproof strobes shall mount in a North American 4" square 1 ½"deep electrical box for indoor applications and a factory supplied back box for weatherproof applications.

The strobe shall be suitable for wall or ceiling mount and operate in temperatures from -40 to 151 degrees F. The word FIRE shall be prominently displayed on the housing.

The strobe output shall be switch selectable as required by its application from the following available settings:

		Standard Candela Output Strobes				High Candela Output Strobes			
		Strobe Switch Position							
Listing	Location	D	C	B	A	D	C	B	A
UL 1971	Indoor	15 cd	29 cd	70 cd	87 cd	102 cd	123 cd	147 cd	161 cd
UL 1638	Outdoor (-35C)	6 cd	12 cd	28 cd	35 cd	41 cd	50 cd	60 cd	65 cd

Selected strobe rating shall be visible when the speaker-strobe is in its installed position

When multiple strobes are installed within view of each other, their outputs shall be synchronized within ten (10) milliseconds of each other for an indefinite period without the need for separate synchronization modules.

Strobe power and synchronization shall be accomplished over a single pair of wires. In and out screw terminals shall accommodate 18AWG to 12 AWG wiring and have captive hardware.

4. Speaker-Wall

Provide low profile wall mounted speakers at the locations shown on the drawings.

The low profile speakers shall mount in a North American 4" x 2 1/8" square electrical box, and protrude less than 1" from the finished wall. The word FIRE shall be prominently displayed on the housing.

The speaker output shall be switch selectable from the following available settings: 2W (90dBA), 1W (87dBA), 1/2W (84dBA), or 1/4W (81dBA) at 10 ft. when measured in reverberation room per UL-464. Frequency response shall be 400 to 4,000Hz. The selected speaker wattage shall be visible when the speaker is in its installed position.

The speaker shall provide in and out screw terminals shall accommodate 18AWG to 12 AWG wiring and have captive hardware.

5. Speaker-Ceiling

Provide ceiling mounted speaker at the locations shown on the drawings.

The speaker shall provide in and out screw terminals shall accommodate 18AWG to 12 AWG wiring and have captive hardware. Provide white speakers (4" or 8", as required per sound study) at the locations shown on the drawings. Speakers shall have a mylar cone, paper cones are not acceptable. The rear of the speakers shall be completely sealed protecting the cone during and after installation. In and out screw terminals shall be provided for wiring. 4" speakers shall provide 1/4w, 1/2w, 1w, and 2w power taps for use with 25V or 70V systems. 8" speakers shall provide 1/2w, 1w, 2w, and 4w power taps for use with 25V or 70V systems. At the 2 watt setting, the speaker shall provide an 87 dBA sound output over a frequency range of 400-4000 Hz. when measured in reverberation room per UL-1480.

6. Speaker-Weatherproof

Provide low profile weatherproof speakers at the locations shown on the drawings.

The weatherproof speaker shall mount in a North American 4" square 1 ½"deep electrical box for indoor applications without a trim skirt and a and a 4" square 2 1/8"deep electrical box when used with a trim skirt. A factory supplied back box shall be supplied for weatherproof applications.

The speaker shall be suitable for wall or ceiling mount and operate in temperatures from -40 to 151 degrees F. The word FIRE shall be prominently displayed on the housing.

The speaker output shall be switch selectable from the following available settings:

Wattage	Switch Position	25Vrms	70Vrms
2W	T	90.0 dBA	89.7 dBA
1W	X	87.1 dBA	86.9 dBA
½ W	Y	84.0 dBA	83.9 dBA
¼ W	Z	80.8 dBA	80.8 dBA

Output is at 10 ft. when measured in reverberation room per UL-464. Frequency response shall be 400 to 4,000Hz. The selected speaker wattage shall be visible when the speaker-strobe is in its installed position.

The speaker shall provide in and out screw terminals shall accommodate 18AWG to 12 AWG wiring and have captive hardware.

7. Speaker-Strobe-Wall

Provide low profile wall mounted speaker-strobes at the locations shown on the drawings.

The low profile speaker-strobes shall mount in a North American 4" x 2 1/8" square electrical box, without trims or extension rings, and protrude less than 1" from the finished wall. The word FIRE shall be prominently displayed on the housing.

The speaker output shall be switch selectable from the following available settings: 2W (90dBA), 1W (87dBA), 1/2W (84dBA), or 1/4W (81dBA) at 10 ft. when measured in reverberation room per UL-464.

Frequency response shall be 400 to 4,000Hz. The selected speaker wattage shall be visible when the speaker-strobe is in its installed position.

The strobe output shall be switch selectable as required by its application from the following available settings: 15cd, 30cd, 75cd & 110cd. Selected strobe rating shall be visible when the speaker-strobe is in its installed position. Amber lens strobes shall be available with outputs of 12/24/60/88cd. Light shall be evenly distributed throughout the required volume using cavity and mask “FullLight” technology to prevent hot spots. Strobes using specular reflectors shall not be considered as equal.

When multiple strobes are installed within view of each other, their outputs shall be synchronized within ten (10) milliseconds of each other for an indefinite period without the need for separate synchronization modules

Strobe power and synchronization shall be accomplished over a single pair of wires. Both the speaker and strobe elements shall provide in and out screw terminals shall accommodate 18AWG to 12 AWG wiring and have captive hardware.

8. Speaker-Strobe-Ceiling

Provide low profile ceiling mounted speaker-strobes at the locations shown on the drawings.

Speaker-strobes shall mount in a North American 4” x 2 1/8” square electrical box, or a 960A-4RF round flush box, and protrude less than 1.6” from the finished ceiling. The word FIRE shall be prominently displayed on the housing.

The speaker output shall be switch selectable from the following available settings: 2W (91dBA), 1W (87dBA), 1/2W (84dBA), or 1/4W (80dBA) at 10 ft. when measured in reverberation room per UL-1480. Frequency response shall be 400 to 4,000Hz. The selected speaker wattage shall be visible when the speaker-strobe is in its installed position.

The strobe output shall be switch selectable as required by its application from the following available settings: 15cd, 30cd, 75cd & 95cd or 95cd, 115cd, 150cd, &177cd. Selected strobe rating shall be visible when the speaker-strobe is in its installed position.

When multiple strobes are installed within view of each other, their outputs shall be synchronized within ten (10) milliseconds of each other for an indefinite period without the need for separate synchronization modules

Strobe power and synchronization shall be accomplished over a single pair of wires. Both the speaker and strobe elements shall provide in and out screw terminals shall accommodate 18AWG to 12 AWG wiring and have captive hardware.

9. Speaker-Strobe-Weatherproof

Provide low profile weatherproof speaker-strobes at the locations shown on the drawings.

The weatherproof speaker-strobes shall mount in a North American 4” square 1 ½”deep electrical box for indoor applications without a trim skirt and a and a 4” square 2 1/8”deep electrical box when used with a trim skirt. A factory supplied back box shall be supplied for weatherproof applications.

The speaker-strobe shall be suitable for wall or ceiling mount and operate in temperatures from -40 to 151 degrees F. The word FIRE <ALERT> shall be prominently displayed on the housing.

The speaker output shall be switch selectable from the following available settings:

Wattage	Switch Position	25Vrms	70Vrms
2W	T	90.0 dBA	89.7 dBA
1W	X	87.1 dBA	86.9 dBA
½ W	Y	84.0 dBA	83.9 dBA
¼ W	Z	80.8 dBA	80.8 dBA

Output is at 10 ft. when measured in reverberation room per UL-464. Frequency response shall be 400 to 4,000Hz. The selected speaker wattage shall be visible when the speaker-strobe is in its installed position.

The strobe output shall be switch selectable as required by its application from the following available settings:

		Standard Candela Output Speaker-Strobes				High Candela Output Speaker-Strobes			
		Strobe Switch Position							
Listing	Location	D	C	B	A	D	C	B	A
UL 1971	Indoor, Clear lens	15 cd	29 cd	70 cd	87 cd	102 cd	123 cd	147 cd	161 cd
UL 1971	Indoor, Amber lens	13 cd	25 cd	59 cd	62 cd	84 cd	101 cd	125 cd	130 cd
UL 1638	Outdoor, Clear lens	6 cd	12 cd	28 cd	35 cd	41 cd	50 cd	60 cd	65 cd
UL 1638	Outdoor, Amber lens	5 cd	10 cd	24 cd	25 cd	34 cd	41 cd	51 cd	52 cd

Selected strobe rating shall be visible when the speaker-strobe is in its installed position

When multiple strobes are installed within view of each other, their outputs shall be synchronized within ten (10) milliseconds of each other for an indefinite period without the need for separate synchronization modules.

Strobe power and synchronization shall be accomplished over a single pair of wires. Both the speaker and strobe elements shall provide in and out screw terminals shall accommodate 18AWG to 12 AWG wiring and have captive hardware.

C. Accessories

1. Surge Suppression Devices

The system shall utilize the following electrical surge protection devices to prevent damage and nuisance alarms caused by nearby lightning strikes, stray currents, or voltage transients.

On the AC Input of all fire alarm panels and remote power supplies: Transtector ACO100BWN3, Leviton OEM-120EFI, EFI HWM-120, Ditek DTK-120HW or DTK-120/240 CM. AC Surge protectors shall be installed at the electrical panel board feeding the fire alarm equipment, and shall be provided and installed by the contractor. Excess lead length shall be trimmed. The branch circuit conductor shall be formed into a 5-10 turn 1" diameter tie-wrapped coil just downstream of the suppressor connection.

On each DC fire alarm circuit entering or leaving the building: Transtector TSP8601, Citel American B280 -24V, Edco P264 and P642, Ditek DTKxLVL series, or equal and shall be provided and installed by the contractor. DC Surge protectors shall be installed on each required circuit at the point of entry into the building.

PART 3 - EXECUTION

A. General

1. The entire system shall be installed in a skillful manner in accordance with approved manufacturer's installation manuals, shop drawings and wiring diagrams.

2. All work shall be performed in accordance with the requirements of NFPA 70 and NFPA 72.

3. All fire alarm devices shall be accessible for periodic maintenance. Should a device location indicated on the contract drawings not meet this requirement, it shall be the responsibility of the installing contractor to bring it, in writing, to the attention of the Project Engineer.

4. Fasten equipment to structural members of building or metal supports attached to structure, or to concrete surfaces.

5. All systems and system components listed to UL864 Control Units for Fire Protective Signaling Systems may be installed within a common conduit raceway system, in accordance with the manufacture's recommendations. System(s) or system components not listed to the UL864 standard shall utilize a separate conduit raceway system for each of the sub-systems.

6. No wiring except life safety system circuits and system power supply circuits shall be permitted in the control panel enclosures.

7. Any low-voltage copper wiring that leaves the protection of a building shall be provided with a compatible UL 497B listed transient protection devices where the circuit leaves the building and where it enters the next building.

8. Devices containing end-of-line resistors shall be appropriately labeled. Devices should be labeled such that removal of the device is not required to identify the EOL device.

B. Electrical

1. Boxes, Enclosures And Wiring Devices

    a. Boxes shall be installed plumb and firmly in position.

b. Extension rings with blank covers shall be installed on junction boxes where required.

c. Junction boxes served by concealed conduit shall be flush mounted.

d. Fire alarm system junction box covers shall be painted red.

e. Wiring within cabinets, enclosures, boxes, junction boxes and fittings shall be installed in a neat and workmanlike manner, installed parallel with or at right angles to the sides and back of any box, enclosure or cabinet, and routed to allow access for maintenance. All conductors that are terminated, spliced, or otherwise interrupted in any enclosure, cabinet, mounting or junction box shall be connected to terminal blocks. Mark each terminal in accordance with the wiring diagrams of the system. Make all connections with approved pressure type terminal blocks, which are securely mounted. All terminal block screws shall have pressure wire connectors of the self-lifting or box lug type. No more than two conductors shall be installed under one connection. Wire nuts, crimp splices and similar devices shall not be used.

2. Conductors

a. Each conductor shall be identified at terminal points. Permanent wire markers shall be located within 2 inches of the wire termination. Marker text shall be visible with protective doors or covers removed.

b. Maintain a consistent color code for fire alarm system conductor functions throughout the installation.

c. All wiring shall be installed in compliance with the National Electric Code, NFPA 70, and the equipment manufacturer's requirements.

Wiring for Signaling Line Circuit and Initiating Device Circuit field wiring shall be solid copper, No. 18 AWG twisted pair conductors at a minimum. Speaker circuits; 16 AWG twisted pair at a minimum. Telephone circuits shall be 18 AWG twisted-shielded pair at a minimum. 24VDC visual and audible Notification Appliance Circuits shall be solid copper No. 14 AWG size conductors at a minimum. The wiring sizes listed herein are minimum sizes. Use larger wire sizes when recommended by the manufacturer, based on system configuration and project specific calculations.

Where shielded wiring is used, the shield shall be grounded at only one point, which shall be in or adjacent to the FACP or other control equipment. Shields shall be continuous, treated as a third conductor, and insulated from ground except as noted.

T-taps (branches) are permitted in Style 4 SLC circuits with interconnections occurring on terminal strips.

Circuits to third-party systems (HVAC, Elevators, fire pumps, etc.) shall terminate in terminal cabinets within three (3) feet of the controllers for those systems.

AC power wiring shall be No. 12 AWG solid copper having insulation rated for 600 volts.
Crimp type spade lugs shall be used for terminations of stranded conductors to binder screws or stud type terminals.

d. All wiring shall be checked and tested to insure that there are no grounds, opens or shorts.

3. Devices

a. All devices and appliances shall be mounted to or in an approved electrical box.

4. Raceways

a. Conduits shall be sized according to the conductors contained therein. Cross sectional area percentage fill for system conduits shall not exceed 40%.

b. Within concealed areas and electrical/mechanical/storage spaces, install all conductors in rigid metal conduit or electrical metallic tubing, utilizing compression type fittings and couplings, with a minimum diameter 3/4". The use of flexible metal conduit not exceeding a six (6) foot length shall be permitted for initiating device circuits.

c. All fire alarm conduit systems shall be routed and installed to minimize the potential for physical, mechanical or fire damage, and shall not to interfere with existing building systems, facilities or equipment.

d. Where raceway is required to be exposed, such as in areas with “waffle” type ceilings, areas with inaccessible ceilings/walls, and concrete structure areas, contractor must use surface mounted raceway equal to Wiremold product. Raceway to be sized sufficiently to accommodate conductors contained within. Surface raceway product shall be mounted at 90 degree angles with building elements, and shall be painted or fabricated to match the surrounding ceiling/wall finish.

e. All system conduits, junction boxes, pull boxes, terminal cabinets, electrical enclosures and device back box locations shall be readily accessible for inspection, testing, service and maintenance.

5. Open cable

a. Power Limited cable, when not installed in UL listed metal conduit or raceway, shall be mechanically protected by building construction features par NFPA 70, Article 760.

1. Installation shall be in areas not subjected to mechanical injury.
2. All circuits shall be supported by the building structure. Cable shall be attached by straps or bridal rings to the building structure at intervals not greater than 10 feet. The use of staples is prohibited. Fire alarm wiring shall not be bundled or strapped to existing conduit, pipe or wire in the facility.
3. Where wiring is installed above drop ceilings, cable shall not be laid on ceiling tiles.
4. Cable shall not be fastened in a manner that puts tension on the cable.

b. Power Limited Cable shall be FPLP, FPLR or FPL, or permitted substitute.

C. Fire Alarm Components

1. Devices

a. All devices and appliances shall be mounted to or in an approved electrical box.

b. All wall mounted *control equipment* shall comply with requirements defined by the International Building Code and Acceptance Criteria for Seismic Qualification by Shake-Table Testing of Nonstructural Components and Systems (AC-156) using a seismic component importance factor of 1.5.

2. Fire Alarm Control Panels

a. Mount the enclosure with the top of the cabinet 72” above the finished floor or center the cabinet at 63”, whichever is lower.

b. Label the fire alarm panels with the room number, electrical panel number and circuit breaker number feeding them.

c. Paint the handles of the dedicated circuit breakers feeding fire alarm panels red, and install handle locks.

d. Within the panel, all non-power limited wiring must be properly separated from power limited circuits.

e. Grounds shall comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3. Remote power supplies and auxiliary fire alarm panels

a. Locate the panel or cabinet with the top of the panel 72" above the finished floor or center the panel at 63", whichever is lower.

b. Do not locate these panels above ceilings or where inaccessible by a person standing on the finished floor of the space.

c. Label the power supplies and auxiliary FACPs with the room number, electrical panel number and circuit breaker number feeding them.

d. Paint the handles of the dedicated circuit breakers feeding fire alarm panels red, and install handle locks.

e. Within the panel, all non-power limited wiring must be properly separated from power limited circuits.

4. Manual Pull Stations

a. Mount stations so that their operating handles are between 42" and 48" above the finished floor.
b. Provide glass break cover for all pull boxes.

5. Notification Appliances: Mount assemblies as follows:

a. All wall mounted audio/visual devices shall be mounted so the entire lens is between 80" and 96" above the finished floor. Where low ceilings exist, devices shall be mounted within 6" of the ceiling.

b. Each speaker's output shall be set to the wattage value required for its specific output required by the sound study for intelligibility.

c. Each strobe's output shall be set to the candela value indicated for its specific location as shown on the drawings.

d. Each speaker-strobe's outputs shall be set to the wattage/candela value indicated for its specific location as shown on the drawings.

e. Where ceiling height exceeds 30 feet, appliances shall be suspended from the ceiling to a height of 30 feet maximum above the finished floor.

f. Appliances installed outdoors shall be UL listed for outdoor use.

6. Smoke Detectors

    a. All smoke detectors on drawings located in commonly populated areas (offices, courtrooms, hallways, etc.) shall utilize VESDA early warning smoke detectors. Install VESDA system per manufacturers specifications. Air sampling equipment to be located in nearest electrical or telecom room and be integrated into fire alarm system.

    b. Smoke and heat detector heads shall not be installed until after construction clean-up is completed. Detector heads installed prior to construction clean-up shall be cleaned by the manufacturer or replaced.

    c. Detectors located on the wall shall have the top of the detector at least 4" and not more than 12” below the ceiling.

    d. On smooth ceilings, detectors shall not be installed over 30 ft. apart in any direction.

    e. Install smoke detectors no closer than 3 ft. from air handling supply air diffusers or return air openings.

    f. Locate detectors no closer than 12” from any part of a lighting fixture.

7. Duct Smoke Detectors

    a. Install sampling tubes so they extend the full width of ducts exceeding 36”.

    b. Detectors shall be located to facilitate ease of maintenance.

    c. All penetrations near detectors located on/in return ducts shall be sealed to prevent air entry.

8. End-of-Line Resistors

    a. Devices containing end-of-line resistors shall be appropriately labeled.

9. Remote Status and Alarm Indicators

    a. Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.

10. CO Detectors

    a. Ceiling mounted CO detectors should be kept 12” from sidewalls.

    b. Wall mounted CO detectors should be at least 48” above the finished floor, but less than 6” from the ceiling.

    c. Locate at least 60” from fuel burning appliances.

    d. Install CO detectors no closer than 3 ft. from air handling supply air diffusers or return air openings.

11. Beam Smoke Detectors

    a. Install beam type smoke detectors in accordance with the shop drawings and the manufacturer's recommendations.

    b. Mount detectors 19" to 24" below the ceiling unless instructed otherwise.

    c. Keep the centerline of the beam 19" from obstructions.

    d. Mount on solid surfaces (brick/block walls, steel beams, or concrete).

    e. Use all mounting points on detector mounts.

    f. Mount where accessible for maintenance.

12. Heat Detectors

    a. Heat detectors shall be installed in strict accordance with their UL listing and the requirements of NFPA 72.

    b. Heat detectors installed in the elevator machinery room to meet ANSI A17.1 requirements for elevator power disconnect, shall be located adjacent to each sprinkler head. Coordinate temperature rating and location with sprinkler rating and location.

13. Addressable Control (relay) Modules

    a. Install the module less than 3 feet from the device controlled.

    b. Orient the device mounting for best maintenance access.

    c. Label all addressable control modules as to their function.

    d. Provide a dedicated 24VDC circuit to feed all auxiliary relays required for inductive loads (auxiliary relays, door holders). Circuits shall be supervised via an end-of-line relay and addressable input module. Auxiliary relays shall not derive their power from the starter or load being controlled.

END OF SPECIFICATION

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SECTION 31 1000

SITE PREPARATION AND DEMOLITION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This Section includes furnishing all equipment, materials, and labor for the preparation of this site and removal of existing pavement, trees, underground sanitary sewer pipe and all improvements as shown by the construction documents.

B. Location and protection of utilities.

C. Site Clearing.

1.2 RELATED SECTIONS

A. SECTION 31 22 00 – EARTHWORK

B. SECTION 31 25 00 – EROSION CONTROL

1.3 SUBMITTALS

A. As required by DIVISION 1 requirements.

1.4 QUALITY CONTROL TESTING

A. As required by DIVISION 1 requirements.

1.5 PROJECT CONDITIONS

A. It shall be the responsibility of the Contractor to obtain a temporary water meter for use during construction.

B. Provide erosion and sedimentation controls as shown on the drawings and maintain for the duration of the project. Provide routine maintenance as required to maintain the integrity of controls and protection measures and remove any accumulations of mud, silt and debris, which would jeopardize the integrity of the control measures. Refer to drawings for details.

C. Contractor shall exercise care during operations to confine dust to the immediate work area and shall employ dust control measures to ensure adequate dust control throughout demolition and construction operations.

D. The use of explosives is prohibited.

PART 2 – PRODUCTS

(Not Used)

PART 3 - EXECUTION

3.1 PROTECTION OF EXISTING ACTIVE UTILITIES

A. The Contractor shall field verify and coordinate with the Owner the location and depths of existing active utilities service lines within the construction limits and shall protect all such utilities from damage during construction operations. Damage to existing utilities to remain shall be repaired at the Contractor's expense for re-establishing the utilities to their pre-damaged condition.

3.2 PROTECTION OF EXISTING ON AND OFF-SITE PAVING

A. The Contractor shall protect all adjacent on and off-site paving and appurtenances from damage. Any damage shall be repaired at the Contractor's expense.

3.3 PROTECTION AND MAINTENANCE OF EXISTING TREES

A. All roots of one inch (1") diameter of existing trees that are exposed during construction must be properly treated, covered as soon as possible, and watered on a consistent routine to assure no damage is done to the existing trees.

B. Primary protection during construction shall consist of a four (4') foot high stock fence six (6") inches above the existing grade at the perimeter of the tree drip line. The stock fence shall be twelve and a half (12 ½) gauge or orange snow fence with six (6') foot metal t-posts at eight (8') foot centers minimum and at each corner to form an enclosure around the tree to remain.

C. Secondary protection during construction shall be used only where primary protection fence cannot be used due to paving/ building encroachment. Secondary protection shall consist of 2x4 lumber four (4') feet long running along the trunk of the tree to remain beginning one (1') above existing grade. There should be a four (4") inch maximum spacing between pickets and the pickets shall be tied together at the top and bottom with ten (10) gauge galvanized wire.

D. PRUNING

1. All pruning as approved by owner.
2. The amount of pruning shall be limited to the minimum necessary to remove dead or injured twigs and branches, but never to exceed one third of the branching structure.
3. Pruning shall be done in such a manner as to not change the natural habit of shape of the plant.
4. All cuts shall be made flush, leaving no stubs. Cuts over one (1") inch in diameter shall be cut back to sound tissue, smoothed and shaped so as not to hold water and painted with approved tree wound dressing. All pruning to be pre-approved by owner.

3.4 SITE CLEARING

A. Exposed subgrade shall be proof rolled with at least a 15-ton pneumatic roller to detect weak soil support areas. These areas will be removed and replaced with site excavated materials or imported materials having the same properties as site materials.

B. Clearing and Grubbing

1. Clear from within limits of construction all trees not marked to remain. Include shrubs, brush, downed timber, rotten wood, heavy growth of grass and weeds, vines, rubbish, structures and debris.
2. Grub (remove) from within limits of construction all stumps, roots, root mats, logs and debris encountered.

3.4 FINAL CLEANUP

A. Remove all traces of demolished items from the site work area and rough grade all areas that have been disturbed. All removed items shall be legally disposed of off-site at no additional cost to the Owner.

END OF SECTION

SECTION 31 2200

EARTHWORK

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section consists of operations required for the excavation of materials on site; compaction of natural or improved sub-grades: finish grading; disposal of excess or unsuitable materials; and other required operations. Earthwork shall conform with dimensions and typical sections shown, and within lines and grades established on Drawings.

1.2 RELATED SECTIONS:

A. SECTION 31 10 00 – SITE PREPARATION AND DEMOLITION

B. SECTION 32 13 13 – PORTLAND CEMENT CONCRETE PAVEMENT

1.3 REFERENCES:

A. ASTM D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort.

B. ASTM G51 - Test for pH of Soil for Use in Corrosion Testing.

C. ASTM G57 - Test for Soil Resistivity.

D. ASTM D4318 - Test for Liquid Limit, Plastic Limit and Plasticity Index of Soils.

1.4 EXISTING UTILITIES

A. Where pipes, ducts and structures are encountered in the excavation but are not shown on the Drawings, immediately notify the Architect.

1.5 DEFINITIONS:

A. Classification: Earthwork materials are classified in accordance with definitions in this Section.

B. General Site Fill: If additional dirt is required to achieve the elevations shown on the drawings it shall be the Contractors responsibility to obtain the needed dirt from an approved source. Excess dirt may be utilized on-site in areas designated by the Owner; otherwise, the Contractor shall legally dispose of it at no additional cost to the Owner.

C. Select Fill Outside of Pavement Areas: Select fill material shall be as required by the Geotechnical report.

D. Subgrade: Consists of that portion of the surface on which a compacted fill, backfill, pavement or topsoil is placed.

E. Borrow: Material taken from approved off-site sources to make up any deficit of excavated material. Obtain from area that is normally dry and well drained. Borrow does not include topsoil.

F. Finish Grading: Operations required for smoothing disturbed areas that are not overlaid with pavement.

G. Excavation: Excavation of every description and of whatever substances encountered within the limits of the project to the lines and grades indicated on the Drawings.

H. Compaction: Compaction of soil materials shall be measured as a percent of Standard Proctor density as determined by the ASTM D 698.

PART 2 - PRODUCTS

2.1 SELECT FILL

A. Obtain select fill material from a source that meets the requirements of the Geotechnical Report.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Objective: As shown on the Drawings, excavate to lines, grades and elevations required for subsequent construction. All excavation shall be made in such manner as to permit all surfaces to be brought to final line and grade within plus or minus 0.1 foot. Over excavation shall be restored by the Contractor at his own expense. Finished grades consistently high or low will not be acceptable and shall be corrected by the Contractor at his expense and no additional cost to the Owner.

B. Drainage: During excavation, maintain grades as required to maintain drainage; or, as directed by the Architect, install temporary drains or drainage ditches to intercept or divert surface water and prevent interference or delay of the work.

C. Stockpiling: If at time of excavation it is not possible to place material in the proper section of permanent construction, stockpile the material in Architect approved areas for later use.

D. Stone or Rock: Stone on rock fragments greater than 6" will not be allowed in fills or embankments. Stones or rock fragments larger than 2 inches in their greatest dimension will not be permitted in top 6 inches of subgrade.

3.2 PLACING FILL AND BACKFILL

A. Examination of Subgrade: Do not place fill on any part of the subgrade until the Architect or Owner has accepted the subgrade preparation.

B. Removing Debris: During the dumping and spreading process, remove all roots, stones and debris that are uncovered in the fill material.

C. Spreading Fill and Backfill: After dumping, spread the material in horizontal layers over the entire fill area. The thickness of each layer before compaction shall not exceed 8 inches unless otherwise directed by the Owner. Maintain positive drainage throughout construction. The combined excavation and fill placing operation shall be such that the material when compacted in the fill will be blended sufficiently to secure the best practicable degree of compaction. The suitability of the materials shall be subject to approval of the Testing Laboratory. After each layer of fill has been spread to the proper depth, it shall be thoroughly manipulated with a disc plow or other suitable and approved equipment until the material is uniformly mixed, pulverized and brought to uniform approved moisture content.

D. Attaining Proper Bond: If, in the opinion of the Testing Laboratory, the compacted surface of a layer is too smooth to bond with succeeding layers, loosen the surface by harrowing or other approved method before continuing the work.

3.3 MOISTURE CONTROL

A. Intent: The required density is desired on the wet side of the natural moisture content in order to limit post construction swelling of the clay soils.

B. Adjustment: If the moisture content is too high, adjust to within the specified limits by spreading the material and permitting it to dry. Assist the drying process by disking or harrowing if necessary. When the material is too dry, sprinkle each layer with water. Work the moisture into the soil by harrowing or other approved method.

3.4 COMPACTION:

A. Rough Grade: Compact each layer of fill material with suitable equipment as necessary to secure 95% of the Standard Proctor Density (ASTM D 698) at minus 1% to plus 3% of the optimum moisture content.

B. Finish Grade: Place and lightly compact topsoil to achieve finish grades.

3.5 MATERIAL DISPOSAL:

A. Excess Excavation Material (soil material free of trees, stumps, logs, brush, roots, rubbish and other objectionable matter which has been accepted by the Owner): Remove excess excavated material from the construction site before Pre-final Inspection.

B. Waste Material (soil material including trees, stumps, logs, brush, roots, rubbish and other objectionable matter which has not been accepted by the Owner): Remove waste material from the project site before final Inspection. Legally dispose of material at a licensed site or with written and notarized permission from the property owner for a private disposal site. All costs associated with waste material removal and the Contractor shall pay for disposal.

3.6 TESTING

A. Laboratory Testing and Inspection Services: As specified in Division 1.

END OF SECTION

SECTION 31 2333

TRENCH EXCAVATION

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This Section includes furnishing all the labor, equipment and materials for the excavation and backfilling of all earth trenches.

1.2 SUBMITTALS

A. Procedures for Submittals: Division 1.

B. Submit laboratory testing reports for each type of excavated or imported soil to be used for trench backfill.

1.3 QUALITY CONTROL TESTING

A. Laboratory Testing and Inspection Services: As specified in Division 1.

B. Sampling and laboratory testing of excavated or imported soils to determine Atterberg Limits and moisture-density compaction characteristics.

1.4 SEQUENCING AND SCHEDULING

A. Demolition: Complete applicable work specified in Section 31 1000 prior to excavating.

B. Registered Professional Land Surveyor is to establish lines and grades per drawings.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 GENERAL

A. Excavate to lines, grades, and dimensions show as necessary to accomplish Work. Unless otherwise noted in the drawings, excavate to within tolerance of plus or minus 0.1 foot. Allow for forms, working space, granular base, topsoil, and similar items, wherever applicable. Trim to neat lines where concrete is to be deposited against earth.

B. Do not over-excavate without written authorization of the Architect.

3.2 UNCLASSIFIED EXCAVATION

A. Excavation is unclassified. Complete all excavation regardless of the type, nature or condition of the materials encountered.

3.3 TRENCH EXCAVATION

A. Cut banks of pipe trench as nearly vertical as practical. Remove stones as necessary to avoid point bearing. Over-excavate wet or unstable soil from the trench bottom to permit construction of a more stable bed for pipe. Over excavation shall be filed and tamped with clean dry sand or other approved bedding material to the specified grade.

B. Dig the trench to the proper width as shown on the Drawings. If the trench width below the top of pipe is wider than specified, install additional bedding at no additional cost to the Owner.

C. Accurately grade the trench bottom to provide proper bedding as required.

D. If any excavation is carried beyond the lines and grades required or authorized, fill such space with concrete or other suitable material as directed by Owner at no additional cost to the Owner.

3.4 DEWATERING

A. Provide and maintain on-site all necessary equipment, pumps and appurtenances for ensuring that all excavated trenches shall be dewatered prior to the installation of any pipe bedding and/or pipe material.

3.5 DISPOSAL OF EXCAVATED MATERIAL

A. Disposal of excavated soils shall be performed in a legal manner and be removed from the site unless needed.

3.6 BACKFILLING UNDER NON-STRUCTURAL AREAS

A. The Contractor is not to leave an open trench longer than 200 linear feet on a daily basis.

B. Do not backfill trenches to a point greater than 2 feet above top of pipe until all required pressure tests are performed and utility systems as installed conform to the requirements of appropriate sections. Joints or sewer and water piping shall remain exposed until acceptance of the pressure and leakage tests. Backfill trenches to ground surface with material as specified. Re-open trenches improperly backfilled to depth required for proper compaction. Refill and re-compact as specified, or otherwise correct the condition in a manner approved by Owner.

C. Open Areas
1. In the pipe zone, place backfill evenly and carefully around, under and over pipe in layers no thicker than 6 inches. Compact with mechanical hand tampers to 90% density of Standard Proctor maximum dry density as determined by ASTM D698, until there is a cover of not less than 1 foot over utility lines. Use backfill material as called for on the drawings. Take special care not to damage pipe wrapping or coating.
2. Above the pipe zone, deposit Low-Plasticity Cohesive Soils in 8 inch layers. Compact each layer to 90% Standard Proctor maximum dry density as determined by ASTM D698 at -1 to +3 percentage points of optimum moisture content.
3. All forms, lumber, trash and debris shall be removed form manholes and other utility structures. Backfill for manholes, utility pull boxes, and other utility structures shall be placed symmetrically on all sides in layers no thicker than 8 inches. Each layer shall be compacted to 90% of Standard Proctor maximum dry density as determined by ASTM D698.

3.7 BACKFILLING UNDER STRUCTURAL AREAS

A. The Contractor is not to leave an open trench longer than 200 linear feet on a daily basis.

B. Do not backfill trenches to a point greater than 2 feet above top of pipe until all required pressure tests are performed and utility systems as installed conform to the requirements of appropriate sections. Joints or sewer and water piping shall remain exposed until acceptance of the pressure and leakage tests. Backfill trenches to ground surface with material as specified. Re-open trenches improperly backfilled to depth required for proper compaction. Refill and re-compact as specified, or otherwise correct the condition in a manner approved by Owner.

C. Pavement Areas
1. In the pipe zone, deposit backfill material as specified on the drawings in layers no thicker than 6 inches or less. Compact each layer to 95% of Modified Proctor maximum dry density as determined by ASTM D 698.

2. Above the pipe zone, backfill with cement-stabilized sand using a 1½-sack mix. Deposit backfill in layers no thicker than 8 inches. Compact each layer to 95% of Modified Proctor maximum dry density as determined by ASTM D 698.
    a. Flowable fill may be substituted for cement-stabilized sand.
3. For manholes and other appurtenances within the pavement area, backfill with cement-stabilized sand using a 1½-sack mix or flowable fill. Deposit backfill in layers no thicker than 6 inches.

3.8 TESTING

A. Comply with the provisions listed in Division 1.

B. The Owner may employ a geotechnical laboratory testing agency to monitor soil quality and compaction of fill during construction. The laboratory testing agency will adhere to the following testing procedures:
1. Inspect and test each lift of trench backfill material. Work shall not proceed until test results for previously completed work verify compliance with requirements.
2. Field density and moisture tests will be performed by the nuclear method in accordance with ASTM D2922 and ASTM D3017.
3. When field in-place density and moisture tests are performed using nuclear methods, the moisture/density gages will be checked and calibrated to correlate to laboratory density and moisture values as determined by ASTM D698 and ASTM D1557, as applicable, at the beginning of each work period.
4. Perform at least one field in-place moisture and density test for every 100 linear feet of trench per lift of backfill, but in no case fewer than three tests for any given lift.

C. Settling: Where settling occurs, remove entire trench backfill, fill with additional approved material, compact and reconstruct surfacing.

D. Trench backfill that does not pass field moisture/density testing shall be scarified, watered if necessary, reworked and re-compacted at no additional cost to the Owner. Soil sampling and laboratory testing associated with re-testing of soil materials that are reworked to correct non-compliance with the specified requirements shall not be an additional cost to the Owner.

END OF SECTION

SECTION 31 2334

TRENCH BACKFILL

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section includes furnishing all labor, materials and equipment for trench backfilling for site utilities with appurtenances, which occur five feet (5') outside of all building structures.

1.2 RELATED SECTIONS

A. SECTION 31 10 00 – SITE PREPARATION AND DEMOLITION

B. SECTION 33 10 00 – WATER UTILITIES

C. SECTION 33 31 00 – WASTEWATER SERVICES

1.3 REFERENCES

A. ASTM C33 - Grading Requirements for Coarse Aggregates

B. ASTM D424 - Test for Plastic Limit and Plasticity Index of Soils

C. ASTM D698 - Test for Moisture-Density Characteristics of Soils Using Standard Effort

D. ASTM D1557 - Test for Moisture-Density Characteristics of Soil Using Modified Effort

E. ASTM D2922 – Test for Density of Soil and Soil-Aggregate in Place by Nuclear Method

F. ASTM D3017 – Test for Water Content of Soil and Rock in Place by Nuclear Method

G. ASTM D4318 - Test for Liquid Limit, Plastic Limit and Plasticity Index of Soils

1.4 SUBMITTALS

A. Procedures for Submittals: Division 01.

B. Submit laboratory testing reports each type of excavated or imported soil to be used for trench backfill specified in this Section.

C. Submit pipe bedding material product data, including material supplier, borrow source identification, and laboratory soil classification and particle gradation analyses.

1.5 QUALITY CONTROL TESTING

A. Comply with the provisions of Division 01.

B. The Owner may engage a qualified independent testing agency to perform field inspections and tests, and to prepare test reports. When such testing indicates that Contractor's work does not comply with the specified requirements, additional testing shall be performed by the Owner's testing agency at no additional cost to the Owner to determine compliance of corrected Work with the specified requirements.

PART 2 - PRODUCTS

2.1 PIPE BEDDING

A. Pipe bedding material for water, sewer and storm drainage lines shall be installed per the plans. Pipe shall be backfilled with a crushed stone to 12 inches above the top of pipe. Backfill material shall have a liquid limit (LL) of no greater than 35 and a plasticity index (PI) of no greater than 10. Backfill material shall be graded as follows:

Passing 2 in. sieve	100%
Passing ½-inch sieve	50 to 85%
Passing No. 4 sieve	20 to 65%
Passing No. 100 sieve	0 to 5%

2.2 BACKFILL MATERIAL

A. Under Non – Structural Areas: The backfill material placed above the crushed stone bedding shall consist of Select Fill material, meeting the requirements of Section 31 22 00.

PART 3 - EXECUTION

3.1 GENERAL

A. Grade as necessary to prevent surface water from flowing into trenches or other excavations.

B. Pipe Zone: The pipe zone is defined as including the pipe bedding, backfill to one-half the pipe diameter (the springline) and the initial backfill to 12 inches above the top of the pipe or as otherwise shown on the drawings.

C. Pipe Bedding: Pipe bedding material shall be installed within the pipe zone per the plans.

D. Water in Excavation: Take such precautions as are necessary to keep the work free from ground or surface water. Pumps of adequate capacity or other approved method shall be provided to remove water from the trench in such a manner that it will not interfere with the progress of the work or the proper placing of other work. Ground or surface water will not be allowed to drain into or be pumped into an existing sanitary sewer system. If the work includes connection to an existing sanitary sewer, a temporary watertight plug must be installed and maintained within the pipe for the duration of the contract and bedding material interrupted in a manner approved by the Architect to isolate new construction from the existing system. All costs of handling the water shall be included in the bid and at no additional cost to the Owner.

3.2 UTILITY INSTALLATION

A. Limit clear space on either side of the pipe and below the pipe to the dimensions shown on the drawings. Above the pipe zone, cut as wide as necessary to sheet and brace and properly perform the work. Provide select fill per the drawings.

B. Excavation for Appurtenances: Excavate sufficiently for manholes, utility pull boxes, and similar structures to leave at least 2 feet clear between the outer surfaces and the embankment of timber that may be used to hold and protect the banks. Any over-depth excavation below such appurtenances not directed will be considered unauthorized and will be refilled with sand, gravel, or concrete as directed at no additional cost to the Owner.

3.3 BACKFILLING UNDER NON-STRUCTURAL AREAS

A. The Contractor is not to leave an open trench longer than 200 linear feet on a daily basis.

B. Do not backfill trenches to a point greater than 2 feet above top of pipe until all required pressure tests are performed and utility systems as installed conform to the requirements of appropriate sections. Joints or sewer and water piping shall remain exposed until acceptance of the pressure and leakage tests. Backfill trenches to ground surface with material as specified. Re-open trenches improperly backfilled to depth required for proper compaction. Refill and re-compact as specified, or

otherwise correct the condition in a manner approved by Owner.

C. Open Areas
   1. In the pipe zone, place backfill evenly and carefully around, under and over pipe in layers no thicker than 6 inches. Compact with mechanical hand tampers to 90% density of Standard Proctor maximum dry density as determined by ASTM D698, until there is a cover of not less than 1 foot over utility lines. Use backfill material as called for on the drawings. Take special care not to damage pipe wrapping or coating.
   2. Above the pipe zone, deposit Low-Plasticity Cohesive Soils in 8 inch layers. The soils shall have a liquid limit (LL) of 35 percent or less and a plasticity index (PI) not less than 5 nor greater than 15. Compact each layer to 90% Standard Proctor maximum dry density as determined by ASTM D698 at -1 to +3 percentage points of optimum moisture content.
   3. All forms, lumber, trash and debris shall be removed form manholes and other utility structures. Backfill for manholes, utility pull boxes, and other utility structures shall be placed symmetrically on all sides in layers no thicker than 8 inches. Each layer shall be compacted to 90% of Standard Proctor maximum dry density as determined by ASTM D698.

3.4 BACKFILLING UNDER STRUCTURAL AREAS

A. The Contractor is not to leave an open trench longer than 200 linear feet on a daily basis.

B. Do not backfill trenches to a point greater than 2 feet above top of pipe until all required pressure tests are performed and utility systems as installed conform to the requirements of appropriate sections. Joints or sewer and water piping shall remain exposed until acceptance of the pressure and leakage tests. Backfill trenches to ground surface with material as specified. Re-open trenches improperly backfilled to depth required for proper compaction. Refill and re-compact as specified, or otherwise correct the condition in a manner approved by Owner.

C. Pavement Areas
   1. In the pipe zone, deposit backfill material as specified on the drawings in layers 6 inches or less. Compact each layer to 95% of Standard Proctor (ASTM D 698) maximum laboratory dry density within plus or minus 2 percentage points.
   2. Above the pipe zone, backfill with cement-stabilized sand using a 1½-sack mix or flowable fill. Deposit backfill in 6-inch layers.
   3. For manholes and other appurtenances within the pavement area, backfill with cement-stabilized sand using a 1½-sack mix or flowable fill. Deposit backfill in 6-inch layers.

3.5 TESTING

A. Comply with the provisions of Division 01.

B. The Owner may employ a geotechnical laboratory testing agency to monitor soil quality and compaction of fill during construction. The laboratory testing agency will adhere to the following testing procedures:
   1. Inspect and test each lift of trench backfill material. Work shall not proceed until test results for previously completed work verify compliance with requirements.
   2. Field density and moisture tests will be performed in accordance with ASTM D 698.
   3. When field in-place density and moisture tests are performed using nuclear methods, the moisture/density gages will be checked and calibrated to correlate to laboratory density and moisture values as determined by ASTM D 698, as applicable, at the beginning of each work period.
   4. Perform at least one field in-place moisture and density test for every 100 linear feet of trench per lift of backfill, but in no case fewer than three tests for any given lift.

C. Settling: Where settling occurs, remove finished surfacing, fill with additional approved material, compact and reconstruct surfacing.

D. Trench backfill that does not pass field moisture/density testing shall be scarified, watered if necessary, reworked and re-compacted at no additional cost to the Owner. Soil sampling and

laboratory testing associated with re-testing of soil materials that are reworked to correct non-compliance with the specified requirements shall not be an additional cost to the Owner.

END OF SECTION

SECTION 31 2335

TRENCH SAFETY SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section specifies furnishing all equipment, materials, and labor for a trench safety system meeting appropriate requirements established in Occupational Safety and Health Administration (OSHA) Safety and Health Regulations, Part 1926, Subpart P - Excavations, Trenching and Shoring.

1.2 RELATED SECTIONS

A. SECTION 31 10 00 - SITE PREPARATION AND DEMOLITION

B. SECTION 31 23 33 - TRENCH EXCAVATION

C. SECTION 31 23 34 – TRENCH BACKFILL

1.3 REFERENCES

A. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
   1. A 36 Specification for Structural Steel.
   2. A 328 Specification for Steel Sheet Piling.
   3. A 588 Specification for High-Strength, Low-Alloy Structural Steel.

B. American Welding Society (AWS)
   1. D1.1 - Structural Welding Code.

C. United States Department of Labor Occupational Safety and Health Administration (OSHA). Part 1926, Subpart P, Code of Federal Regulations.

1.4 SUBMITTALS

A. Procedures for Submittals: Division 01.

B. Submit drawings showing the design and details of proposed sheeting, shoring and bracing, and the proposed sequence of excavation and backfill to Owner for review.

PART 2 - PRODUCTS

2.1 TIMBER

A. Trench sheeting materials shall be a minimum of 2” in thickness, solid and sound, free from weakening defects such as loose knots and splits.

2.2 STEEL SHEET PILING

A. Steel sheet piling shall conform to the following specifications:
   1. ASTM A 328
   2. ASTM A 572, Grade 50

B. Steel for stringers and cross braces shall conform to ASTM A 588.

2.3 TRENCH BOXES

A. Portable trench boxes shall be constructed of steel conforming to ASTM A 36.

PART 3 - EXECUTION

3.1 GENERAL

A. Trench safety system shall be constructed, installed and maintained in accordance with the OSHA regulations and to the design prepared by the Contractor's Registered Professional Engineer to prevent death of injury to personnel or damage to structures in or near these trench excavations.

3.2 INSTALLATION

A. Installation of trench safety system shall meet OSHA regulations and the Contractor's Registered Professional Engineer's requirements.

3.3 SUPERVISION

A. Provide competent supervisory personnel at each trench while work is in progress to ensure Contractor's methods, procedures, equipment and materials pertaining to the safety systems in this item are sufficient to meet requirements of OSHA regulations.

3.4 MAINTENANCE OF SAFETY SYSTEM

A. The safety system shall be maintained in the condition required by the OSHA regulations or as specified by the Contractor's Registered Professional Engineer.

B. Take all necessary precautions to ensure the safety systems are not damaged during their use.

3.5 INSPECTION

A. Make daily inspection of trench safety system to ensure that the system meets OSHA requirements.

3.6 REMOVAL

A. Bed and backfill pipe to a point at least one foot above top of pipe prior to removal of any portion of trench safety system, but in no case allow construction personnel or other persons in the trench unless the trench conditions comply with OSHA requirements.

END OF SECTION

SECTION 31 2500

EROSION CONTROL

PART 1 - GENERAL

1.1 DESCRIPTION

A. Furnish all labor, materials and equipment for providing and placing erosion control facilities for this project

B. Establish permanent or temporary grass, as necessary to prevent erosion during construction.

1.2 RELATED SECTIONS

A. SECTION 31 10 00 - SITE PREPARATION AND DEMOLITION

1.3 REFERENCES

A. American Society for Testing and Materials, ASTM.

1.4 SUBMITTALS

A. Procedures for Submittals: Section 01.

B. Product data for geotextiles and erosion control matting.

PART 2 - PRODUCTS

2.1 SILT FENCE FABRIC

A. General: The filter fabric shall be of non-woven polypropylene, polyethylene or polyamide thermoplastic fibers with non-raveling edges.

B. Physical Requirements: The fabric shall meet the following requirements when sampled and tested in accordance with the methods indicated:

Physical Properties	Method	Requirements	Units
Fabric Weight	ASTM D5261	min. 4.0	oz / sy
Water Flow Rate	ASTM D4491	max. 40	gal / min / sf
Apparent Opening Size	ASTM D4751	40 to 100	US std sieve
Millen Burst Strength	ASTM D3786	min. 300	psi
Ultraviolet Resistance	ASTM D4355	min. 70 @ 500	% @ hr

2.2 POSTS

A. Posts shall be painted or galvanized steel Tee or Y Posts with anchor plates, not less than 5 feet in length with a minimum weight of 1.3 pounds per foot, and with a minimum Brinell Hardness of 143.

2.3 WIRE FENCE

A. Wire fence shall be welded wire fabric 4 x 4 - W1.4 x W1.4.

2.4 GRASS SEED

A. Grass seed shall be as shown on the Landscaping Drawings.

2.5 FERTILIZER

A. Fertilizer shall be as shown on the Landscaping Drawings.

PART 3 - EXECUTION

3.1 STORM WATER POLLUTION PREVENTION PLAN

A. Comply with the Storm Water Pollution Prevention Plan (SW3P).

3.2 SILT FENCE

A. Deploy silt fence as shown on the Drawings.

B. Install silt fence with the steel support posts on a slight angle toward the anticipated runoff source. Posts must be embedded a minimum of 1 foot.

C. The toe of the silt fence shall be trenched in with a spade or mechanical trencher so that a 6”W x 6”D trench is formed perpendicular to the line of flow.

D. Lay the silt fence fabric into the trench and backfill with compacted soil. Where fence cannot be trenched in (e.g., pavement), weight the fabric flap with rock on uphill side to prevent flow from seeping under fence.

E. Silt fence shall be securely fastened to each steel support post, or to woven wire fabric which in turn shall be securely fastened to each steel support post. Where fabric ends meet, lap fabric a minimum of 3 feet and securely fasten both ends to woven wire fabric.

F. Maintain the silt fence in good working order, and as specified on the Drawings and in Section 01165.

3.3 CONSTRUCTION EXITS

A. Construct construction exits at the locations shown on the Drawings.

B. Proof-roll the subgrade to ensure a firm, hard subgrade on which to lay the foundation course.

C. Spread the foundation course in one 6-inch lift and compact.

D. Place the coarse aggregate surface course on top of the foundation course, and form approach transitions at each end of the exit using foundation course aggregate.

E. Maintain the construction exit in good working order.

3.4 REVEGETATION

A. Prior to final acceptance of the project, vegetate all disturbed areas within the project’s construction limits.

B. Watering for establishing vegetation of all disturbed areas shall be continued during construction until the project is accepted.

C. Once vegetated areas are established and accepted by the Owner, remove all erosion control measures and dispose of all accumulated trapped silt from the site.

END OF SECTION

SECTION 31 63 01

HELICAL PILES

PART 1 - GENERAL

1.1 SUMMARY

A. This section specifies the furnishing of all necessary engineering and design services, supervision, labor, tools, materials, and equipment to perform all work necessary to install the Helical Piles per the specifications described herein, and as shown on the drawings. The Contractor shall install a Helical Pile that will develop the load capacities as detailed on the drawings.

B. Related Sections include the following:

1. Division 1 Section "Unit Prices" for modification of actual length installed.

1.2 QUALIFICATIONS OF THE HELICAL PILE CONTRACTOR

A. The Helical Pile Contractor shall be experienced in performing design and construction of Helical Piles and shall furnish all materials, labor, and supervision to perform the work. The Contractor shall provide names of on-site personnel materially involved with the work.

1.3 ALLOWABLE TOLERANCES

A. Centerline of Helical Piles shall not be more than 3" from indicated plan location.

B. Helical Pile plumbness shall be within 2 degrees of design alignment.

C. Top elevation of Helical Pile shall be within +1" to -2" of the design vertical elevation.

1.4 DESIGN CRITERIA

A. Helical Piles shall be designed to meet the specified loads and acceptance criteria as shown on the drawings. The calculations and drawings shall be submitted to the Architect for review and acceptance in accordance to Section 1.5 "Construction Submittals".

B. The allowable working load on the Helical Piles shall not be less than load specified on construction drawings.

C. Helical Pile attachment (pile cap) shall distribute the design load (DL) to the concrete foundation such that the concrete bearing stress does not exceed those in the ACI Building Code and the stresses in the steel plates/welds does not exceed AISC allowable stresses for steel members.

D. Corrosion Protection: Each Helical Pile and associated coating and/or auxiliary corrosion protection system shall be designed to meet the foregoing requirements for a life of 75 years.

1.5 SUBMITTALS

A. Construction Submittals

1. The Contractor shall prepare and submit to the Architect, for review and approval, working drawings and design calculations for the Helical Piles. Calculations shall be sealed by an engineer registered in the state of Texas.
2. The Working Drawings shall include the following:

    a. Helical Pile number, location and pattern by assigned identification number
    b. Helical Pile design load
    c. Type and size of central steel shaft
    d. Helix configuration (number and diameter of helix plates)
    e. Minimum effective installation torque
    f. Minimum overall length
    g. Inclination of Helical Pile
    h. Cut-off elevation
    i. Helical Pile attachment to structure relative to grade beam, column pad, pile cap, etc.

3. The Contractor shall submit shop drawings for all Helical Pile components, including corrosion protection and pile top attachment to the Architect for review and approval. This includes Helical Pile lead/starter and extension section identification (manufacturer's catalog numbers).
4. The Contractor shall submit copies of calibration reports for each torque indicator or torque motor, and all load test equipment to be used on the project. The calibration tests shall have been performed within forty five (45) working days of the date submitted. Helical Pile installation and testing shall not proceed until the Architect has received the calibration reports. These calibration reports shall include, but are not limited to, the following information:

    a. Name of project and Contractor
    b. Name of testing agency
    c. Identification (serial number) of device calibrated
    d. Description of calibrated testing equipment
    e. Date of calibration
    f. Calibration data

5. Work shall not begin until all the submittals have been received and approved by the Architect. The Contractor shall allow the Architect a reasonable time to review, comment, and return the submittal package after a complete set has been received. All costs associated with incomplete or unacceptable submittals shall be the responsibility of the Contractor.

B. Installation Records

1. Provide copies of Helical Pile installation records within 24 hours after each installation is completed. Formal copies shall be submitted on a weekly basis. These installation records shall include, but are not limited to, the following information.

    a. Name of project and Contractor
    b. Name of Contractor's supervisor during installation
    c. Date and time of installation
    d. Name and model of installation equipment
    e. Type of torque indicator used
    f. Location of Helical Pile by assigned identification number
    g. Actual Helical Pile type and configuration - including lead section (number and size of helix plates), number and type of extension sections (manufacturer's SKU numbers)
    h. Helical Pile installation duration and observations
    i. Total length of installed Helical Pile
    j. Cut-off elevation
    k. Inclination of Helical Pile
    l. Installation torque at one-foot intervals for the final 10 feet
    m. Comments pertaining to interruptions, obstructions, or other relevant information
    n. Rated load capacities

PART 2 - PRODUCTS AND MATERIALS

2.1 CENTRAL STEEL SHAFT

A. The central steel shaft, consisting of lead sections, helical extensions, and plain extensions, shall be Square Shaft or Round Shaft as required in order to meet the specified pile capacity.

2.2 HELIX BEARING PLATE

A. Shall be hot rolled carbon steel sheet, strip, or plate formed on matching metal dies to true helical shape and uniform pitch. Bearing plate material shall conform to the following ASTM specifications.

1. ASTM A572 with minimum yield strength of 50 ksi. Minimum plate thickness is 1/2".

2.3 BOLTS

A. The size and type of bolts used to connect the central steel shaft sections together shall conform to the following ASTM specifications.

1. ASTM A193 Grade B7.

2.4 PLATES, SHAPES, OR PILE CAPS

A. Depending on the application, the pile cap shall be a welded assembly consisting of structural steel plates and shapes designed to fit the pile and transfer the applied load. Structural steel plates and shapes for HELICAL PILE top attachments shall conform to ASTM A36 or ASTM A572 Grade 50.

PART 3 - EXECUTION

3.1 SITE CONDITIONS

A. Prior to commencing Helical Pile installation, the Contractor shall inspect the work of all other trades and verify that all said work is completed to the point where Helical Piles may commence without restriction.

B. The Contractor shall verify that all Helical Piles may be installed in accordance with all pertinent codes and regulations regarding such items as underground obstructions, right-of-way limitations, utilities, etc.

C. In the event of a discrepancy, the Contractor shall notify the Architect. The Contractor shall not proceed with Helical Pile installation in areas of discrepancies until said discrepancies have been resolved. All costs associated with unresolved discrepancies shall be the responsibility of the Contractor.

3.2 INSTALLATION EQUIPMENT

A. Shall be rotary type, hydraulic power driven torque motor with clockwise and counter-clockwise rotation capabilities. The torque motor shall be capable of continuous adjustment to revolutions per minute (RPM's) during installation. Percussion drilling equipment shall not be permitted. The torque motor shall have torque capacity 15% greater than the torsional strength rating of the central steel shaft to be installed.

B. Equipment shall be capable of applying adequate down pressure and torque simultaneously to suit project soil conditions and load requirements. The equipment shall be capable of continuous position adjustment to maintain proper Helical Pile alignment.

3.3 INSTALLATION TOOLING

A. A torque indicator shall be used during Helical Pile installation. The torque indicator can be an integral part of the installation equipment or externally mounted in-line with the installation tooling.

B. Shall be capable of providing continuous measurement of applied torque throughout the installation.

C. Shall be capable of torque measurements in increments of at least 500 ft-lb

D. Shall be calibrated prior to pre-production testing or start of work. Torque indicators which are an integral part of the installation equipment, shall be calibrated on-site. Torque indicators which are mounted in-line with the installation tooling, shall be calibrated either on-site or at an appropriately equipped test facility. Indicators that measure torque as a function of hydraulic pressure shall be calibrated at normal operating temperatures.

E. Shall be re-calibrated, if in the opinion of the Architect and/or Contractor reasonable doubt exists as to the accuracy of the torque measurements.

3.4 INSTALLATION PROCEDURES

A. Central Steel Shaft: (Lead and Extension Sections)

B. The Helical Pile installation technique shall be such that it is consistent with the geotechnical, logistical, environmental, and load carrying conditions of the project.

C. The lead section shall be positioned at the location as shown on the working drawings. The Helical Pile sections shall be engaged and advanced into the soil in a smooth, continuous manner at a rate of rotation of 5 to 20 RPM's. Extension sections shall be provided to obtain the required minimum overall length and installation torque as shown on the working drawings. Connect sections together using coupling bolt(s) and nut torqued to 40 ft-lb.

D. Sufficient down pressure shall be applied to uniformly advance the Helical Pile sections approximately 3" per revolution. The rate of rotation and magnitude of down pressure shall be adjusted for different soil conditions and depths.

3.5 TERMINATION CRITERIA

A. The torque as measured during the installation shall not exceed the torsional strength rating of the central steel shaft.

B. The minimum installation torque and minimum overall length criteria as shown on the working drawings shall be satisfied prior to terminating the Helical Pile installation.

C. If the torsional strength rating of the central steel shaft and/or installation equipment has been reached prior to achieving the minimum overall length required, the Contractor shall have the following options:

1. Terminate the installation at the depth obtained subject to the review and acceptance of the Owner, or:

2. Remove the existing Helical Pile and install a new one with fewer and/or smaller diameter helix plates. The new helix configuration shall be subject to review and acceptance of the Owner. If re-installing in the same location, the top-most helix of the new Helical Pile shall be terminated at least (3) three feet beyond the terminating depth of the original Helical Pile.

D. If the minimum installation torque as shown on the working drawings is not achieved at the minimum overall length, and there is no maximum length constraint, the Contractor shall have the following options:

1. Install the Helical Pile deeper using additional extension sections, or:

2. Remove the existing Helical Pile and install a new one with additional and/or larger diameter helix plates. The new helix configuration shall be subject to review and acceptance of the Owner. If re-installing in the same location, the top-most helix of the new Helical Pile shall be terminated at least (3) three feet beyond the terminating depth of the original Helical Pile.

E. De-rate the load capacity of the Helical Pile and install additional Helical Pile(s). The de-rated capacity and additional Helical Pile location shall be subject to the review and acceptance of the Owner.

F. If the Helical Pile is refused or deflected by a subsurface obstruction, the installation shall be terminated and the pile removed. The obstruction shall be removed, if feasible, and the Helical Pile re-installed. If the obstruction can't be removed, the Helical Pile shall be installed at an adjacent location, subject to review and acceptance of the Owner.

G. If the torsional strength rating of the central steel shaft and/or installation equipment has been reached prior to proper positioning of the last plain extension section relative to the final elevation, the Contractor may remove the last plain extension and replace it with a shorter length extension. If it is not feasible to remove the last plain extension, the Contractor may cut said extension shaft to the correct elevation. The Contractor shall not reverse (back-out) the Helical Pile to facilitate extension removal.

H. The average torque for the last three feet of penetration shall be used as the basis of comparison with the minimum installation torque as shown on the working drawings. The average torque shall be defined as the average of the last three readings recorded at one-foot intervals.

I. Assumed depth for Bidding Purposes: Contractor to assume a depth of 55' for each helical pile. Refer to Unit Prices for adjustments to actual depths encountered. Contract sum will be adjusted by change order if variations from assumed depths occur.

END OF SECTION 31 63 01

SECTION 32 1313

PORTLAND CEMENT CONCRETE PAVEMENT

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. This section includes furnishing all labor, materials and equipment necessary for forming and placing reinforced concrete pavement to the lines and grades shown on the Drawings.

1.2 RELATED SECTIONS

A. SECTION 31 22 00 – EARTHWORK

B. SECTION 03 10 00 – CONCRETE FORMWORK

C. SECTION 03 20 00– CONCRETE REINFORCEMENT

D. SECTION 03 30 00 – CAST-IN-PLACE CONCRETE

1.3 REFERENCES

A. ASTM A 615 – Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

B. ASTM C 31 – Standard Practice for Making and Curing Concrete Test Specimens in the Field.

C. ASTM C 39 – Standard Test Method for Compressive Strength of cylindrical Concrete Specimens.

D. ASTM C 94 – Standard Specification for Ready-Mixed Concrete.

E. ASTM C 309 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

F. ASTM D 1751 –Standard Specification for Preformed Expansion Joint Fillers for Concrete and Structural Construction.(Nonextruding and resilient Bituminous Types)

PART 2 – PRODUCTS

2.1 PORTLAND CEMENT CONCRETE

A. Classification and mix design shall be as follows:
   1. Concrete shall attain a minimum strength of 3,000psi at 28 days unless otherwise shown on the Drawings.
   2. Maximum size of aggregates 1-1/2 inches.
   3. Slump shall range from 1-1/2 to 3 inches.
   4. Air entrainment concrete mixture shall have an air content by volume of 4.5 percent plus or minus 1.5%.
   5. Concrete shall be mixed in conformance with ASTM C 94.
   6. The concrete mix shall be designed by a commercial testing laboratory, and submitted for approval.
   7. The Contractor shall obtain written permission from the Engineer prior to the use of Type III cement when Type III cement is not shown on the plans.

2.2 REINFORCEMENT

A. Reinforcing steel shall meet the specifications of ASTM A615, Grade 60. Bars shall be deformed billet steel free of defects.

2.3 BOARD FILLER

A. Materials shall be as shown on the Drawings.

B. Board filler shall be free of defects, which will impair their usefulness as expansion joint fillers.

2.4 PREFORMED BITUMINOUS EXPANSION BOARD

A. Preformed bituminous boards shall meet the specifications for ASTM D 1751.

2.5 JOINT SEALING MATERIAL

A. Pavement joint sealing material shall be as shown on the Drawings.

2.6 DEFORMED CONTRACTION JOINT METAL STRIPS

A. Deformed contraction joint metal strips shall be 28 ga. steel, galvanized 1.25 oz. per square foot or heavier.

2.7 CURING COMPOUND

A. Curing compound shall conform to the specifications if ASTM C 309 Type 2, white pigmented.

2.8 LOAD TRANSMISSION DEVICES FOR EXPANSION AND CONTRACTION JOINTS

A. Load Transmission devices shall be as detailed on plans and conform to the properties specified in ASTM A615, Grade 60 steel.

2.9 STEEL DOWEL BARS

A. Steel dowel bars and steel reinforcement shall be deformed or smooth bars conform on properties to ASTM A 615 Grade 60. Unless otherwise shown on the plans all reinforcing steel shall be deformed bars, all dowel bars at joints shall be smooth bars, and all curb dowels shall be deformed bars.

PART 3 - EXECUTION

3.1 PAVEMENT

A. Placing and removing forms.
   1. Forms shall be of wood or metal, properly treated to insure concrete does not adhere to the forms, straight, clean, free from warp or defect, and of sufficient depth. The forms shall be so placed that when each form section will be firmly in contact for its whole length and base width and exactly at the established grade. Any subgrade under the forms below established grade shall be corrected using suitable material, placed, sprinkled, and rolled. Forms shall be securely staked and tightly joined and keyed to prevent displacement. Sufficient stability of forms to support equipment operated thereon and to withstand its vibration without springing shall be required. Forms shall remain in place not less than 24 hours after concrete is placed.

B. Joints in Concrete Pavement.
   1. Shall be constructed in the pavement slab at locations and according to details as shown on the drawings. Stakes, braces, brackets or other devices shall be used as necessary to keep the entire joint assembly in true vertical and horizontal position.
   2. When prefabricated plastic strips are used to form joints, they shall be placed after the concrete surface has been leveled and before the finishing is completed. The strips shall be of a type specifically manufactured for the purpose of forming joints in concrete pavement and to the dimensions as required to form the specified joints. The strips shall be removed after the concrete has set per the manufacturer's recommendations. Any blemishes caused by the removal of the strips shall be repaired immediately using approved methods.

C. Tie Bars and Load Transmission Devices.
   1. Shall be accurately placed as shown on drawings and held securely (parallel to pavement surface and perpendicular to joint) during placing and finishing of pavement.

D. Expansion Joints.
   1. Shall be constructed with board filler and sealed at top. Board filler must be perpendicular to plane of concrete slab. Alignment of joint shall not vary more than 1/4 inch in 10 feet.

E. Concrete Placing and Finishing.
   1. Concrete not placed as herein prescribed within 90 minutes after mixing shall be rejected.
   2. Concrete shall not be placed when temperature is below 40°F and falling, but may be placed when the temperature is above 35°F and rising, the temperature being taken in the shade and away from artificial heat.
   3. Concrete shall not be placed before the time of sunrise, and shall not be placed later than will permit the finishing of the pavement during sufficient natural light.
   4. Concrete shall be consolidated by a mechanical vibrator to remove all voids. Special care shall be exercised in placing and spading concrete against forms and at all joints to prevent the forming of honeycombs and voids and to prevent displacement of steel reinforcements and load transmission devices.
   5. The concrete shall be struck off with an approved strike-off screed to such elevation that when consolidated and finished, the surface of pavement shall conform to the required section and grade. In no case shall the maximum ordinate from a 10-foot straight edge to the pavement be greater than 1/8 inch.
   6. The strike template shall be moved forward with a combined transverse and longitudinal motion in the direction the work is progressing, maintaining the template in contact with the forms, and maintaining a slight excess of material on front of the cutting edge.
   7. After completion of a strike-off, consolidation and transverse screeding, a hand-operated longitudinal float shall be operated to test and level the surface to the required grade.
   8. Workmen shall operate the float from approved bridges riding in the forms and spanning the pavement. The longitudinal float shall be held in contact with the surface and parallel to the centerline, and operated with short longitudinal strokes while being passed from one side of the pavement to the other. If contact with the pavement is not made at all points, additional concrete shall be placed if required, and screeded, and the float shall be used to produce a satisfactory surface. After a section has been smoothed so that the float maintains contact with the surface at all points being passed from one side to the other, the bridges may be moved forward half the length of the float, and the operations repeated.
   9. After completion of the straightedge testing, a pass with a burlap drag shall be made as soon as construction operations permit and before the water sheen has disappeared from the surface. As many passes of the drag as required to produce the desired surface texture shall follow this.
   10. After completion of dragging and about the time the concrete becomes hard, the edge of the slab and joints shall be left smooth and true to line.
   11. Concrete is to match historic (color, aggregate, finish, tool marks and profile).

F. Curing
   1. Concrete pavement shall be cured by protecting it against excessive loss of moisture for a period of not less than 72 hours from the beginning of curing operation. Immediately after finishing operations have been completed, the entire surface of the newly laid concrete shall be covered and cured. Special care should be exercised to keep spraying curing compound out of pavement joints.

3.2 APPLICATION OF JOINT SEALING COMPOUND

A. Joints shall be thoroughly cleaned of loose scale, dirt, dust and curing compound. When necessary, existing joint material shall be removed to the depth as shown on the plans.

B. Joints shall be filled to the full depth of the joint opening. Pouring shall be done in a neat and workman like manner to give satisfactory results. Sufficient joint sealer shall be poured into the joints

so that upon the completion of the work the surface of sealer within the joint shall be 1/4” above the top of the pavement surface.

3.3 TESTS

A. CONCRETE TEST SPECIMENS

Test cylinders from compressive strength shall be taken and cured in accordance with ASTM C 31 and tested in accordance with ASTM C 39. At least 3 cylinders shall be made for each day for each 100 c.y. of concrete or fraction thereof, placed. A testing for the tests shall be laboratory selected and paid for by the Owner. Laboratory technician will prepare concrete test cylinders.

B. TESTING OF CONCRETE SURFACE

After finishing is complete and while the concrete is still workable, the surface shall be tested for trueness with an approved 10’ steel straightedge. The straightedge shall be operated from one side of the pavement placed parallel to the pavement center line and passed across the slab to reveal any high spots or depressions. The straightedge shall be advanced along the pavement in successive stages of not more than 1/2 its length. A tolerance of 1/8” in 10’ must be met. Any correction of the surface required shall be accomplished by adding concrete if required and by operating the longitudinal float over the area. The surface test with straightedge shall then be repeated.

C. OPENING PAVEMENT TO TRAFFIC

The pavement shall be closed to all traffic, including vehicles of the Contractor, until the concrete is at least 7 days old or has attained a minimum average of 2000 psi compressive strength. The Contractor at no extra cost to the Owner shall repair any damage to the pavement prior to acceptance by the Owner. This does not relieve the Contractor from the normal liabilities and maintenance responsibilities, implied or otherwise, for the pavement or other items.

END OF SECTION

SECTION 32 8400

PLANTING IRRIGATION

PART I - GENERAL

1.1 SUMMARY

A. Provide complete landscape irrigation system as shown on drawings as described herein.

1.2 RELATED SECTIONS

A. Landscaping - Section 02900

B. Lawns and grass - Section 02930

I.3 QUALITY ASSURANCE

A. Installer:

1. An irrigator licensed in the State of Texas with a minimum five (5) years continuous experience installing systems of this size and complexity must supervise system installation.

2. If requested, submit a list of references including Owner, Landscape Architect (if applicable), date of installation and approximate installation cost.

B. Testing: Perform required testing under observations of Architect. Give 48 hours notice that such tests are to be conducted.

C. Assembly Procedures: Do not alter design hydraulics by installing additional tees or elbows unless approved by Architect.

D. Install system per all State of Texas laws and rules and all local codes and ordinances. These items are made apart of these specifications whether shown or not. State of Texas laws and rules and all local codes and ordinances take precedence over the plans and specifications.

E. Furnish certificates showing which materials have been manufactured within a five Hundred (500) mile radius of the site per LEED requirement MRc5.1 – Regional Materials.

I.4 REFERENCES STANDARDS:

A. American Standard for Testing and Materials (ASTM) - Latest edition.
1. D2241 Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR)
2. D2464 Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Thread, Schedule 80
3. D2466 Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
4. D2467 Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Socket Type, Schedule 80
5. D2564 Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings
6. D2287 Flexible Poly Vinyl Chloride (PVC) Plastic Pipe
7. F656 Poly Vinyl Chloride (PVC) Solvent Weld Primer
8. D2855 Making Solvent - Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings

1.5 SUBMITTALS

A. Procedure: Comply with Division I Specification requirements.

B. Product Data: Submit copies of equipment manufacturer's specifications and literature for all specified materials.

C. Project Record Documents

1. Locate by written dimension, routing of mainline piping, remote control valves and quick coupling valves. Locate mainlines by single dimensions from permanent site features provided they run parallel to these elements. Locate valves, intermediate electrical connections, and quick couplers by two dimensions from a permanent site feature at approximately 70 degrees to each other.

2. When dimensioning is complete, transpose work to reproducible tracings. Tracings will be provided by Architect.

3. Submit completed tracings prior to final acceptance. Mark tracings "Record Prints Showing Significant Changes". Date and sign drawings.

4. Provide three complete operation manuals and equipment brochures neatly bound in a hard-back three-ring binder. Include product data on all installed materials. Include warranties and guarantees extended to the Contractor by the manufacturer of all equipment.

5. Provide controller chart for each controller specified for the project. Identify the area of coverage for ach zone using distinctly different colors drawn over entire area of coverage. Seal chart between two layers of 20 mil thick plastic. Chart must be completed and approved prior to final acceptance of the irrigation system.

D. Water Pressure: Prior to starting construction, determine if static water pressure is as stated on Drawings. Confirm findings to Architect in writing. If static pressure varies from pressure stated on drawings, do not start work until notified to do so by Architect.

E. Quick Coupler Keys: Provide three (3) coupler keys with boiler drains attached using brass reducer. Boiler drains to be equipped w/ warning tag per State of Texas laws and rules and all local codes and ordinances.

F. Controller Keys: Provide two (2) sets of keys to controller enclosure(s).

1.6 COORDINATION

A. Complete sleeve installation (not otherwise provided) in coordination with paving and other concrete pours.
B. Coordinate to ensure that electrical power source is in place.

C. Coordinate system installation with work specified in other Sections and coordinate with landscape installer to ensure plant material is uniformly watered in accordance with intent shown on drawings.

I.7 WARRANTY AND MAINTENANCE

A. Extend to the Owner warranties and guarantees provided by the manufacturer of all equipment used.

B. Fully warrant all materials and workmanship for a minimum of one year after final acceptance.

C. Include repair of backfill settlement, packing the earth firmly around the heads, quick couplers and valve boxes.

1.8 CONNECTION TO DOMESTIC WATER SUPPLY

A. Complete connection to water supply in accordance with governing state and local codes and regulations.

B. Provide and pay for any required permits, tap fees, and impact or capital recovery fees.

PART 2 - PRODUCTS

2.1 DEFINITIONS:

A. Mainline: Piping from water source to operating valves. Hydrant lines and lines supplying quick coupling valves (QCV) are considered mainlines.

B. Lateral Piping: Piping from operating valves to sprinkler heads.

2.2 POLYVINYL CHLORIDE PIPE

A. Polyvinyl Chloride Pipe (PVC): Manufactured in accordance with standards noted.

1. PVC Mainline and Lateral Piping: Class 200, SDR-21. Pipe shall be permanently marked with ASTM standard number and the NSF (National Sanitation Foundation) seal. Provide pipe free of blisters, internal striations, cracks, or other defects.
2. PVC Pipe Fittings: Schedule 40.

B. Pipe Connection Materials:

1. Solvent Weld Fittings: Use primer and adhesive solvent. Cans of primers and solvents to have labels intact and stamped with date of manufacture. Cans dated over two years old will not be permitted. Do not thin primer or solvent.
   a. Solvents: Weld-On #705 by IPS Corporation.
   b. Primer: Weld-On #P-68 by IPS Corporation.
2. Threaded Fittings: PVC to PVC, or PVC to copper, use Teflon tape.
3. Flexible PVC: Use only solvents made for flexible pipe.
   a. Solvents: Weld-On #795 by IPS Corporation.
   b. Primer: Weld-On #P-68 by IPS Corporation.
   c. Do not use spiral barbed fittings with flexible PVC. Refer to drawing details.

2.3 COPPER PIPE MATERIALS

A. Pipe: Type “M”, hard, straight lengths of standard size and dimension.

B. Fittings: Cast brass of wrought copper, sweat-solder type.

C. Pipe Connection Materials: Threaded fitting, copper to copper, copper to brass, and copper to PVC: Teflon tape.

2.4 DRIP IRRIGATION

A. Control zone values to have pressure regulator and filter per manufacturer’s recommendations.

1. Filter to be 200 mesh and installed in a “Y” body.
2. Pressure Regulator and electric valve shall be “low flow” models made specifically for drip irrigation.

B. Inline Emitter Tubing: Tubing to have factory installed, pressure compensating, inline emitters installed every 12” on center. Flow rate to be .90 gallons per hour.

C. Compression Fittings

1. Provide leak free compression connections.
2. Use flush cap to close off line.
3. ABS materials with Buna-N rubber seals.

D. Air Relief Valves: Made of quality rust-proof plastic material with a maximum pressure rating of 140 psi.

E. Flush Valves: Made of quality rust-proof plastic material with a maximum pressure rating of 57 psi.

F. Soil Staples: 12-gauge galvanized steel pre-bent rod staple. Stake to be corrosion-resistance with notches.

2.5 MISCELLANEOUS MATERIALS

A. Wire: Type UF with minimum 4/64 inches insulation, Underwriters Laboratory (UL) approved for direct underground burial in National Electrical Code Class II Circuit (30 volts AC or less). Size according to controller manufacturer's recommendations and consideration of length of run, but no smaller than #14.

B. Nipples:

1. Shrub heads: Threaded polyethylene, nominal ½ inch by ± 5 inches.
2. Spray Pop-up heads: Flexible PVC manufactured from virgin PVC material and tested at 200 psi; static pressure for two hours with a quick burst rating of 400 psi min. manufactured by Agrifim (NDS).
3. Rotary heads: Schedule 80 PVC, Type 1, Grade 1, plus Lasco swing joint assemblies with 'O-Ring' fittings.

C. Pea Gravel: Washed native aggregate graded 3/4 to 1-1/2 inches.

D. Wire Connectors: Waterproof splice kit connectors. Type DBY by 3M or King One Step sealant filled connector.

E. Quick Coupler Valves and Keys:

1. Valves: One inch (1") bronze bodied valves with a rubber seat and purple vinyl cover.
2. Keys: Bronze construction with one inch (1") MIP x ¾" FIP threads.

2.6 IRRIGATION EQUIPMENT: Refer to drawing notes and legend.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas to be sprinkled and conditions under which irrigation sprinkler system is to be installed.

B. Verify that interfacing work specified elsewhere is complete.

C. Notify Architect in writing of conditions detrimental to proper irrigation coverage and timely completion of Work.

D. Do not proceed until conditions are satisfactory.

3.2 INSTALLATION

A. General
1. Compliance: Complete installation in strict accordance with manufacturer's recommendation, State of Texas laws are rule and all local codes and ordinances which shall be considered a part of these specifications.
2. Staking: Stake location of each sprinkler before proceeding. Do not exceed manufacturer's maximum spacing limits for the stated head pressure.
3. Piping Layout: Piping layout is diagrammatic. Route piping around trees and shrubs to avoid damage to plantings. Do not dig within balls of newly-planted trees and shrubs. Also, if applicable, do not trench within the dripline of existing trees. These trenches must be dug by hand.
4. Discrepancies
   a. Point out any discrepancy between the drawings and the field conditions that may affect uniform coverage. Do not proceed until any design change made necessary by such discrepancy is approved.
   b. Should such changes create extra cost, approval for extra compensation shall be obtained in writing before commencing work.
   c. Should such changes create a savings in cost, a written reduction in the contract price shall be approved in writing before commencing work.

d. If Contractor fails to comply with Item a. above, and proceeds with the installation, then the Contractor assumes responsibility for cost of subsequent system modifications to assure that uniform water coverage is achieved.

B. Excavations: Excavations are unclassified and include earth, rock, or combinations, in wet or dry state. Backfill trenches with material removed except if rock is encountered, haul this material off site and backfill to ensure a minimum of 3 inches of rock-free soil surrounding pipe.

C. Water Meter and Backflow Prevention: Refer to drawings.

3.3 PIPE INSTALLATION

A. General: Width of trenches to be approximately twice as large as the pipe diameter.
1. Maintain a minimum horizontal distance of 3'-0" between any valves that are installed side by side.
2. Maintain a minimum 1'-6" distance between any fittings installed in the main line and lateral lines (except for reducer bushings). Crosses are not allowed.

B. Mainline Piping: Install in 4-inch wide trenches with minimum of 18 inches of cover over pipe, but no more than 24 inches of cover.

C. Lateral Piping: Install in 4 inch-wide trenches with minimum 12 inches of cover over pipe, but no more than 18 inches of cover.

D. Trenching: Provide firm, uniform bearing for entire length of pipe to prevent uneven settlement. Wedging or blocking of pipe is not permitted. Remove foreign matter from inside of pipe before welding. Keep inside of piping clean during and after layout.

E. Backfill: Water jet and compact to prevent aftersettling. Hand rake trenches and adjoining areas to leave grade in condition equal to before installation.

3.4 PVC PIPE AND FITTINGS ASSEMBLY

A. Solvent: Use solvent and procedures recommended by manufacturer to make solvent-welded joints. Thoroughly clean pipe and fittings with purple primer before applying solvent.

B. PVC to Metal Connections: Use Teflon tape.

C. Threaded PVC Connections: Use threaded PVC adapters into which pipe may be welded. Use Teflon tape on threads.

3.5 COPPER PIPE AND FITTINGS ASSEMBLY

A. Clean pipe and fittings thoroughly and buff connections with sandpaper to remove residue from pipe.

B. Flux pipe and fitting and solder connection using "No-Lead" solder.

3.6 REMOTE CONTROL AND GATE VALVES

A. Provide valves in accordance with materials list and size according to drawings.

B. Install valves in a level position in accordance with manufacturer's specifications and per paragraph 3.3 (4.2).

C. Center a plastic valve box over valve, flush with finish grade. Provide valve box extensions as required.

D. Install 0.5 cubic feet washed pea gravel in bottom of valve box.

3.7 SPRINKLERS

A. General: Provide in accordance with materials list, with nozzling in accordance with Drawings. Change nozzle degree and trajectory if wind conditions affect coverage. Receive approval from the Architect

prior to any change. Install heads adjacent to walks and curbs two (4) inches clear of paving. Avoid excess water on walks, walls, fences, etc.

B. Shrub Heads: Provide spray nozzles on copper tube risers attached to lateral piping with Poly and flexible PVC nipples sufficiently high to water over plantings and as directed by Architect. Firmly tamp soil around copper riser and leave plumb. Refer to drawing details.

C. Lawn Pop-up Heads: Attach sprinklers to lateral piping with flexible PVC and schedule 80 fittings. Use solvent made especially for flexible PVC. Firmly tamp soil around base plate and leave head plumb. Set top of sprinkler ¼" above finish grade. Provide strainer in each head. Refer to drawing details.

D. High Pop-up Heads: Attach sprinklers to lateral piping with flexible PVC and schedule 80 fittings. Use solvent made especially for flexible PVC. Use bottom connection only unless otherwise directed by Architect. Firmly tamp soil around base plate and leave head plumb. Set top of sprinkler ¼" above finish grade. Provide strainer in each head. Refer to drawing details.

E. Rotary Heads: Attach to lateral piping with pre-manufactured Lasco swing joint assemblies and schedule 80 PVC. Refer to drawing details.

3.8 DRIP IRRIGATION

A. Install drip control zone valve in accordance with manufacturer's recommendations.

1. Set pressure regulator at required pressure.

B. Install headers and sub headers. Headers to be PVC Class 200. Maximum distance between headers to be 80'-0".

C. Install flush valves and air relief valves as required by the manufacturer or as shown on the plans. Install flush valves and air relief valves per manufacturer's recommendations. In general, flush valves to be installed at the lowest point of the zone and air relief valves on the highest point of the zone.

D. Thoroughly flush all headers before drip tubing is installed.

E. Tubing to be staked at 4'-0" on center (minimum) along length of tubing. Use "u" pins specifically made for use with drip tubing.

3.9 QUICK COUPLING VALVES (QCV)

A. Provide in accordance with materials list and as detailed on Drawings. Stake with galvanized pipe securely attached to QCV with two stainless steel worm gear clamps. Install with individual shut off valve. QVC and shut off valve to be installed in valve box with purple lid.

3.10 WIRING

A. No conduit shall be required for U.F. wire, unless otherwise noted on Drawings. Tuck wire under piping.

B. Make wire connections with waterproof non-hardening two-piece connectors according to manufacturer's recommendations.

C. Provide a separate wire from controller to each electric valve. Provide a common neutral wire from controller to valves served by a particular controller.

D. Provide 24-inch long wire coils at valves.

E. Bundle wires together with waterproof electrical tape at ten-foot intervals.

3.11 TEMPERATURE SENSOR

A. Exterior Controller: Securely mount sensor on bottom of controller, or if pedestal controllers are specified, mount sensor to the inside of the pedestal using stainless steel nuts, bolts and lock nuts.

Secure bulb probe flat against outside of controller with nylon wire strip. Remove bracket usually supplied with unit and reuse bolts.

B. Interior Controller:

1. Locate sensor probe in a location exposed to outside air temperature. Receive Architect's approval of location prior to installation. Seal opening with silicone sealant.
2. Provide electrical conduit for connection from sensor box to controller. Securely fasten conduit permanently to wall in manner appropriate for wall material.

C. Use separate conduit or remote control valve wire conduit for sensor. Do not install in same conduit with 115V power supply.

D. Locate as directed by Architect or Landscape Architect.

3.12 RAIN SENSOR

A. Pedestal Mount Controller: Unless noted otherwise, securely attach rain gauge to top of 2" galvanized pipe 10' above grade and 2' below grade set in concrete. Locate sensor probe in a location exposed to outside rain conditions. Refer to drawing details.

B. Wallmount Controller: Unless noted otherwise, securely attach rain gauge to top of building parapet or wall. Locate sensor probe in a location exposed to outside rain conditions. Refer to drawing details.

C. Use separate conduit or remote control valve wire conduit for sensor. Do not install in same conduit with 115V power supply.

D. Locate as directed by Architect or Landscape Architect.

3.13 TESTING

A. Notify Architect to review work 48 hours prior to testing pipe and fittings for leaks.

B. Test mains for a period of four (4) hours under static pressure. If leaks (or pressure drops) occur, correct defect and repeat test.

3.14 FINAL ADJUSTMENT

A. Make final adjustments of sprinkler system prior to Architect's final inspection.

B. Flush system by removing nozzles from heads.

C. Adjust sprinklers for proper operation and proper alignment for direction of throw.

D. Adjust each section for operating pressure and balance to other sections by use of flow adjustment on top of each valve. Correct operating pressure at last head of each section – 45 to 50 psi for rotary heads and 25 to 30 psi for spray heads.

E. Adjust nozzling for proper coverage. Prevailing wind conditions or slopes may indicate that arc of angle or trajectory of spray should be other than as shown on drawings. Change nozzles to provide correct coverage.

F. Provide all items as required by State of Texas laws and rules and all local codes and ordinances.

3.15 CLEANUP

A. Keep premises clean and neat.

END OF SECTION

SECTION 32 9000

PLANTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Furnish all work required to complete as indicated by the Contract Documents and furnish all supplementary items necessary for completion of all work specified in this section.

B. The work included in the section while not all inclusive but listed, as a guide shall include:

1. Furnishing and installing shrubs, ground cover, annuals, and special features.
2. Preparation of all bed areas, including excavation and backfilling.
3. Maintenance of all plant materials during installation to include, weeding, cultivating, pick pruning, watering fertilizing, insecticide. herbicide application, mulching, and mowing.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 32 8400 – Planting Irrigation

B. Section 32 9000 - Turf and Grasses

1.3 REFERENCES

A. American Standard for Nursery Stock published by American Association of Nurserymen: 27 October 1980, Edition.

B. American Joint Committee on Horticultural Nomenclature: 1942 Edition of Standardized Plant Names.

C. Texas Highway Department-Standard Specifications for Construction-Item 164, Seeding for Erosion Control.

D. Texas Association of Nurserymen, Grades and Standards.

E. Hortus Third, 1976 - Cornell University.

1.4 QUALITY ASSURANCE

A. General: Comply with applicable Federal, State, County, and local, regulations governing landscape materials and work.

B. Personnel: Employ only experienced personnel who are familiar with the required work. Provide full-time supervision by a qualified foreman acceptable to Owner.

C. Do not make substitutions of any plant materials. If required material is not obtainable, notify Owner/Owners Representative prior to submission of bid.

D. Selection of Plant Material

1. A pre-bid conference will be scheduled to discuss details, design issues and plant material selections. Attendance is mandatory to consider bid complete.
2. Make contact with suppliers immediately upon obtaining notice of contract acceptance to select and book materials. Develop a program of maintenance (pruning and fertilization), which will insure the purchased materials will meet and/or exceed Project specifications.
3. The Owner/Owners Representative shall inspect all plant materials when reasonable at place of growth for compliance with requirements for genus, species, and cultivar. Variety, size and quality. Owner retains the right to further inspect all plant material upon arrival at the site and

during installation for size and condition of root balls, limbs, branching habit, insects, injuries, and latent defects. The Owner may reject unsatisfactory or defective material at any time during process of the work. Remove rejected materials from the site immediately.

1.5 SUBMITTAL

A. Submit for approval sufficient representative quantities of black topsoil, bedding soil, and composted bark mulch.

B. Planting Schedule: Submit proposed planting schedule coordinated with that of the master schedule indicating anticipated dates and locations for each type of planting. Update schedules twice monthly as work progresses.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Packaged Material: Deliver in containers showing weight, analysis and name of manufacturer. Protect from deterioration during delivery and while at site.

B. Plant Material

1. Handle in accordance with best horticultural practices so that root balls are adequately protected from sun and drying winds. Do not bind plants with rope or wire in a manner that would damage bark, break branches, or destroy their natural shapes.
2. Dig balled and burlapped (B&B) plants with firm, natural ball of earth of sufficient diameter and depth to encompass fibrous and feeding root systems necessary for full recovery of plant. Securely wrap balls with burlap and bind with cord; size balls to requirements of A. A. N. Standards.
3. Do not plant balled and burlapped plant which has root ball cracked or broken. Lift and handle with a saddle from bottom of root ball only; do not lift by trunk. Plants handled otherwise will be rejected.

C. Protection During Delivery

1. Deliver plant material to site only after beds are prepared and ready for planting.
2. Thoroughly protect shipments of plant materials from sun and drying winds during transit.

D. Protection After Delivery

1. Plant material as soon as possible after delivery. Keep roots of plants that cannot be installed immediately moist and adequately protected until planted.
2. Cover root balls of balled and burlapped plants with topsoil or an approved mulch and keep constantly moist until planted.

E. Notification of Delivery

1. Notify the Owner/Owners Representative 48 hours prior to delivery so materials may be reviewed for conformance upon unloading operations.
2. All rejected material shall be removed from the site immediately.

F. Liability

1. Contractors shall assume liability and replace all materials which are damaged, stolen, or misplaced on the job site prior to acceptance of the work.
2. Contractor shall be responsible for submitting delivery tickets noting confirmed quantities, especially quantities of bed preparation and bark mulch.

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1.7 SITE CONDITIONS

A. Existing Conditions

1. Planting bed areas will be left unfilled. Confirm this condition at pre-bid meeting prior to submitting bid. Contractor should expect to perform excavation as necessary. Coordinate with General Building Contractor. Refer to Specification Section for 02930 for work in lawn areas.
2. Determine locations of underground pipes and valves. Perform work in a manner to avoid possible damage. Hand excavate, as required to minimize possibility of damage to underground pipes, utilities, and existing structures. Maintain grade stakes set by others until removal is mutually agreed upon by parties concerned.

B. Site Use

1. Contractor shall be permitted use of designated areas on site for an office and storage area. Coordinate location with Site Contractor or Owner.
2. Storage area shall be kept clean and organized to permit inspections of stored materials by Owner on a regular basis.

1.8 COORDINATION

A. Plant during normal seasons for such work. Perform planting only when weather and soil preparation are suitable.

B. All planting operations shall be coordinated with the master schedule, irrigation system installation, and other trades involved in concurrent work.

C. Contractor shall provide protection to other trades work to include but not be limited to:

1. Do not move equipment over existing or newly placed surfaces without approval.
2. Board roading to protect flatwork and environmentally sensitive areas (tree root zones).
3. Determine locations of underground improvements and hand excavate if required to perform work in a manner which avoids damage.

D. Landscape Contractor shall be responsible for coordination of irrigation pipes and valves with Irrigation Contractor so as to prevent conflict with plant installation. If irrigation piping is encountered during plant installation, Irrigation Contractor shall be responsible for rerouting pipe or valves.

1.9 GUARANTEE

A. Guarantee plants for one (1) year after construction final acceptance. Owner will be responsible for proper maintenance of plants after final acceptance. Replace dead materials and materials not in vigorous, thriving condition within 15 days from notification from the Owner, weather permitting. Replace plants which have partially died, thereby damaging shape, size, or symmetry.

B. Replace plants with same kind and sizes as originally planted at no cost to Owner. Include cost of special equipment required to replace material in contract. Provide one (1) year guarantee on replacement plants. Protect irrigation system, other piping, conduit, and other work during replacement. Repair any damage immediately.

C. During the guarantee periods, dead and unsightly plant materials shall be removed and replaced as required.

D. Water plants at least twice a week during dry period and cultivate beds once a month after acceptance.

1.10 MAINTENANCE OF PLANT MATERIALS

A. The Contractor shall maintain all plant materials until final acceptance. Such maintenance shall include pruning, spraying, weeding, cultivation, fertilization, watering, disease and insect control, application of anti-desiccants, resetting and straightening plant to proper grades on vertical position, replacing damaged wrapping, restoring plant saucers, replenishment to levels specified of any soil mixture or mulch that has been lost from erosion or settling, replacement of any and all unacceptable materials,

plus any procedures consistent with good horticultural practices necessary to insure normal, vigorous, and healthy growth.

B. Plants shall be tended at least weekly by the Contractor during the maintenance period.

C. Coordinate irrigation stationing to best respond to bed and lawn areas and so as to maintain plant materials in best of health and appearance.

1.11 SOIL TEST

A. Contractor shall obtain soil samples from three (3) sites selected in consultation with the Owner/Owners Representative and request a complete soil test including arsenic presence from A & L Plains Agricultural Laboratories, Inc., 302 34th Street, P. O. Box 1590, Lubbock, Texas 79408. Telephone (806) 763-4278.

B. In making the soil test request, Contractor will identify kind of planting to be performed in each test site area, i.e., trees, shrubs, ground cover, lawn turf, Bermuda Grass or other.

C. Collect all samples in plastic containers or bags and mark in a permanent manner. Follow standard method of soil sample collection as outlined by the testing lab.

D. Distribute copies of report to Owner/Owner Representative. This report will guide the final fertilization program for the specific plant type. The fertilization program in these specifications is a guide only. The final soil test reports will guide the final fertilization schedule.

1.12 ACCEPTANCE

A. General: The Owner/Owner Representative will be in continuous contact with the Contractor during the installation phase of the Project to guide placement and grouping of all materials. Inspection of materials shall be an ongoing process.

B. Initial Inspection: The Owner/Owner Representative is available for initial inspection of sub areas of the Project upon written request by the Contractor. The purpose of initial inspection shall serve to bring a fine adjustment to the Project that the Contractor can develop through the warranty.

C. Punch List: The Owner/Owner Representative shall prepare a list of any deficiencies or omissions after the initial inspection which the Contractor shall immediately correct.

D. Initial Acceptance: When the contractor has completed all items of the punch list to the satisfaction of the Owner/Owner Representative, a walk through shall be requested to formally review the Project area. Any deficiencies identified by the Owner shall be immediately corrected and initial acceptance shall be given the Contractor. Initial acceptance signifies the beginning of an intensified maintenance period to bring the Project into final conformance.

E. Final Acceptance: Upon completion of the total Project and by written request, the Owner/Owner Representative shall make a final inspection. Punch lists and inspection notes shall be provided as required. The Owner/Owner Representative shall ascertain the conditions of all plant materials noting any deficiencies and need to replace any plant material that has died or otherwise become unacceptable. Upon satisfactory completion of all punch list items, the work shall receive final acceptance. The one (1) year guarantee period shall begin on this date.

PART 2 - PRODUCTS

2.1 PLANTS

A. General: Equal to well-formed Number 1 Grade or better nursery stock in accordance with requirements of applicable standards as noted herein, subject to Owner's approval. Plants collected in native state will conform to root-ball size standards set forth by the American Standard for Nursery Stock. The listed plant heights are from top of plants balls to nominal tops of plants. The Owner will inspect plants individually prior to planting. Remove rejected plants from site.

B. Shrubs and Ground Covers (Nursery Grown and Collected Native Plants): Healthy, vigorous, bushy, and well branched, of normal habit of growth of species, free from disease, insect eggs, and larvae. Specified sizes shall be before pruning and plants shall be measured with their branches in normal position.

2.2 SOIL PREPARATION MATERIALS

A. Topsoil: Clean friable, rich black bottom land soil, locally available soil free of clay lumps, rocks, weed, and grasses. Soil containing Nut Grass, Johnson Grass, or other noxious weed shall be rejected.

B. Pine Bark: New 100% Southern Pine Bark Mulch, dark Brown in color graded 3/4 inch diameter down. Available from Texas Fertile Mulch Company, Rusk, Conroe, Texas. 1-800-442-8519 or Natural Earth Technologies, (903-683-2195).

C. Bedding Soil: Naturally acidic (pH 6.0 - 6.5), biologically active with natural soil organisms, rich in organic matter, containing 40% medium graded bark mulch, aged 1 1/2" diameter and smaller, 30% Vital Earth Peat replacer, and 30% sand as produced by Vital Earth Resources, Gladewater, Texas 75647 (214) 845-5985 or Acid Gro New Life Soil Conditioner, complete mix, 50% compost, 50% sand soil mix with a soil pH of 6.5.

D. Materials Fertilizer:

1. Sulfur Coated Urea: 32-0-0, granular, heavy weight grade pellets, or approved equal.
2. Triple Super Phosphate: 0-46-0, heavy weight granular pellets, or approved equal.
3. K-MAG: A sulfur, potash, and magnesium soil supplement, pellet form by Western Co.

E. Other Soil Supplements:

1. Iron Chelate: Liquid Iron supplements by Fertilome or approved equal.

2.3 MISCELLANEOUS MATERIALS

A. Steel Edge: Edging shall be steel 1/8" x 4" set 1" above finished grade as produced by Ryerson.

B. Anti-Desiccant: Emulsion type, polymer film-forming agent, designed to permit transpiration but retard extensive loss of moisture from plants. Deliver in manufacturer's fully identified containers and mix in accordance with manufacturer's instructions. Provide NuFilm Number 17 or approved equal.

C. Herbicides, Pesticides, Fungicides and Fumigants:

1. General: All herbicides, pesticides, fungicides and fumigants shall be properly handled and applied in order to prevent injury to humans, domestic animals, desirable plant life, fish and other wildlife. The Contractor shall follow the directions and heed all precautions listed on the container label, respecting all U. S. Department of Agriculture pesticide regulations and policies, and abiding by all applicable state and local regulations. None of these materials shall be used without written approval from the Owner/Owner Representative.
2. The following specific type shall be acceptable if approved in advance by the Owner/Owner Representative.

    a. Grass Weed Control: `Roundup', as manufactured by Monsanto Co., or approved equal.
    b. Broadleaf Weed Control: `2-4-D' or approved equal.
    c. Borer Prevention: `Lindane' or approved equal.
    d. Soil Fumigant: Vapam or approved equal.

3. Submit alternative products to the Owner for evaluation or approved.

2.4 PLANT LIST

Refer to planting plan for summary lists of plant materials.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine the sub-grade upon which the work is to be performed, verify grade elevations and verify that beds have been cleaned of any trash and debris. Observe the conditions under which the work is to be performed and confirm that unsatisfactory conditions have been corrected prior to proceeding.

B. Cooperate with other Contractors and trades working in and adjacent to landscape work areas. Examine drawings which show development of the entire site and become familiar with scope of other work required.

3.2 TIME OF PLANTING

A. Planting operations shall be conducted under favorable weather conditions during the seasons which are normal for such work as determined by acceptance practice in the locality.

B. At the option of and at the sole risk of the Contractor, planting operations may be conducted under unseasonable conditions. The Contractor shall bear all responsibility and financial risk of planting under such conditions.

3.3 LAYOUT

A. Stake and lay out beds as shown on Drawings. Place plants in position on bed areas before containers are removed. Obtain written approval from the Owner. Plant where located, setting plants with tops of balls even with tops of beds, and compact soil carefully around plant ball. Water plants thoroughly with hoses to eliminate air pockets. Carefully prune plants to remove dead or broken branches and hand rake bed areas to smooth, even surfaces. The Owner reserves the right to interchange or shift locations of plants prior to planting.

B. Preserve and protect plant material designated on drawings to remain.

3.4 HANDLING OF MATERIALS

Employ a suitable method of handling plant materials that conforms to sound horticultural practices and standard safety procedures.

3.5 BED PREPARATION

A. Verify that planting areas have been provided as noted in 1.07 and 1.08. Remove any rock or debris deposited by previous grading operations. Set all plants to bear the same relationship to the finished grade of the surrounding edges that they bore to previous existing grade of soil. An herbicide may be used for removal of weeds in topsoil with approval of Owner. All plants not installed in prepared bed areas will be pocket planted using Vital Earth Bedding Soil or Acid Gro Complete Mix.

B. Contractor may mix and wet the amended soil mix at a remote location. In this case, Contractors operation is subject to regular inspection to include amendment specified are being used and sufficient quality control procedures are being implemented. The Contractor shall be required in any case to submit delivery tickets verifying source and name of supplier of materials. The Owner/Owner Representative reserves the right to reject mixes that do not meet specification or if any reasons exist that remote mixing operations are not of a sufficient quality control.

C. Soil Mix:

1. All bed preparation shall be 'Vital Earth' Bedding Soil complete mix. No substitutions. For Bed Preparation No. 1, add a 2" layer of Vital Earth Bedding Soil around all existing trees in new planting beds. For Bed Preparation No. 2, excavate as necessary to allow backfill of a 4" layer of Vital Earth Bedding Soil. Prior to backfill, till subgrade to a 6" to 8" depth of break hardpan. Flood with water to insure good drainage. If good drainage does not exist, stop work and notify Landscape Architect. Finished bed shall be mounded in the center or high in the rear of bed to insure good drainage. Till bedding soil into subgrade to create fine, loose, friable soil suitable for planting. Do not damage roots of existing trees.

D. Amended soil shall be moist during installation procedures. Wet finished grades of beds to initiate settlement. Final finish grades after planting shall be 15% higher than indicated finished grades unless noted otherwise to accommodate long term settlement. This will create a slight mounded effect in all bed areas. Edges of all ground cover planters shall be raked back so as to be 1 1/2" below curb or sidewalk to prevent mulch from washing out during rains. This is an edge treatment only to reduce maintenance related problems during watering and rains.

E. Application of herbicides to eliminate noxious grasses and weeds shall only be performed when its affects would not be detrimental to existing or proposed plant material. In all cases, herbicide used shall be closely monitored to insure conformance to manufacturer's specifications.

3.7 TREE PITS AND PLANTING

Refer to Specification Section 02910, Sub-Section 2.2 and Sub-Section 3.6.

3.8 FINAL GRADING

A. Loosen and fine rake areas to break up lumps and produce a smooth even gradient free of unsightly variation, ridges, or depressions.

B. Ponding of water on the finished bed areas shall not be permitted. Provide appropriate slopes to area drains and subsurface drain systems.

C. Remove from site all stones, rock, and debris one (1) inch or larger.

D. Final grading is subject to careful review by the Owner/Owner Representative only after repeated watering or rains to insure settlement has not adversely affected drainage.

3.9 PRUNING

A. Pruning shall be limited to the minimum necessary to remove dead wood, suckers, broken twigs or branches and to compensate for loss of roots during transplanting. Pruning shall be carried out under the direction of the Landscape Architect, to thin and balance plant materials to achieve natural forms intended by the design.

B. In no case shall pruning exceed one third of the branching structure. Pruning shall preserve the natural character and structure of the plant.

C. All pruning operations shall be performed in accordance with standard arborcultural practices.

3.10 MULCHING

A. After work of planting has been completed, top dress all planting areas with a 1" layer of shredded Pine Bark Mulch.

B. Contractor shall place mulch on a regular basis as required to maintain a 1" layer of mulch on all planting areas until final acceptance.

3.11 CHEMICAL APPLICATION

A. Fertilizer-Shrubs, Ground Cover and Perennial Beds:

1. Apply 3 lbs/1000 sq. ft. of triple super phosphate, 0-46-0, and 3lbs/1000 sq.ft. Sulfur coated Urea, and 4 lbs/1000 sq. ft. of K-MAG fertilizer to all areas prior to general planting. Insure fertilizer is tilled thoroughly into soil.
2. After general planting, broadcast 3 lbs/1000 sq. ft. of Sulfur coated Urea, and 4 lbs/1000 sq. ft. of K-MAG at 6 week intervals or until final acceptance.

B. Additional Soil Supplements:

1. Iron Chelate shall only be used if an iron deficiency becomes apparent during the installation period. Foliage feedings as well as soil injections shall be used to correct plant deficiencies.

C. Provide safe guards in applications of fertilizers to insure against detrimental effects on plant materials. Establish a regular watering program.

D. Submit revised fertilization program along with soil tests to Owner for review and approval prior to making any applications.

3.12 HERBICIDE - PESTICIDE APPLICATION

Apply Roundup or other approved herbicide to all areas supporting Bermuda Grass and other noxious grass within the planting areas on a frequent enough basis to eliminate grasses prior to planting.

3.13 MAINTENANCE

A. Maintenance period shall extend from time of installation of planting areas to final acceptance of landscape.

B. Maintain trees, shrubs and other materials by pruning, cultivating and weeding as required for healthy growth. Tighten and repair stake and guy supports (if used during construction period) and reset trees and shrubs to proper grades and vertical position as required. Restore or replace damaged wrappings. Spray as required to keep trees and shrubs free of insects and disease.

3.14 STEEL EDGING

A. Provide steel edging at interface of planted areas and lawn or as otherwise areas as indicated on drawings.

B. Set edging as indicated in true lines as designed with top of edging one (1) inch above finished grade.

C. Ground cover against edging shall be true creating an even exposure of edge of the main viewing sites.

3.15 CLEAN-UP

A. Remove all debris generated by work operations from the site on a daily basis to achieve a clean site at all times.

B. All paved areas shall be cleaned daily by sweeping and washing. Do not use acid type cleaner unless approved by Owner.

C. Leave entire planting areas in raked condition free of debris and paved surfaces in a broom clean condition ready for final acceptance by Owner.

SECTION 32 9200

TURF AND GRASSES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Furnish all work required to complete as indicated by the contract documents and furnish all supplementary items necessary for completion.

B. Types of lawn work required include the following:

1. Fine grading and preparation of lawn areas.
2. Sod lawn areas.
3. Topsoil.

1.2 SUBMITTAL

A. Certification of Grass: Submit vendors certified statement for each type stating botanical name, common name, purity, germination, and weed seed content as appropriate.

1.3 REFERENCES

A. American Standard for Nursery Stock published by American Association of Nurserymen: 27 October 1980, Edition.

B. American Joint Committee on Horticultural Nomenclature: 1942 Edition of Standardized Plant Names.

C. Texas Highway Department-Standard Specifications for Construction-Item 164, Seeding for Erosion Control.

D. Texas Association of Nurserymen, Grades and Standards.

E. Hortus Third, 1976 - Cornell University.

1.4 QUALITY ASSURANCE

A. General: Comply with applicable Federal, State, County, and Local regulations governing landscape materials and work.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver fertilizer to the site in original, unopened containers which bear the manufacturer's guaranteed statement of analysis.

B. Store fertilizer in weatherproof locations in such a manner that is will be kept dry until use on the site.

1.6 SPECIAL LANDSCAPE PROVISIONS

A. Maintenance: Until final acceptance, and until an approved stand of grass is achieved, maintain turf area by watering, to keep turf in a vigorous, healthy condition.

1. Watering: As necessary to keep top 2" of soil moist.

1.7 CONDITION OF SURFACES

Examine all areas of the Project to determine limits of work required. Notify the Owner/ Owners Representative of conflicts. Establish and maintain grade stakes.

1.8 PROTECTION

A. Take adequate precautions to protect the work and materials against damage. Erect barricades and warning sign as necessary.

B. No pre-emergent herbicides shall be used on any areas to receive grass. Use post-emergent herbicides only under manufacturer's direction.

1.9 ACCEPTANCE

The work will be accepted when seeding operations are complete and a solid stand of grass is achieved.

1.10 SCHEDULES

Sodding: Complete no later than 15 September or earlier than 1 May under favorable conditions for Bermuda grass. **If project schedule falls between these dates, contractor to obtain clarification of needs at prebid conference.**

1.11 GUARANTEE

Contractor shall guarantee establishment of acceptable turf areas and provide replacement as necessary to establish 100% coverage of designated areas.

PART 2 - PRODUCTS

2.1 TOPSOIL

A. Topsoil shall be obtained from grading operations within project area.

B. If topsoil is not available, provide the following:

1. Black clay loam, fertile, friable and representative of the local productive soil, capable of sustaining vigorous plant growth and free from lumps, clods, subsoil, noxious weeds or other foreign matter such as stones, roots, sticks, and other extraneous material. Topsoil shall not contain Johnson Grass, Nut Grass, Crab Grass, or other like weeds. Submit samples to the Owner.

C. Notify the Owner/Owners Representative 48 hours prior to preparation of lawn turf areas.

2.2 FERTILIZER

A. 17-7-12 Fertilizer: Blend of resin-coated prills which supply controlled release nitrogen, phosphorus and potassium, along with uncoated, rapidly soluble prills containing nitrogen and phosphorous, as manufactured by Sierra Chemical Company or approved equal.

1. Total Nitrogen (N): 17%
2. Available Phosphoric Acid (P_2O_5): 7%
3. Soluble Potash (K_20): 12%
4. Derived from ammonium nitrate, ammonium phosphates, ammonium sulfate, calcium phosphates, potassium sulfate and ferrous sulfate.

2.3 GRASS SOD

A. Provide strongly rooted sod, not less that two (2) years old with a uniform thickness of not less that two (2) inches, and free of weeds and undesirable native grasses. Provide sod capable of growth and development when planted (not dormant), consisting of the following:

1. Bermuda grass (Cynodon dactylon) minimum 98% purity content.

B. Deliver sod on pallets and protect root system from exposure to wind or sun, and especially from drying out.

C. Time delivery so that sod will be placed within 24 hours after stripping. Protect sod against drying and breaking off rolled strips. Keep stored under shade or covered with shade cloth or burlap.

PART 3 - EXECUTION

3.1 GRADING AND SOIL PREPARATION

A. 1. In all areas affected by construction, contractor will repair grades by releveling areas and/or adding topsoil so as to restore original grades. Blade to create smooth transition to adjoining grades. Insure positive drainage. Any heavy compacted soil areas to receive turf will first be tilled and broken up to a depth of six inches.
2. Fine grade by hand raking or other approved method to break up lumps and produce a smooth, even grade, free from unsightly variations, ridges or depression. Remove stones and clods 1 ½" inches or larger, sticks, roots, and other debris and legally dispose of off-site.
3. Obtain the Owner's/Representative's approval of fine grading before proceeding with lawn work.
4. Remove all excess soil from site.

B. Moisten prepared lawn areas before planting if soil is dry. Water thoroughly and allow surface to dry off before planting of lawns. Do not create a muddy soil condition.

3.2 SODDING

A. Refer to the drawings for the area limits of installation.

B. Sodding shall be done only after fine grade of prepared sod bed has been approved by the Owner/Owner's Representative. Contractor will re-sod areas damaged by all work operations.

C. Moisten the soil surface with a fine mist spray using irrigation system immediately before laying sod. Do not over water, or allow soil to become muddy.

D. Starter strip (first row of sod) shall be laid in a straight line behind sidewalks or curbs with subsequent rows placed parallel to and tightly against each other. Lateral joints shall be staggered to promote more uniform growth and strength. Care shall be taken to insure that the sod is not stretched or over-lapped and that all joint areas butted tight in order to prevent voids which would cause air drying of the roots. Cut sod into grades as required to meet existing turf are grades.

E. Rake topsoil over the joints to fill any spaces that may permit air to enter and dry the joints.

F. Tamp or roll with a light weight turf roller to eliminate all air pockets; provide a true and even surface, and insure knitting without displacement of sod or deformation of the surface of the sodded areas.

G. The entire sodded areas shall be saturated to a depth of two (2) inches by watering with irrigation system within four (4) hours after sod has been placed.

3.3 PROTECTION

Erect barricades and warning signs as required to protect newly planted lawn areas from traffic. Maintain barricades throughout maintenance period until lawns are established.

3.4 FERTILIZATION

Provide appropriate fertilizer to hydromulch slurry based on time of year and soil requirements.

3.5 MAINTENANCE

A. Begin maintenance of lawns within project limits only immediately after each area is planted and continue until final acceptance.

B. Maintain lawns by watering, rolling, regrading, and replanting as required to establish a smooth, acceptable lawn, free of eroded or bare areas.

C. Re-mulch with new grass areas which been disturbed by wind, rain, drainage or maintenance operations, or where it has failed to germinate.

D. Replant bare areas using same materials specified for lawns.

E. Roll areas as necessary and as directed by Owner/Owners Representative, to achieve a smooth, even lawn surface.

3.6 INSPECTION AND ACCEPTANCE

A. The Owner/Owners Representative will inspect all work for substantial completion upon written request by the Contractor. Areas shall be inspected and accepted by the Owner.

B. Continue maintenance only until final acceptance.

C. Upon completion and re-inspection of all repairs or replacements necessary in the judgment of the Owner/Owners Representative, will certify final acceptance in writing to the Contractor.

3.7 PERFORMANCE

Establish a dense lawn of permanent grasses, free from lumps and depressions. Any part of the area failing to show uniform cover shall be redone, and such replacement shall continue until a 100% uniform lawn is achieved.

3.8 CLEAN-UP

A. Remove trash, debris and other material resulting from planting operations.

B. Clean walks, paving and other areas of all soil and other material resulting from lawn work.

C. Leave site in a broom clean condition.

SECTION 33 1000

WATER DISTRIBUTION

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Furnish labor, materials and equipment necessary for the construction of domestic water and fire services.

1.2 RELATED SECTIONS

A. SECTION 31 23 33 – TRENCH EXCAVATION

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM)
ASTM D 1783 Rigid Poly (Vinyl Chloride) (PVC) Compounds
ASTM D 1784 Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120
ASTM D 2241 Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR)
ASTM D 2321 Fusion of Polyethylene Pipe
ASTM D 2466 Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 3034 PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3212 Joints for Drain and Plastic Sewer Pipes Using Flexible Elastomeric Seals

B. American Water Works Association (AWWA)
AWWA C110 Ductile-Iron and Gray-Iron Fittings, 3 Inches through 48 Inches, for water and other liquids
AWWA C509 Resilient Seated Gate Valves, 3 Inches through 12 Inches NPS, for water systems.
AWWA C900 Poly (Vinyl Chloride) (PVC) Pressure Pipe, 4 Inches through 12 Inches for Water

C. State Department of Health Rules and Regulations for Public Water Systems, Adopted 1988.
Para. 337.204 Water Systems
Para. 337.206 Water Distribution

D. Texas Water Commission (TWC) Rules, Title 31 Texas Administrative Code (TAC), Chapter 31, “Design Criteria for Sewage Systems”.
Para. 317.1 General Provisions
Para. 317.2 Sewage Collection System

1.4 SUBMITTALS

A. Procedures for Submittals: DIVISION 1.

B. Pipe Certification: Manufacturer’s certifications that pipe meet the requirements of these specifications.

PART 2 - PRODUCTS

2.1 WATER SYSTEM

A. Polyvinyl Chloride (PVC) PIPE:
1. PVC Water Pipe (6” through 12”): AWWA C900, pressure class 200
2. PVC Water Pipe (1” through 4”): Schedule 40 ASTM D 1785, pressure class 150

B. Fittings:
1. Buried Fittings: Schedule 40 PVC, ASTM D 2466, NSF approved and sealed or marked for potable water use.

2. Rating: Fittings working pressure rated to 250 psi.
3. Wrapping: Buried ductile iron fittings wrapped with 8-mil polyethylene encasement, AWWA C105.

C. Water Meter and Box: Public meters shall meet City of Bonham requirements.

PART 3 - EXECUTION

3.1 GENERAL

A. Contractor shall field verify location and depth of all existing water lines. If required, valve boxes shall be adjusted to the grades of the new pavement. The Contractor is to provide for a Registered Public Land Surveyor to stake the accurate locations of proposed piping system including pipe alignment, valves, and all other appurtenances.
   1. Do not lay pipe in water, or when trench or weather are unsuitable for work. Keep water out of trench until jointing is complete and bedding is placed to top of pipe. When work is not in progress, close ends of pipe and fittings securely so that no trench water, earth or other substance will enter pipes or fittings.
   2. Contractor shall be responsible for securing all permits for work in public right-of-way and connecting to facilities owned and maintained by the City of Bonham.

3.2 WATER SERVICES

A. All work will be done in accordance with TCEQ requirements.

END OF SECTION

SECTION 33 3100

WASTEWATER SERVICES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Complete sanitary sewers and appurtenances using construction techniques and materials as required by the Construction Plans and these Specifications.

1.2 RELATED SECTIONS

A. SECTION 31 23 33 – TRENCH EXCAVATION

1.3 REFERENCES

A. American Society of Testing and Materials (ASTM)

ASTM C144	Aggregate for Masonry Mortar.
ASTM C270	Mortar for Unit Masonry.
ASTM C478	Precast Reinforced Concrete Manhole Sections.
ASTM D2241	Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR-Series).
ASTM D3034	Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
ASTM D3212	Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

B. Texas Commission on Environmental Quality
TCEQ Testing Requirements - 30 TAC 313.5(c)(10)(B)

1.4 SUBMITTALS

A. Procedures for submittals: DIVISION 1.

B. Product Certifications: Manufacturer's certifications that pipe meet the requirements of these specifications.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements: Texas Water Commission (TWC) Rules, Title 31 Texas Administrative Code (TAC), Chapter 317, "Design Criteria for Sewage Systems."
1. Para. 317.1 General Provisions.
2. Para. 317.2 Sewage Collection System.

B. Regulatory Requirements: Texas Council on Environment Quality Rules (TCEQ), 30 TAC 313.5 and 317.5.

PART 2 - PRODUCTS

2.1 SANITARY SEWER PIPE

A. Polyvinyl Chloride Pipe (PVC):
1. For Gravity Sewer Main Where Required Due to Clearance From Waterline: AWWA C150 PVC pipe, minimum pressure rating of 150 psi.
2. For Gravity Sewer Only: ASTM D3034, SDR35, (UNI-BELL UNI-B-7) PVC pipe and fittings, as applicable.

2.2 CLEANOUTS

A. Install in accordance with TCEQ and as shown on the plans.

PART 3 - EXECUTION

3.1 EXCAVATION, BACKFILLING AND COMPACTION

A. Excavation, backfill, and compaction of the trench shall be in accordance with Sections 31 23 33 – TRENCH EXCAVATION and BACKFILL.

3.2 PIPE INSTALLATION

A. General:
   1. Lay type, class, and size of pipe as scheduled on Drawings. Install piping in accordance with manufacturer's installation instructions.
   2. Protect pipe during handling against impact shocks and freefalls. Do not install damaged or defective pipe.
   3. Keep pipe clean as work progresses. Keep interior of pipe clear of dirt and deleterious materials during installation.

B. Lay piping at lowest point of trench with spigot end pointing in direction of flow.

C. Lay each pipe firmly and true to line and grade, forming a closed concentric joint with the adjoining pipe and preventing sudden offsets of the flow line.

D. Make adjustments to line and grade scraping away or filling under the body of the pipe. Wedging to blocking under the pipe ends is prohibited.

E. When work is not in progress, close open ends of pipe and fittings to prevent water, earth or other substances from entering the pipe and fittings.

3.3 SERVICE CONNECTIONS

A. The Contractor shall coordinate the exact location of all sanitary sewer connections with Drawings prepared by the Mechanical Engineer.

3.4 MANHOLES – INSTALLATION

A. General: Manhole base may be either cast-on-site or monolithic round, precast reinforced concrete base sections.

B. Precast Concrete:
   1. Provide bottom or floor of precast base sections with minimum thickness of 12 inches, unless shown otherwise on Drawings. Bottom shall project no less than 6 inches beyond the outside walls of the base to form a flange intended to resist uplift.
   2. Provide suitable cutouts no less than 6 inches above inside surface of the floor of the base.
   3. Provide precast sections 48 inches in diameter for pipe sized up to and including 30 inches.
   4. Invert channels shall be smooth, accurately shaped, and in accordance with the Drawings.
      a. Invert may be formed directly in the concrete of the manhole base, shaped by mortar, or constructed by laying a full section of pipe straight through the manhole and cutting out the top half after the concrete base is constructed and set.
      b. Top of manhole invert outside the flow channel shall be steeply sloped to the channels.
   5. Provide tongue-and-groove or O-ring joints at manhole barrel sections, as shown on Drawings. Seal joints with Neenah Foundry Company Manhole Sealant, or approved equal.
   6. Where pipe are connected to the manhole base or barrel, seal space between pipe and hole with an assembly consisting of rubber gaskets or links mechanically compressed to form a watertight barrier, "Press-Wedge", "Res-Seal" or approved equal.
   7. Build-up manholes with precast concrete grade rings so that the cover, when placed, is at scheduled elevation. Total grade ring thickness not to exceed 12 inches, under the casting.

C. Encase manhole drop structure in mortar to form one continuous structure with the manhole.

D. Epoxy Liner:
   1. Install epoxy liner on interior concrete surfaces, except floors, 65 mils dry film thickness.
   2. Liner shall be pinhole free and applied by spraying, brushing or troweling in one or more coats.
   3. Prepare surfaces and install in accordance with manufacturer's installation instructions.
   4. Liner may be applied by the precast concrete manufacturer at the plant but shall be touched-up or repaired after manhole installation.

3.5 FIELD QUALITY CONTROL

A. General: During construction, perform leakage testing and displacement testing as work progresses. No more than 500 linear feet of installed sewer shall be allowed to remain untested. After backfilling and removing debris from each section of sewer line, conduct a line acceptance test under observation of the engineer. Follow all TNRCC requirements for testing.

B. Leakage Testing: Test the sanitary sewer lines in strict accordance with the following leakage test using low-pressure air. If the test results indicate an unacceptable installation, locate the source of leakage, correct the defect, and retest until the installation is proven satisfactory. Follow all TCEQ requirements for testing.
   1. Minimum Requirements for Equipment:
      a. Control panel.
      b. Low-pressure air supply connected to control panel.
      c. Pneumatic plugs of acceptable size for diameter of pipe to be tested; capable of withstanding internal test pressure without leaking or requiring external bracing.
      d. Air hose from control panel to:
         (1) Air supply.
         (2) Pneumatic plugs.
         (3) Sealed Line for pressurizing.
         (4) Sealed line for monitoring internal pressure.
   2. Test Pneumatic Plugs: Test plugs before using in actual test installation.
      a. Place one length of pipe on ground and seal at both ends of pneumatic plugs to be checked.
      b. Pressurize plugs to 25 psig; then pressurize sealed pipe to 5 psig.
      c. Plugs are acceptable if they remain in place against the test pressure without external aids.
   3. Compensating for Groundwater Pressure:
      a. Where groundwater exists, install a capped nipple at the same time the sewer line is placed. Use a 1/2-inch capped pipe nipple approximately 10 inches long. Make the installation through the manhole wall on top of the sewer line where the line enters the manhole.
      b. Immediately before performing the line acceptance test, remove the pipe cap, clear the pipe nipple with air pressure, and connect a clear plastic tube to pipe nipple. Support the tube vertically and allow water to rise in the tube. After the water stops rising, measure the height in feet of water over the invert of the pipe. Divide this height by 2.3 feet/psi to determine the groundwater pressure to be used in line testing.
   4. Line Testing: After pneumatic plugs have been checked, place plugs in line at manhole and inflate plugs to 25 psig. Introduce low-pressure air into the sealed line until the internal air pressure reaches 4 psig greater than the groundwater pressure. Allow at least 2 minutes for air pressure to stabilize. If at least 3.5 psig over groundwater pressure is maintained, disconnect the air hose from the control panel to the air supply and measure the time of the pressure drop between 3.5 and 2.5 psig above groundwater pressure.
      a. The installation is acceptable if the air low rate does not exceed 0.003 cfm per square foot of internal pipe surface with an average test pressure of 3.0 psig greater than groundwater pressure.
      b. The line between manholes is within acceptable limits if the time for the 1 psig pressure drop is not less than the time listed below for pipe sizes indicated.

Pipe Diameter in Inches	Minutes Pressure is Maintained
6	3.0
8	4.0
10	5.0
12	5.5
15	7.5
18	8.5
21	10.5
24	11.5
30	14.5
36	17.0

C. Test for Displacement of Sewers: Test plastic pipe sizes 6 inches through 30 inches for deflection by pulling a mandrel with an outside diameter equal to 95 percent of the base inside diameter of the pipe through the pipe after backfilling is complete. Base inside diameters for PVC pipe shall be as per pipe manufacturer's published data.

1. Mandrel shall be cylindrical in shape and constructed with at least seven evenly spaced arms or prongs. Mandrels with less arms will be rejected as not sufficiently accurate. Contact length of the mandrel's arms shall equal or exceed the nominal diameter of the sewer to be inspected.
2. Hand pull mandrel through all plastic sewer lines. Uncover sections of sewer not passing the mandrel and replace. Retest or replace sewer lines.
3. Inspection no earlier than 30 days after reaching final trench backfill grade, provided that the soil has thoroughly settled throughout the entire trench.

END OF SECTION

SECTION 33 4000

SITE PREPARATION AND DEMOLITION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide the required material and workmanship for the installation of storm sewer pipe, culverts, grate inlets and appurtenances.

1.2 RELATED SECTIONS

A. SECTION 31 10 00 - SITE PREPARATION AND DEMOLITION

B. SECTION 31 23 33 - TRENCH EXCAVATION

C. SECTION 31 23 34 - TRENCH BACKFILL

D. SECTION 31 23 35 - TRENCH SAFETY SYSTEMS

E. SECTION 31 25 00 - EROSION CONTROL

1.3 REFERENCES

A. ASTM C76 - Reinforced Concrete Culvert, Storm Drain and Sewer Pipe.

B. ASTM D1784 - Rigid Poly (Vinyl Chloride) (PVC Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

C. ASTM F405 - Standard Specification for Corrugated Polyethylene (PE) Tubing and Fittings

D. ASTM M252 - Standard Specification for Corrugated Polyethylene Pipe, 75mm to 250mm Diameter (3”-10”)

E. ASTM M254 - Standard Specification for Corrugated Polyethylene Pipe, 300mm to 1200mm Diameter (12”-48”)

1.4 SUBMITTALS

A Procedures for Submittals: DIVISION 1.

B. Pipe Certification: Manufacturer’s certifications that pipe meet the requirements of these specifications.

PART 2 - PRODUCTS

2.1 STORM SEWER PIPE

A. Reinforced Concrete Pipe: Provide reinforced concrete pipe, which conforms to ASTM C76, Class III or Class IV.

B. Plastic Pipe:

1. Provide Rigid Poly (Vinyl Chloride) Schedule 40 pipe, which conforms to ASTM D1784 and ASTM D2466.
2. Provide High Density Polyethylene (HDPE) pipe, which conforms to ASTM M252 and ASTM M294.

C. Perforated Plastic Pipe: Provide ADS perforated N-12 dual wall High Density Polyethylene (HDPE) pipe with ADS Drain Guard and Sock or equal, which conforms to ASTM F405 and ASTM F606.

PART 3 - EXECUTION

3.1 EXCAVATION, BACKFILLING AND COMPACTION

A. Excavation, backfill, and compaction of the trench shall be in accordance with Sections 02350 - TRENCH EXCAVATION and 02360 - TRENCH BACKFILL.

B. Perforated Plastic Pipe: Backfill shall be in accordance with the Drawings.

3.2 PIPE INSTALLATION

A. Pipe Sewers and Culverts: Do not place pipe until the excavation has been completed, the bottom of the trench shaped, proper bedding material placed, and the line and grade have been obtained. Lay pipe accurately to line and grade in a straight line with spigot or tongue end of the pipe pointing in the direction of flow. Fit pipes together and match them so that when laid, the pipe will form a sewer or culvert with smooth and uniform invert except where there is a pipe size change, in which case, the crowns of the larger and smaller pipes shall be at the same elevation and a concrete collar used to make the connection, unless otherwise shown.

B. PVC culvert pipe joints shall be solvent welded with appropriate solvent weld compound as recommended by the PVC pipe manufacturer.

C. HDPE culvert pipe shall be installed per manufacturer's recommendation.

D. Perforated Plastic Pipe shall be installed per manufacturer's recommendation.

3.3 MANHOLE AND INLET INSTALLATION

A. Construct all headwalls to line and grade and at locations shown. Construct in accordance with Section 03300 – CAST-IN-PLACE CONCRETE, and as detailed in the Drawings. Neatly cut off all pipe leads at the appropriate face of the headwall, manhole or inlet wall and finish with mortar.

END OF SECTION